9th european congress on telepathology

3rd international congress on virtual microscopy

Programme and Book of Abstracts

III INTERNATIONAL CONGRESS ON VIRTUAL MICROSCOPY

IX EUROPEAN CONGRESS ON TELE PATHO LOGY

TOLEDO - SPAIN. 15-17 MAY 2008 HOTEL BEATRIZ www.seapcongresos.com/telepathology2008

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// 9TH EUROPEAN CONGRESS ON TELEPATHOLOGY // 3RD INTERNACIONAL CONGRESS ON VIRTUAL MICROSCOPY

Toledo, Spain. 15-17 May 2008

Arriving at the Information Technology Age in Pathology

SCIENTIFIC PROGRAMME

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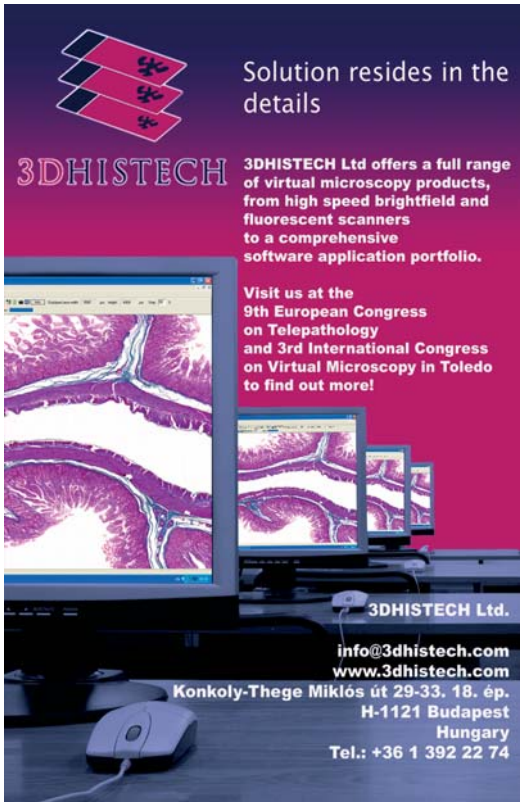

INVITATION

The Health Care Service of Castilla-La Mancha and the University of Castilla-La Mancha cordially invite you to join us at the 9th European Congress on Telepathology and 3rd International Congress on Virtual Microscopy to be held in Toledo, Spain, in May 15th–17th, 2008, under the auspices of the Spanish Society of Pathology (SEAP), the Spanish Society of Health Informatics (SEIS), and the International Academy of Telepathology (IAT).

Information technology is helping pathologists in their clinical work, research activities, education, and quality assurance programmes. Since necessary technology is becoming increasingly complex, the collaboration of Computer Science professionals, Informatics experts, or Information Technology and Communication researchers is becoming increasingly necessary.

For that reason, the 9th European Congress on Telepathology and 3rd International Congress on Virtual Microscopy would like to become a forum to join together pathologists, biologists, information technology professionals, including software engineers, computer science researchers, and any other biomedical informatics professional. They will have the opportunity to discuss their experiences with a broad range audience, from well-known pioneers to our young colleagues, and also including the industrial partners. This will be possible due to the maturity of this congress, after the success of the previous editions.

New European and International collaboration projects on telepathology, imaging and computing in general in Pathology, are being designed. These groups will have the opportunity to meet together during the 9th European Congress on Telepathology and 3rd International Congress on Virtual Microscopy, and create new alliances with other related groups.

Be welcome to Toledo, one of world's architectonical treasures, with magnificent monuments, especially from Moorish, Mudejar, Gothic and Renaissance periods. Surrounded by this historical environment we would like this congress to become a watchtower where we can foresee the emerging future of Pathology.

Marcial García Rojo / Gloria Bueno García / Jose Sacristán París

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- **Aurelio Ariza.** President. Spanish Society of Pathology (SEAP), Spain
- **Salvador Arribas.** General Secretary. Spanish Society of Health Infomatics (SEIS), Spain
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- **Antonio del Barrio**, Director. IT Area of Health Care Service of Castilla-La Mancha (SESCAM), Spain
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Gerhard Stauch, Aurich, Germany.
Janus Szymas, Poznan, Poland.
Yasunari Tsuchihashi, Kyoto, Japan.
Ronald S. Weinstein, Tucson, Arizona, USA.
Bruce Williams, Washington D.C., USA.
Yukako Yagi, Boston, Massachusetts, USA.

AGENDA

Thursday, May 15th, 2008

	ROOM 1 / Salones Beatriz	ROOM 2 / Salón Guadalajara
09:45-10:15	OPENING CEREMONY	
10:15-10:45	KEYNOTE LECTURE 1 Klaus Dietmar Kunze	
10:45-11:15	KEYNOTE LECTURE 2 Yukako Yagi	
11:15-12:30	ROUND TABLE: OPEN SOURCE	
12:30-13:30	Lunch	DAKO SATELLITE SYMPOSIUM
13:30-14:00	KEYNOTE LECTURE 3 Chhut Serey Vathana	
14.00-15:30	SCIENTIFIC SESSION 1	OLYMPUS SATELLITE SYMPOSIUM
15:30-15:50	Coffee break	Coffee break
15:50-16:20	KEYNOTE LECTURE 4 Bruce H. Williams	SLIDE SCANNING TRAINING COURSE (SPANISH)
16:20-17:20	SCIENTIFIC SESSION 2	
17:20-17:45	KEYNOTE LECTURE 5 Ernesto Moro	
17:45-18:10	KEYNOTE LECTURE 6 Janusz Szymas	
18:10-19:00	SCIENTIFIC SESSION 3	

Friday, May 16th, 2008

	ROOM 1 / Salones Beatriz	ROOM 2 / Salón Guadalajara	ROOM 3 / Salón Alcázar
08:30-09:00	EUROTELEPATH		
09:00-09:20	KEYNOTE LECTURE 7 Béla Molnár		
09:20-10:30	SCIENTIFIC SESSION 4	IHE TRAINING COURSE	
10:30-10:50	Coffee break		
10:50-11:20	KEYNOTE LECTURE 8 Klaus Kayser		
11:20-12:30	SCIENTIFIC SESSION 5		
12:30-13:00	PRACTICAL SESSION Clovis Klock	12:00-13:00 COST Action IC0604 (Eurotelepath) WG2 (Standards)	
13:00-14:00	Lunch		
14:00-14:30	KEYNOTE LECTURE 9 John R. Gilbertson	SNOMED-CT TRAINING COURSE	VIRTUAL SLIDE SEMINARS (COMPUTER ROOM)
14:30-16:30	SCIENTIFIC SESSION 6		
16:30-17:00	Coffee break. POSTER SESSION – DISCUSSION. EXHIBITION AREA		
17:00-18:00	SPECIAL SESSION Bruce A. Beckwith	MEETING OF INTERNATIONAL ACADEMY OF TELEPATHOLOGY	VIRTUAL SLIDE SEMINARS (COMPUTER ROOM)

Saturday, May 17th, 2008

	ROOM 1 / Salones Beatriz	ROOM 2 / Salón Guadalajara	ROOM 3 / Salón Alcázar
08:30-09:00	KEYNOTE LECTURE 10 Yrjö Collan	08:30-10:00 IHE-PATHOLOGY	VIRTUAL SLIDE SEMINARS (COMPUTER ROOM)
09:00-11:00	SCIENTIFIC SESSION 7		
11:00-11:30	Coffee break	10:00-14:00 DICOM WG26 MEETING	
11:30-13:00	INNOVATIVE TECHNOLOGY		
13:00-13:30	ROUND TABLE DISCUSSION		
13:30-14:00	OPEN DISCUSSION AND CLOSING REMARKS		
14:00	Lunch		

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SCIENTIFIC PROGRAMME

THURSDAY, MAY 15TH, 2008. / ROOM 1. SALONES BEATRIZ

INAUGURATION

09:45-10:15 **OPENING CEREMONY**

Chairperson: **Roberto Sabrido**
Regional Health Minister, Castilla-La Mancha Government, JCCM

Vocals: **Evangelina Aranda**
Vice-Director of Toledo Campus and Institutional Relationships. University os Castilla-La Mancha, UCLM
George Mihalas
President of the European Federation for Medical Informatics, EFMI
Aurelio Ariza
President of the Spanish Society of Pathology, SEAP-DEAIP
Salvador Arribas
General Secretary. Spanish Society of Health Informatics, SEIS
Marcial García Rojo
Organising Committee Chair, HGCR-SESCAM-SEIS

TELEPATHOLOGY NOWADAYS

Chairpersons: Yrjö Collan (Finland)**, Janusz Szymas** (Poland)

10:15-10:45 **KEYNOTE LECTURE 1**

Presenter: *Efficiency and diagnostic reliability of telepathology consultation*
Klaus Dietmar Kunze
Institut für Pathologie, Technische Universität Dresden, Germany.

10:45-11:15 **KEYNOTE LECTURE 2**

Presenter: *The importance of optical optimization in whole slide imaging (WSI) and digital pathology imaging*
Yukako Yagi, John R. Gilbertson
Department of Pathology, Harvard Medical School, Boston, USA.

OPEN SOURCE IN PATHOLOGY

Chairpersons: Vincenzo Della Mea (Italy)**, Jorma Isola** (Finland)

11:15-12:30 **ROUND TABLE**

Presenters: *Open source solutions in public health services*
José Sacristán
Head of Systems Service. Information Technology Area. SESCAM, Toledo, Spain.

Open source tools for Pathology
Vincenzo Della Mea
Dept. of Mathematics and Computer Science, University of Udine, Udine, Italy.

Telepathology and distant diagnosis with small size virtual slide (SSVS)
Francisco Marcano[1], Juan José Quintana[1], Olga Ferrer-Roca[2]
1. Eng. Fellow of the UNESCO Chair in Telemedicine, University of La Laguna.
2. MD. PhD. Full Professor of Pathology. UNESCO Chair in Telemedicine.
University of La Laguna. 38071 Tenerife. Canary Islands. Spain.

12:30-13:30 **Lunch (DAKO SATELLITE SYMPOSIUM. Room 2)**

THURSDAY, MAY 15TH, 2008. / ROOM 1. SALONES BEATRIZ

WORLDWIDE EXPERIENCES IN TELEPATHOLOGY

Chairpersons: Yasunari Tsuchihashi (Japan), **Arunas Lukosevicius** (Lithuania)

13:30-14:00 **KEYNOTE LECTURE 3**

Presenter: *Need, feasibility and sustainability in two projects of telepathology in developing countries, Africa and South East Asia*

Serey Vathana Chhut[1], Gerhard Stauch[2], Sam Ang Cheng[1], Gaudens Komba[3], Ponsiano Tonja[3], Martin Oberholzer[4]

1 Phnom Penh Institute of Pathology
2 Aurich
3 St Joseph's Mission Hospital Peramiho
4 Department of Pathology, University of Basel.

14.00-15:30 **SCIENTIFIC SESSION 1**

Presenters: *Telepathology in emerging countries pilot project between Italy and Egypt*

Essam Ayad[1], Francesco Sicurello[2]

1 Departament of Pathology. Cairo University and Italian Hospital in Cairo. Egypt
2 @ITIM-Italian Association of Telemedicine and Medical Informatics, University of Milano Bicocca, Italy.

Dynamic active telepathology over National Health Laboratory System (NHLS) network, South Africa. Feasibility pilot study using Nikon Coolscope

L Banach, A Stepien, J Schneider, E Wichrzycka-Lancaster

NHLS and Walter Sisulu University, Mthatha, South Africa.

Virtual Health Care Center in Georgia

Thomas Schrader[1], Ekaterina KIdiashvili[2]

1 Department of Pathology, University Hospital Berlin – Charite. Berlin. Germany.
2 Georgian Telemedicine Union (Association). Tbilisi. Georgia.

Telepathology network in the Pomerania: Evaluation and acceptance study of mamma biopsy applied virtual slides

Eduard Wolf[1], Annette Lebeau[2], H Pickartz[3], M Anders[4], P Debold[4], Mikael Lundin[5], Thomas Betz[6], Janusz Szymas[7]

1 Institut für Hämatopathologie, Hamburg, Germany.
2 Institut für Pathologie, Universität Hamburg, Germany.
3 Institut für Pathologie, Berlin-Spandau, Germany.
4 Labor für Histologie u. Cytologie, Greifswald, Germany.
5 Biomed Informatics Group, Dept of Oncology & Folkhälsan Research Center, Univ of Helsinki, Finland.
6 Carl Zeiss MicroImaging GmbH, Germany
7 Department of Clinical Pathology, University of Medical Sciences. Poznan. Poland.

Serendipia: Castilla-La Mancha telepathology network

Carlos Peces[1], Marcial García-Rojo[2], José Sacristán[1], Antonio José Gallardo[1], Ambrosio Rodríguez[1]

1 Information Technologies Department of the Regional Health Care Services of Castilla-La Mancha (SESCAM). Toledo, Spain
2 Pathology Department. Hospital General de Ciudad Real, Spain.

14.00-15:30 **OLYMPUS SATELLITE SYMPOSIUM. ROOM 2**

15:30-15:50 **Coffee break**

THURSDAY, MAY 15TH, 2008. / ROOM 1. SALONES BEATRIZ

TELEPATHOLOGY ORGANIZATIONS AND APPLICATIONS

Chairpersons: Gloria Bueno (Spain), **Péter Gombás** (Hungary)

15:50-16:20 **KEYNOTE LECTURE 4**

Presenter: *Telemedicine: The art of the workaround*

Bruce H. Williams
DVM, DACVP Chairman, AFIP Dept. of Telemedicine. Washington, DC, USA.

16:20-17:20 **SCIENTIFIC SESSION 2**

Presenters: *Telediagnostics of intraoperative biopsies of mammary carcinoma*

I.N. Shestakova, Yu.P. Gribunov, Yu.L. Perov, L.S. Khodasevich
Medical Center, General Management Department of the President of the Russian Federation. Moscow, Russia.

Use of virtual slide system for quick frozen intra-operative telepathology diagnosis in Kyoto, Japan

Yasunari Tsuchihashi[1], Terumasa Takamatsu[2], Yukimasa Hashimoto[3], Tooru Takashima[3], Kooji Nakano[3], Setsuya Fujita[1]
1 Louis Pasteur Centre for Medical Research, Ukyo, Kyoto, Japan.
2 CLARO Inc., Aomori, Japan.
3 Yamashiro Public Hospital, Kizu, Kyoto, Japan.

Organizational model for a telepathology system

Roberto Mencarelli[1], Adriano Marcolongo[2], Alessio Gasparetto[3]
1 Department of Surgical Pathology.
2 General Manager.
3 Department of Information Technology - Azienda ULSS 18. Rovigo, Italy.

The integration of whole slide images as research data in the scientific metadata repository of the Open European Nephrology Science Center

Uwe Kuehn[1], Claudia Hahn[2], Sonja Niepage[2], Yao Zhou[2], Dietmar Keune[2], Sabine Hanss[3], Thomas Weckend[4], Gabriele Schmidt[1], Thomas Schrader[2]
1 Brandenburg University of Applied Sciences, Brandenburg, Germany.
2 Department of Pathology, Charité Universitätsmedizin Berlin, Germany.
3 Institute of Medical Informatics, Charité Universitätsmedizin Berlin, Campus Benjamin Franklin, Germany.
4 IT-Center, Charité Universitätsmedizin Berlin, Germany.

THURSDAY, MAY 15TH, 2008. / ROOM 1. SALONES BEATRIZ

TELEPATHOLOGY AND VIRTUAL MICROSCOPY IN EDUCATION

Chairpersons: Klaus Kayser (Germany), **Serey Vathana Chhut** (Cambodia)

17:20-17:45 **KEYNOTE LECTURE 5**

Presenter: *Discontinuous video recording of biopsies in the context of an integral third degree teaching program*

José Ernesto Moro Rodríguez

Anatomic Pathology Area. Universidad Rey Juan Carlos. Alcorcón, Madrid, Spain.

17:45-18:10 **KEYNOTE LECTURE 6**

Presenter: *Digital pathology as teaching and testing system in pre- and postgraduate courses*

Janusz Szymas

Department of Clinical Pathology, University of Medical Sciences. Poznan. Poland.

18:10-19:00 **SCIENTIFIC SESSION 3**

Presenters: *Hypertext atlas of fetal and neonatal pathology*

Marta Ježová[1], Katarína Múčková[1], Ondřej Souček[1], Josef Feit[1], Pavel Vlašín[2]

1 Institute of Pathology, Masaryk University, Brno, Czech Republic.

2 Prenatal Diagnostic Center, Brno, Czech Republic.

Teaching veterinary pathology in 21st century

Andreas Pospischil, Maja Ruetten, Vahid Djamei, Lloyd Vaughan

Veterinary Pathology Zurich, Switzerland

Teaching dental students pathology with use of Webmicroscope - three years experiences

Janusz Szymas[1], Mikael Lundin[2]

1 Department of Clinical Pathology, University of Medical Sciences. Poznan. Poland.

2 Biomed Informatics Group, Dept of Oncology & Folkhälsan Research Center, University of Helsinki, Finland.

16:00-19:00 **SLIDE SCANNING TRAINING COURSE (Spanish). ROOM 2**

Thursday, May 15th, 2008. ROOM 2. Salón Guadalajara

12:30-13:30
DAKO SATELLITE SYMPOSIUM
Image Analysis in Routine Clinical Diagnostic

Programme

12:30-12:35 **Welcome**
Chair: **Marcial García Rojo**
Pathology Department. Hospital General de Ciudad Real, Spain.

12:35-13:00 *Pathology Workflow and Integration of ACIS III in Dako Link*
Joachim Schmid
Director, Imaging & Pathology Workflow, Dako, USA

13:00-13:25 *Use of ACIS III in daily use to support the breast panel diagnosis*
Fernando A. Soares
University of São Paulo, São Paulo. Medical Hospital A.C. Camargo, São Paulo, Brazil.

13:25-13:30 **Discussion and closing**
Marcial Garcia Rojo

Lunchbox will be served during the meeting
Please come and visit us in the Exhibit Hall, Booth number: 32

14:00-15:30
OLYMPUS SATELLITE SYMPOSIUM
Experiences of digital histology in clinical practice and research

Programme

14:00-14:15 **Welcome**
Chair: **Christel Daniel**
DIH-Hôpital Européen Georges Pompidou- APHP. INSERM UMRS. Paris. France

14:15-14:45 *Automated Tissue Microarray image analysis to identify and quantitatively determine tumor relevant proteins*
Daniel Goettel
Application Specialist, Olympus Soft Imaging Solutions GmbH, Berlin, Germany.

14:45 -15:15 *Virtual microscopy: a tool for the Italian Pathology Society (SIAPEC IAP) activities*
Claudio Clemente
Informatic Commission of SIAPEC-IAP, Milano, Italy.

15:15-15:30 **Discussion and closing**
Christel Daniel

Please come and visit us in the Exhibit Hall, Booth numbers: 12, 13, 14.

SLIDE SCANNING training course (Spanish)
Curso básico de escaneado y gestión de preparaciones digitales (microscopía virtual)
(en español, digirido a Patólogos y Técnicos de Anatomía Patológica y Citología)

16:00-19:00 **IZASA / Nikon / Aperio**
Teachers: **Jordi Recansens / Óscar Gamo**
Grupo Instrumentación científica. Izasa, Spain.

FRIDAY, MAY 16TH, 2008. ROOM 1. SALONES BEATRIZ

PERSPECTIVES IN virtual MICROSCOPY

Chairpersons: Vincenzo Della Mea (Italy), **Klaus Dietmar Kunze** (Germany)

08:30-09:00 **EUROPEAN RESEARCH PROJECTS**

Presenter: *COST Action IC0604: Eurotelepath*

Marcial García Rojo[1], Luis Gonçalves[2]
1. Department of Pathology, Hospital General de Ciudad Real, Spain.
2. Department of Pathology, Hospital de Évora, Portugal.

09:00-09:20 **KEYNOTE LECTURE 7**

Presenter: *Digitalisation of routine histology laboratory processes: sign-out, immunohistochemistry, education*

Béla Molnár[1], Renata Kis[2], Laszlo Fonyad[3], Tibor Krenacs[2], Laszlo Gerely[2], Viktor Varga[1], Levente Ficsor[1], Andras Matolcsy[3]
1 2nd Deptartment of Internal Medicine, Semmelweis University, Budapest, Hungary.
2 3DHISTECH Ltd., Budapest, Hungary.
3 Semmelweis University, Budapest, Hungary.

09:20-10:30 **SCIENTIFIC SESSION 4**

Presenters: *Computational pathology: from telepathology to e-learning and diagnostic support in virtual microscopy*

Klaus Kayser[1], Jürgen Görtler[2], Ekkehard Vollmer[3], Dominik Radziszowski[4], Gian Kayser[5]
1 UICC-TPCC, Institute of Pathology, Charite, Berlin, Germany.
2 IBM, DeepComputing.
3 Institute of Pathology, Research Center Borstel, Borstel, Germany.
4 AGH University of Science and Technology, Krakow, Poland.
5 Institute of Pathology, University of Freiburg, Freiburg, Germany

Virtual microscope interface to high resolution histological images

Josef Feit[1], Luděk Matyska[2], Vladimír Ulman[2], Lukáš Hejtmánek[2], Hana Jedličková[3], Marta Ježová[1], Mojmír Moulis[1], Věra Feitová[4]
1 Institute of Pathology, Masaryk University, Brno, Czech Republic.
2 Faculty of Informatics, Masaryk University, Brno, Czech Republic.
3 Dept. of Dermatovenerology, St. Anna Hospital, Masaryk University, Brno, Czech Republic.
4 Dept. of Radiology, St. Anna Hospital, Masaryk University, Brno, Czech Republic.

High-throughput virtual slide scanning of fluorescence in situ hybridization (FISH)

Jorma Isola, Mikael Lundin, Johan Lundin, Juho Konsti, Vilppu J. Tuominen
Institute of Medical Technology, University of Tampere, Finland.

Speed improvement of automated fluorescent digital slide scanning

Viktor Sebestyén Varga[1], Levente Ficsor[1], Barnabás Galamb[2], Viktor Kamarás[2], Béla Molnár[1], Zsolt Tulassay[1]
1 2nd Deptartment of Internal Medicine, Semmelweis University, Budapest, Hungary.
2 3DHISTECH Ltd. Budapest, Hungary.

09:00-13:00 **IHE Training Course**

10:30-10:50 **Coffee break**

FRIDAY, MAY 16TH, 2008. ROOM 1. SALONES BEATRIZ

QUALITY ASSURANCE IN TELEPATHOLOGY

Chairpersons: Ernesto Moro (Spain), **Yrjö Collan** (Finland)

10:50-11:20 **KEYNOTE LECTURE 8**

Presenter: *How to measure image quality in tissue-based diagnosis (diagnostic surgical pathology)*

Klaus Kayser[1], Jürgen Görtler[2], Konradin Metze[3], Torsten Goldmann[4], Ekkehard Vollmer[4], Masoud Mireskandari[5], Zdravko Kosjerina[7], Gian Kayser[7]
1 Department of Pathology, Charité Universitätsmedizin Berlin, Germany
2 IBM, Brussels.
3 University Campinas, Brazil.
4 Research Center Borstel. Borstel, Germany.
5 University of Medical Sciences, Tehran, Iran.
6 University Novi Sad, Serbia.
7 University Freiburg, Germany.

11:20-12:30 **SCIENTIFIC SESSION 5**

Presenters: *A relationship between slide quality and image quality in whole slide imaging (WSI)*

Yukako Yagi, John R. Gilbertson
Department of Pathology, Harvard Medical School, Boston, USA.

Search for possibility to use wavelet transform in virtual slides quality evaluation

Slawomir Walkowski, Janusz Szymas
Department of Clinical Pathology, University of Medical Sciences. Poznan. Poland.

Image quality improvement algorithm for digital histology slides

Ole Eichhorn, Cynthia Perz
Aperio Technologies, Inc. Vista, CA, USA.

12:30-13:00 **PRACTICAL SESSION**

Presenter: *Web conferencing systems: Skype and MSN in telepathology*

Clóvis Klock
Hospital Sta. Teresinha. Erechim. Rio Grande do Sul, Brazil.

13:00-14:00 **Lunch**

FRIDAY, MAY 16TH, 2008. ROOM 1. SALONES BEATRIZ

PROCESS OPTIMIZATION IN PATHOLOGY

Chairpersons: Bruce H Williams (USA), **Thomas Schrader** (Germany)

14:00-14:30 **KEYNOTE LECTURE 9**

Presenter: *Histology, imaging and new diagnostic workflows in Pathology*

John R. Gilbertson, Yukako Yagi
Department of Pathology, Harvard Medical School, Boston, USA.

14:30-16:30 **SCIENTIFIC SESSION 6**

Presenters: *Issues for application of virtual microscopy to cytoscreening, perspectives based on questionnaire to Japanese cytotechnologists*

Ichiro Mori[1], Osamu Nunobiki[2], Takashi Ozaki[1], Emiko Taniguchi[1], Kennichi Kakudo[1]
1 Department of Pathology, School of Medicine, Wakayama Medical University. Japan.
2 Faculty of Health Sciences, Kobe Tokiwa University. Nagataku, Kobe, Japan.

A study on the establishment of pathological diagnostic processes and their quantitative analysis

Ikuo Tofukuji[1], Yasunari Tsuchihashi[2]
1 Takasaki University of Health and Welfare. Japan.
2 Luis Pasteur Center for Medical Research, Kyoto, Japan.

Experience the benefits of a digital environment: Digital Pathology is here

Ole Eichorn
Aperio Technologies, Inc. Vista, CA, USA.

14:00-16:30 SNOMED TRAINING COURSE. ROOM 2

16:30-17:00 **Coffee break. POSTER SESSION DISCUSSION. EXHIBITION AREA**

HEALTH INFORMATICS STANDARDS IN PATHOLOGY

Chairpersons: Christel Daniel (France), **John R. Gilbertson** (USA)

17:00-18:00 **SPECIAL SESSION**

Presenters: *Virtual slide imaging with JPEG2000 and JPIP network protocol. A software package demostrating the utility of JPEG2000 an JPIP as an efficient means of using virtual slides in DICOM.*

Vilppu J. Tuominen, Jorma Isola
Institute of Medical Technology, University of Tampere, Finland.

Standards for digital images in pathology

Bruce A. Beckwith
Department of Pathology. North Shore Medical Center. Salem, MA, USA.

17:00-17:30 MEETING OF INTERNATIONAL ACADEMY OF TELEPATHOLOGY. ROOM 2

FRIDAY, MAY 16TH, 2008. ROOM 2. SALÓN GUADALAJARA

INTEGRATING HEALTHCARE ENTERPRISE (IHE) SHORT TRAINING COURSE

Lecturers: Christel Daniel[1], Thomas Schrader[2]
1 DIH-Hôpital Européen Georges Pompidou- APHP. INSERM UMRS. Paris. France
2 1 Department of Pathology, University Hospital Berlin – Charite. Berlin.(Germany).

09:00-12:00 **The IHE Pathology Technical Framework: Introducing informatics standards in Pathology**

09.00 – 09.10 *Welcome*
Christel Daniel, Thomas Schrader

09.10 – 10.30 *Integrating the Healthcare Enterprise (IHE) & Pathology – General Aspects & Standards*
Christel Daniel

10.30 – 10.50 *Break*

10.50 – 11.10 *Integration Profiles*
Thomas Schrader

11.10 – 11.50 *Transactions*
Christel Daniel, Thomas Schrader

11.50 – 12.00 *Conclusion & Summary*
Christel Daniel, Thomas Schrader

TELEPATHOLOGY NETWORK IN EUROPE

Chairpersons: Christel Daniel (France), **Marcial García Rojo** (Spain)

12:00-13:00 **COST Action IC0604 (Eurotelepath) Working Group 2 (Medical Informatics Standards in Pathology) business meeting**

13:00-14:00 **Lunch**

SNOMED-CT SHORT TRAINING COURSE

14:00-16:30 **Structured reports and coding in Pathology. SNOMED-CT**

16:30-16:50 **Coffee break**

FRIDAY, MAY 16TH, 2008. EXHIBITION AREA

POSTERS SESSION

Chairpersons: Gloria Bueno (Spain), **Thomas Schrader** (Germany)

16:30-17:00 **POSTER SESSION DISCUSSION**

SATURDAY, MAY 17TH, 2008. ROOM 1. SALONES BEATRIZ

READING VIRTUAL SLIDES. THE ROLE OF IMAGE ANALYSIS

Chairpersons: Janina Slodkkowska (Poland), **Janusz Szymas** (Poland)

08:30-09:00 **KEYNOTE LECTURE 10**

Presenter: *Gastric biopsies with virtual microscopy*

Yrjö Collan
Department of Pathology, University of Turku, Finland.

09:00-11:00 **SCIENTIFIC SESSION 7**

Presenters: *Object orientated automated image analysis: Quantitative and qualitative estimation of inflammation in mouse lung*

Coralie Apfeldorfer, Kristina Ulrich, Gareth Jones, David Goodwin, Susie Collins, Emanuel Schenck, Virgile Richard
Pfizer Ltd., DSRD, Ramsgate Road, Sandwich, Kent CT13 9NJ, UK.

Use of image analysis and digital slides in clinical IHC pathology applications and the impact of region selection on quantitative results

Joachim Schmid[1], Lee Ryan[1], Roscoe Atkinson[2]
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2 University of Southern California, CA. USA.

Image analysis in the study of Mammaglobin, a novel tumor marker for breast cancer

Sonia L. El-Sharkawy[1], Wafaa E. Abd El-Aal[1], Marwa A. El-Shaer[1], Naglaa Fathy Abbas[1], Mona F. Youssef[2]
1 Pathology Deptartment, National Research Centre. Cairo. Egypt.
2 Clinical Pathology Deptartment , Ain Shams University. Cairo. Egypt.

Assessment of HER-2/neu expression in breast carcinoma: A comparative approach by automated cellular imaging system (ACIS) and ScanScope Aperio

Janina Slodkowska[1], Jan Breborowicz[2], Martina Ploghoft[3], Michal Wojciechowski[4], Violetta Filas[2], Karolina Pisula[3], Wojciech Staniszewski[4]
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2 Department of Tumour Pathology, Wielkopolskie Center of Oncology, Poznan, Poland
3 Dako, Copenhagen, Denmark.
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Automated region of interest retrieval and classification using spectral analysis

Myriam Oger[1], Philippe Belhomme[2], Jacques Klossa[3], Jean-Jacques Michels[4], Abderrahim Elmoataz[5]
1 EPF-TRIBVN-GRECAN, Paris, France
2 GRECAN, F. Baclesse Cancer Centre, Caen, France.
3 TRIBVN, Châtillon, France.
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Benefice of virtual microscopy on prostatic biopsy cores examination

Philippe Camparo[1], Eva Comperat[2], Cyrus Chargari[1]
1 HIA Val de Grace, Paris, France.
2 CHU Pitié Salpétrière, Paris, France.

11:00-11:30 **Coffee break**

SATURDAY, MAY 17TH, 2008. ROOM 1. SALONES BEATRIZ

INNOVATIVE TECHNOLOGY

Chairpersons: Klaus Kayser (Germany), **Ernesto Moro** (Spain)

11:30-13:00 **INNOVATIVE TECHNOLOGY REMARKS**

Presenter:

Colour model analysis for microscopic image processing

Gloria Bueno[1], Roberto González[1], Oscar Déniz[1], Jesús González[2], Marcial García-Rojo[2]
1 Engineering School, Universidad de Castilla-La Mancha, Ciudad Real, Spain
2 Department of Anatomical Pathology. Hospital General de Ciudad Real, Spain.

Practical aspects to consider when adopting a digital pathology solution

Michael E. Getman
Ph.D. Senior Scientist. BioImagene, Inc. Cupertino, California, USA.

Towards the fully digitalized surgical pathological laboratory: integration of digital microscopy diagnostics, textual reporting and remote consultation using digital networks

Péter Gombás[1], Béla Molnár[2], András Huszár[3]
1 State Health Centre, Division of Pathology, Budapest, Hungary
2 2nd Deptpartment of Internal Medicine, Semmelweis University, Budapest, Hungary.
3 Department of Forensic Medicine, University of Pécs, Hungary.

CONCLUSIONS

13:00-13:30 **ROUND TABLE DISCUSSION**

Participants: **Marcial García Rojo, Peter Gombas, Klaus Kayser, Yasunari Tsuchihashi**

13:30-14:00 **OPEN DISCUSSION AND CLOSING REMARKS**

Chair: **Klaus Kayser**
President of the International Academy of Telepathology, IAT

Vocals:
Antonio del Barrio
Director. IT Area of Health Care Service of Castilla-La Mancha, SESCAM
Gloria Bueno
Chair of the Scientific Committee
Marcial García Rojo
Chair of the Organising Committee
Peter Gombas
State Health Centre, Division of Pathology, Budapest, Hungary

14:00 **Lunch**

Saturday, May 17th, 2008. ROOM 2. Salón Guadalajara

08:30-10:00	IHE-PATHOLOGY MEETING(*)
10:00-14:00	DICOM WORKING GROUP 26 (PATHOLOGY) MEETING (*)

(*) Joint meeting with COST Action IC0604 Working Group 2 (Standards)

11:00-11:20	Coffee break

Saturday, May 17th, 2008. ROOM 3. Salón Alcázar

08:30-13:00	VIRTUAL SLIDE SEMINARS
11:00-11:20	Coffee break

POSTER SESSION. Exhibition area

FRIDAY, MAY 16TH, 2008.

Chairpersons: Gloria Bueno (Spain), **Thomas Schrader** (Germany)

16:30-17:00 POSTER SESSION DISCUSSION

1/ Portable telepathology: Methods and tools

Luis Alfaro[1], Mª José Roca[2]
1 Departments of Pathology. Hospital Rey Don Jaime. Castellón. Spain.
2 Hospital Lluis Alcanyis. Xativa. Valencia. Spain.

2/ A survey on non specialized off-the-shelf JPEG2000 viewers for digital microscopy use

Vincenzo Della Mea[1], Nicola Bortolotti[2], Carlo Alberto Beltrami[2]
1 Dept. of Mathematics and Computer Science, University of Udine, Udine, Italy.
2 Dept. of Medical Morphological Research, University of Udine, Udine. Italy.

3/ eSlide: an open source, multi platform system for digital microscopy

Vincenzo Della Mea[1], Nicola Bortolotti[2], Carlo Alberto Beltrami[2]
1 Dept. of Mathematics and Computer Science, University of Udine, Udine, Italy.
2 Dept. of Medical Morphological Research, University of Udine, Udine. Italy.

4/ Automated classification of inflammation in colon histological sections based on digital microscopy and advanced image analysis

Levente Ficsor, Viktor Varga, Attila Tagscherer, Béla Molnár
2nd Dept. of Int.Med., Semmelweis University, Budapest, Hungary

5/ Quantitative analytical technique applied to histopathology of birds infected experimentally by the virus of chicken anemia virus

Luz García1, Victor Bermudez [2], Mariela Brett[1], Luzmila Peroza[1], Juan Landa[1], Franklin Borregales[1]
1 Instituto Nacional de Investigaciones Agrícolas (INIA). CENIAP. Sanidad Animal. Venezuela.
2 Universidad Central de Venezuela. Maracay. Estado Aragua. Venezuela.

6/ Implementation of the notation BPMN (business process modelling notation) in the modelling of pathology subprocesses

Marcial García Rojo, Elvira Rolón[2], Luis Calahorra[3], Felix Óscar García[2], Rosario Paloma Sánchez[3], Francisco Ruiz[2], Nieves Ballester[3], María Armenteros[3], Teresa Rodríguez[3], Rafael Martín Espartero[3]
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3 Quality Unit. Hospital General de Ciudad Real. Ciudad Real, Spain.

7/ Reading virtual slide using web viewers. Results of subjective experience with three different solutions

Marcial García Rojo[1], Antonio J. Gallardo[2], Lucía González[1], Carlos Peces[2], Cristina Murillo[1], Jesús González[1], Jose Sacristán[2]
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2 Information Technologies Department of the Regional Health Care Services of Castilla-La Mancha (SESCAM). Calle Huerfanos Cristinos 5, 47071 Toledo, Spain.

8/ Telepathology and continuous education. Important tools for pathologists of developing countries

Hugo Góngora Jara, Héctor A. Barceló
Cátedras de Histología y Patología - Instituto Universitario de Ciencias de la Salud Fundación H.A. Barceló. Servicio de Anatomía Patológica - Hospital Regional Dr. E. Vera Barros. La Rioja, Agentina

9/ Integration of digital image data to TMA databases for high-throughput analysis of EGFR expression in giant cell tumors of bone (GCTB)

Levente Ficsor[1], Peter Balla[1], Linda Moskovszky[1], Vivien Angeli[2], Tibor Krenacs[2], Miklos Szendroi[1], Zoltan Sapi, Laszlo Kopper, Bela Molnar
1 2nd Department of Internal Medicine, Semmelweis University, Budapest, Hungary.
2 3DHISTECH Ltd, Budapest, Hungary.

10/Tissue microarrays analysis in chondrosarcomas. Light microscopy, immunohistochemistry and xenograft study.

Isidro Machado, Francisco Giner, Empar Mayordomo, Carmen Carda, Samuel Navarro, Antonio Llombart-Bosch
Department of Pathology, University of Valencia, Valencia, Spain.

11/Quantitative digital microscopy immunohistochemistry evaluation method for breast cancer slides with Mirax

Tamas Micsik[1], Levente Ficsor[2], Tibor Krenács[3], Béla Molnár[2]
1 I. Department of Patology and Experimental Cancer Research, Semmelweis University, Budapest, Hungary
2 2nd Dept. of Int.Med., Semmelweis University, Budapest, Hungary
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12/GFAP and alpha1a-AR staining and nuclear morphometry of oligodendrogliomas by confocal microscopy and image analysis. Useful parameters for predicting survival in oligodendrogliomas

Ernesto Moro-Rodríguez[1], Javier Figols[2], Mariano Alvira, José A Uranga-Ocio[1], Eduardo García-Poblete[1].
1 Universidad Rey Juan Carlos, Madrid, Spain.
2 Hospital Universitario Marqués de Valdecilla, Santander, Spain.

13/Tissue microarrays: Applications in study of p16 and p53 alterations in Ewing's cell lines

Rosa Noguera[1], Isidro Machado[1], Marta Piqueras[1], Jose Antonio Lopez-Guerrero[2], Samuel Navarro[1], Empar Mayordomo[1], Antonio Pellin[1], Antonio Llombart-Bosch[1]
1 Department of Pathology, University of Valencia, Valencia, Spain
2 Fundación Instituto Valenciano de Oncología, Valencia, Spain

14/Introduction and implementation digital scanning in a routine-based pathology laboratory using the Mirax Scan

Rob Teunissen, Math Pieters, Marius Nap
Laboratory of Pathology, Atrium MC hospital, Heerlen, Netherlands.

// 9TH EUROPEAN CONGRESS ON TELEPATHOLOGY //
3RD INTERNACIONAL CONGRESS ON VIRTUAL MICROSCOPY

Toledo, Spain. 15-17 May 2008

Arriving at the Information Technology Age in Pathology

ABSTRACTS

KEYNOTES

KL-1

Standards for digital images in pathology

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Abstract

Introduction: The practice of pathology has followed the lead of radiology and become increasingly digitized, with growing adoption of virtual microscopy. As digital pathology images are used for clinical purposes, there is an increasing need to standardize methods for storage, retrieval and viewing as well as annotation of image files with clinical metadata. This session will discuss international efforts that are underway to address these issues.

Methods: Subgroups focused on Pathology workflow and issues have been formed within three major international standards organizations. In 2005, DICOM, the worldwide standard for communication of digital images in medicine, created a new Pathology working group. It has been working toward extending the capabilities of DICOM to handle pathologic images, including whole-slide imaging and other recent technical advances, such as multispectral imaging. Health Level 7 (HL7) has also recently initiated the Anatomic Pathology Special Interest Group and their initial efforts include formalizing a specimen model for pathology. Uniting and extending these efforts is the Integrating the Healthcare Enterprise (IHE) Pathology Working Group. IHE works to provide suggested best practices for workflow and to make specific suggestions (called integration profiles) regarding how to use the complex and flexible standards promulgated by DICOM and HL7 in particular areas of clinical practice.

Results: A new Pathology Specimen Module has been created and is currently being balloted within DICOM. This module allows for a full description, including preparation steps, of specimens which are the subject of imaging. Work is also progressing on a further DICOM supplement regarding whole slide images. The IHE Pathology group is currently focused on the workflow related to pathology specimen processing, imaging and diagnostic reporting.

Discussion/Conclusions: As is true of medicine as a whole, the future of Pathology is clearly going to be in the digital realm, but in order for this potential to completely realized, we need to work to ensure that there are comprehensive and widely accepted standards in place and that they are implemented in a consistent fashion.

KL-2

Gastric biopsies with virtual microscopy

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Abstract

Objective: The aim of this study is analyzing image scanning strategy to improve reporting gastroscopic biopsies with virtual microscopy.

Methods: 10 gastroscopic biopsies were studied with the intent to demonstrate the value of virtual microscopy (VM)in their diagnostics. Scanning of the slides was done at 10x and 40x objective magnification. Slides were thereafter reviewed at low power, with zooming in when necessary for improved resolution. In duodenal biopsies villar architecture could be evaluated from images scanned at 10x and 40x magnification (10/40), and an evaluation of lymphocytes within the epithelium could be given. Gastric biopsies were evaluated with the Sydney system. In biopsies from antrum and corpus chronic inflammation could be graded in 10/40.

Results: Demonstration of activity with the detection of granulocytes within the gland epithelium was laborious and time consuming and only practical from images scanned 40x objective. Atrophy and intestinal metaplasia could be evaluated in 10/40. Only scanning at 40x could show evidence of Helicobacteria, but the resolution did not generally satisfy the pathologist leaving a state of uncertainty.

Discussion/conclusion: It is obvious that reporting gastroscopic biopsies with virtual microscopy at the moment is slower than with the traditional microscopy. Implementation can be improved by organizing the image scanning strategy, possibly with automatic image scanning with simultaneous evaluation by the observer. The classification result should be entered on a form on screen during the evaluation. Grading of Helicobacter infestation can be improved by improved resolution. The ways to improve this point may include scanning at higher than 40x magnification, improved resolution of the camera (from 1 M pixels to 2M pixels), and improved resolution of the screen (e.g. High Definition, or of 2M pixels).

Key words: Gastroscopic biopsies, Sydney classification, Virtual microscopy.

KL-3

Open source tools for pathology

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Abstract

Introduction: Open source is an approach to software development aimed at providing not only compiled software, but also source code, and allowing modifications and enhancement by third parties, with some constraint to protect intellectual rights of authors. Open source is often considered only for its apparent gratuity, but this is not always the case, as a business model exists also for open source, centred around maintenance and personalization.

Main Reasons: Open source in Medicine might be of interest for ate least three main reasons.
The first one is the possibility of avoiding vendor –locking, i.e., the strict link between software and its provider. In fact, while current medical software is usually proprietary, meaning that changing maintainer means changing software too. With open source, the initial maintainer can be substituted if inadequate, while maintaining the same software.
Another reason is related to software involved in research, for example in image processing. Having the source code, it is possible to independently verify the algorithms implementation, thus discriminating between possibly fallacious algorithms and possibly fallacious implementation.
Finally, the "free" aspect of open source may allow for systems adoption in developing countries.

Open source in Pathology: Until now, Pathology has been centred around a strictly analog device, i.e., the microscope; however images can be digitized, processed, analysed, and communicated. In the recent years, some software has been developed according to the open source principles that can be applied for pathology image processing and analysis.
At the basis of all there is a generic biomedical image processing tool, ImageJ (1), that can be extended by means of plugins, macros, Java code, etc. This has been then used for a number of other tools, including LargeMontage (2) for montage of digital slides, MicroManager
(3) for multidimensional microscope images (like confocal images or in- vivo recordings), and eSlide (4), for digital slide acquisition and visualization.
Another class of open source tools has been developed for Tisue Micro Array management, including Stanford TMA (5), TMAJ (6) and TIMAN (7).
Finally, one open source web application for telepathology is available (iPath, (8)) and also a generic telemedicine tool that can be successfully adopted for static telepathology (TelemedMail, (9)).
All these tools can be seen as the first of a series that will become available in the future for Pathology applications.

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KL-4

Telepathology and distant diagnosis with small size virtual slide (SSVS)

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Abstract

Objective: The present study analyzes the diagnostic capability of the Small Size Virtual Slide (SSVS) created by us (Ferrer-Roca et al 2005). SSVS is a low power acquisition (4x) with a high resolution camera system that digitizes the whole slide and builds a JPEG2000 10:1 image from 16 to 24 MB. The area of interest (ROI) is digitized at 20x. SSVS are reviewed, annotate and transmitted through intranet or Internet using JPIP (JPEG2000 internet Protocol) as if they were seen under a microscope.

Material and Methods: SSVS was implemented in the TEXCAN-II® software. The high resolution camera used was OscarAVTF810C 2469x3272. The system was tested for diagnosis and quality control with nine cytology smears and pathology slides classified regarding malignancy in five degrees (1-negative to 5-clearly positive). The ROI was determined by the cytotechnologist or was done at random in case of no indications. Ten pathologists not trained in telepathology and three trained ones evaluated the virtual slides for diagnosis and quality. Diagnostic quality for SSVS validity was evaluated with ROC analysis and the analysis of concordance and reproducibility with the Kappa of Cohen.

Results: Validity for diagnosis of the SSVS showed an area under the ROC curve of 0.95 $p<0.001$, indicative of good diagnostic quality. Comments of the users where mainly devoted to improve the sampling area of the ROI. Concordance and precision was high with $k=0.73$, $p<0.001$ in telepathology trained pathologist and low $k=0.4$, $p<0.0001$ for the non-telepathology trained.

Conclusion: The SSVS technique allows the technicians to digitize a virtual slide easy to storage due to its small size. The slide is perfectly suitable for discussion and diagnosis at distance through intranet and Internet providing a cheap digital microscope and an online collaborative system. For specimens that require high power to make diagnosis, the SSVS+ROI technique has been proved of value.

Key words: Telepathology, Telecytology, Telemedicine, Small Size Virtual Slide, TEXCAN-II, JPEG 2000, JPIP server.

KL-5

Histology, imaging and new diagnostic workflows in pathology

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Abstract

Introduction: Since their introduction in 1999, fully automated, high speed, high resolution whole slide imaging devices have become increasing more reliable, fast and capable. While by now means perfect, these devices have evolved to a point where one can consider placing them in a pre-diagnostic role in a clinical histology lab.

Methods: At the Massachusetts General Hospital, we are running a pilot study placing high end WSI devices in our main clinical histology lab (after the cover slipper and before slides are sent to the pathologist) to examine the requirement for both the machine and the laboratory.

Results: Placing WSI systems in the clinical lab stresses the system in terms of reliability and throughput. Significantly however, success requires significant modification to the lab workflow. It is likely laboratories need to move from manual, large batch processes to increasingly automated, continuous flow (or mini-batch) processes orchestrated by the LIS using bar coding to track and direct slides, and incorporating the decision to image into the specimen type and the histology orders. Furthermore, image quality, capture speed and reliability are functions of the quality of the histology presented to the WSI devices.

Conclusions: Imaging in pathology does not begin in a WSI robot but in the grossing room and in the histology lab. As more and more imaging devices are placed in histology lab, the inter-relationships histology and pathology imaging will become increasing understood.
Key words: Whole Slide Imaging, Histology

KL-6

Virtual slide imaging with JPEG2000 and JPIP network protocol

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Abstract

Introduction: Despite rapidly increasing use, virtual microscopy currently lacks of a universally accepted image format. A promising candidate is JPEG2000, which has potential advantages for handling gigabyte-sized virtual slides. To date, no JPEG2000-based software has been specifically suited for virtual microscopy.

Methods: To study the utility of JPEG2000 in virtual microscopy, we first optimized JPEG2000 code-stream parameters for virtual slide viewing (i.e., fast navigation, zooming, and use of an overview window). Compression using ratios ranging from 25:1 to 30:1 with the irreversible wavelet filter were found to provide the best compromise between file size and image quality. Optimal code-stream parameters also consisted of 10 wavelet decomposition levels, progression order Resolution-Position-Component-Layer (RPCL), a precinct size of 128 ? 128, and code-block size of 64 ? 64. Tiling and the use of multiple quality layers were deemed unnecessary.

Results: A compression application (JVScomp) was developed for creating optimally parameterized JPEG2000 virtual slides. A viewing application (JVSview) was developed specifically for virtual microscopy, offering all of the basic viewing functions. JVSview also supports viewing of focus stacks, embedding of textual descriptions, and defining regions of interest as metadata. Combined with our server application (JVSserv), virtual slides can be viewed over networks by employing the JPEG2000 Interactive Protocol (JPIP).

Conclusion: The software can be tested using virtual slide examples located on our public JPIP server (http://jvsmicroscope.uta.fi/). The software package is freely downloadable and usable for noncommercial purposes.

KL-7

How to measure image quality in tissue-based diagnosis (diagnostic surgical pathology)

Klaus Kayser[1], Jürgen Görtler[2], Konradin Metze[3], Torsten Goldmann[4], Ekkehard Vollmer[4], Masoud Mireskandari[5], Zdravko Kosjerina[7], Gian Kayser[7]

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Abstract

Background: Automated image analysis, measurements of virtual slides, and open access electronic measurement user systems require standardized image quality assessment in tissue – based diagnosis.
Aims: To describe the theoretical background and the practical experiences in automated image quality estimation of colour images acquired from histological slides.

Theory, material and measurements: Digital images acquired from histological slides should present with textures and objects that permit automated image information analysis. The quality of digitized images can be estimated by spatial independent and local filter operations that investigate in homogenous brightness, low peak to noise ratio (full range of available gray values), maximum gradients, equalized gray value distribution, and existence of gray value thresholds. Transformation of the red-green-blue (rgb) space into the hue-saturation-intensity (hsi) space permits the detection of colour and intensity maxima/minima. The feature distance of the original image to its standardized counterpart is an appropriate measure to quantify the actual image quality. These measures have been applied to a series of H&E stained, fluorescent (DAPI, Texas Red, FITC), and immunohistochemically stained (PAP, DAB) slides. More than 5,000 slides have been measured and partly analyzed in a time series.

Results: Analysis of H&E stained slides revealed low shading corrections (<10%) and moderate gray value standardization (10 – 20%) in the majority of cases. Immunohistochemically stained slides displayed greater shading and gray value correction. Fluorescent stained slides often revealed to high brightness. Images requiring only low standardization corrections posses at least 5 different statistically significant thresholds, that are useful for object segmentation. Fluorescent images of good quality only posses one singular intensity maximum in contrast to good images obtained from H&E stained slides that present with 2 – 3 intensity maxima.

Conclusion: Evaluation of image quality and creation of formally standardized images should be performed prior to automated analysis of digital images acquired from histological slides. Spatial dependent and local filter operations as well as analysis of the rgb and hsi spaces are appropriate methods to reproducible evaluated formal image quality.

Keywords: Image quality, tissue-based diagnosis, virtual slides, colour space, image standardization.

KL-8

Web conferencing systems: Skype and MSN in telepathology

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Abstract

Introduction: Virtual pathology is a very important tool that can be used in several ways, including interconsultations with specialists in many areas and for frozen sections.

Methods: We considered in this work the use of Windows Live Messenger and Skype for image transmission. The conference was made through wide broad internet using Nikon E 200 microscope and Digital Samsung Color SCC-131 camera. Internet speed for transmission varied from 400 Kb to 2.0 Mb. Both programs allow voice transmission concomitant to image, so the communication between the involved pathologists was possible using microphones and speakers.

Results: Alive image could be seen by the receptor pathologist who was able to ask for moving the field or increase / diminish the augmentation. No phone call or typing required. The programs MSN and Skype can be used in many ways and with different operational systems installed in the computer. The capture system is simple and relatively cheap, what proves the viability of the system to be used in developing countries and in cities where do not exist pathologists.

Conclusion: With the improvement of software and the improvement of digital image quality, associated to the use of the high speed broad band Internet this will be able to become a new modality in surgical pathology.

KL-9

Efficiency and diagnostic reliability of telepathology consultation

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Abstract

Introduction: Telepathology (TP) has become a well established tool to deliver histological and cytological diagnosis at a distance and to assess second opinion consultations. The efficiency and reliability of a TP-assisted diagnostics compared to conventional diagnostic procedures are crucial for a broad practical use.

Material and methods: The evaluation of remote diagnosis and consultation in pathology is based on long-standing experiences with an Internet-based TP-system (iPath, http://telemed.ipath.ch). The results are derived from two representative user groups: (1) SHCH (Telepathology at the Sihanouk Center of Hope, Cambodia) and (2) HPF (Histopathology Forum). SHCH is a closed user group for remote diagnosis. It consists of two referring colleagues in Phnom Penh and a panel of established experts from Europe. HPF is a place for discussion of challenging cases in histopathology. It is open for referring pathologists and consultants from different countries. Until now more than 1100 cases have been discussed over the last three years.

Results: To assess the reliability of a store- and forward TP-system between SHCH in Cambodia and consulting pathologists in Europe the original glass slides were reviewed and compared with the TP diagnosis. In the first year of the project (2003) for 179 of 212 specimen (84,4%) the TP diagnosis was completely identical with the review diagnosis on the original glass slide. Eighteen (8,5%) and five (2,4%) specimen showed minor and moderate disagreement, respectively. Only seven cases (3,3%) exhibited a major disagreement.
The analysis of 177 specimen from the ensuing year (2004) revealed an increase to 89,8% for cases with a complete agreement and a decrease to 1,1% for cases with marked diagnostic discordance.
An analysis of the potentially influential factors exhibits that the diagnostic accuracy significantly correlated with the appropriate selection of images ($p<0.001$) and the quality of communication ($p<0.001$).
The discussion of problematic cases in the HPF resulted in a clarification or confirmation of the diagnosis in about 70%. Twenty five percent of the submitted cases were finished with a differential diagnosis or a tentative diagnosis. About five percent of all cases could not be clarified due to inadequate image quality and other reasons.

Conclusions: The results emphasize the efficiency and reliability of a TP service for hospitals in developing countries as well as for second opinion consultations. The main problems of inadequate image selection and communication deficiencies can be overcome or diminished by training and experience.

KL-10

Digitalisation of routine histology laboratory processes: sign-out, immuno-histochemistry, education

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Abstract

Background: Vrtual microscope technology became widely available in the last years. The digitalisation of histology laboratories are entering now a new routine phase. Results from large scale clinical and technical trials are needed to show the pros and cons of the application of this new technology in a routine setting.

Materials and methods: Virtual microscopy application fields were identified in a middle sized university pathology department (<400 slides / day). All produced slides (altogether appr. 5200/month) were scanned after one month of the sign-out date on optical microscopy (OM) and represented to the staff pathologist after digitalisation on a high-throughput scanner (Mirax-Scan, Zeiss, Germany) in digital microscope(DM). Immunohistochemistry analysis was supported by special scoring program. Diagnostic concordance was defined between optical and virtual microscopy diagnosis using the kappa statistics. Education room was equipped with PC-s (45) instead of the microscopes and an annotated education material was introduced (www.pathonet.com). Acceptance was questioned on standard form. Archive samples for demonstration purposes were digitised by a manual scanner (Mirax Desk).

Results: The kappa value was 0.96 between the two methods. Significant clinical errors were not found on DM. Automated slide loading and identification, high throughput evaluation was generally accepted by the staff pathologist. Mechanical errors in the loading could be reduced by using a dedicated slide loading technology. Immunohistochemistry, FISH analysis, TMA evaluations needed a lower capacity scanner (6-10 slides) but a higher resolution with fluorescence illumination and multichannel digital slide and corresponding evaluation quantification viewer. Correlation between DM based scoring to OM one was r=0.94%. Education became more interactive, highly visited. It raised deeper visual impression and understanding due to the common view and exchangeable slide control features of the educational software tools.

Conclusions: Slide scanning, dispatching and visualisation technology is available today for routine use in histology laboratories having <400 slides/day. The diagnostic concordance between the OP and VM is high. Acceptance of VM is very good in staff pathologists. Students favour DM based education to the OM one.

KL-11

Discontinuous video recording of biopsies in the context of an integral third degree teaching program

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Abstract

Background: The application of Information and Communication Technologies (ICTs) in the field of university education can play an important role in order to fulfil the objectives of the European Space for Higher Education (ESHE). In absence of an infrastructure that allows virtual preparations, the high definition video may become an alternative for many PC users and telepathology enthusiasts. No matter if we watch high definition TV at home or a DVD while travelling, we always prefer high quality images. The new video formats that are being launched into the market (H.264, HMV-HD and MPEG-2) meet that demand and allow us to watch high definition films on our computers. The high definition video (HDV) offers a practical functioning scheme easily accepted by both consumers and manufacturers. All things considered, this might be a good solution since it is not as costly as the professional HD production systems (Sony HDCam and Panasonic DVCPro HD) and it offers a reasonable quality and fidelity similar to the DV video (MiniDV, DVCam or DVCPro).

Methods:We have begun a video biopsy discontinuous recording pilot programme, also known as interval cinematography, in order to give our students pathological images to gather documentary evidence to follow their clinical cases. We have a working post available with a ZEISS Axioshop 2 microscope connected to a JVC digital camera with a double output for video, a PVM_14N1MDE Sony Triniton colour monitor and a LG RH199 HDD-DVD recorder.

Results: Together with microscopic assessment, the pathologist carries out a discontinuous video recording on the fields he considers to be the most interesting for the final diagnosis. Those videos last between 45" and 5' according to the case. Later those videos are assessed all together and given to the student and /or the doctor who requested the case study.

Conclusion: Through this procedure we have been able to carry out better follow-up studies of the cases and we have found the point of view of the clinic beneficial as it contributes to the enrichment of integral patient care.

KL-12

Open source solutions in public health services

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Abstract

Introduction: Open source is a concept related to freedom. The user is free to:

- Run program anyplace with any purpose and for ever
- Study the source, and even adapting it to our own needs
- Redistribution
- Improve the software code and publishing those improvements

All these freedoms are guaranteed by a license.
The main reason for open source are ethical ("software is knowledge, and knowledge must be distributed without fences", Free Software Foundation), and practical ("open source offers technical and economical advantages", Open Source Initiative).
Open source in Public Administration allows for independence of vendors, avoiding giving priorities to specific companies, and also makes easier the adoption of standards. It also makes easier maintaining data and information in open formats and access. Public Administration is a big consumer of software, and when they promote the generation of free software, they make it available to citizens at no cost, like Molinux in Castilla-a Mancha.
In order to promote the use and implementation of open source software in Public Health Services of Castilla-La Mancha (SESCAM), a Centre for Innovation in Open Source in Healthcare (CISOS) was created in 2005.

Esculapio: This project has allowed computerization of over 250 primary care centres in Castilla-La Mancha, including access of electronic patient records.

Hospital information systems (HIS): Several actions have been performed, like migration of HP/UX to Linux in HP-HIS, and use of Enterprise 3.0 AS, Kernel 2.4.21-SMP and Software Cluster RedHAT with 8 support nodes. A very significant increase in performance has been observed after that change.

Extended Enterprise Processes (EAI): The EAI acts as a communication system that allows that different information systems can work integrated with flexibility and platform and geographical independence. Based in BIE v6.0.5, available in SourceForge, SESCAM has created a new integration solution called HIGEIA.

Centres of Innovation on Information technology (CITIs): Advanced telecommunication and software development solutions are studied, tested and implemented in these centres, where physicians from specific medical specialties and engineers work jointly in hospitals, coordinated by the central R+D+I unit in Toledo. Nowadays the following CITIs have been created: Dermatology, Pathology, Nuclear Medicine, Gynaecology, Gastroenterology, Ophthalmology, and Cardiology.

Projects forge: All these institutional projects are coordinated with an enterprise application integrator open source. This is necessary for planning, personalizing, integration (also with external systems).

Compromise with the future: The compromise of the SESCAM with open source include the growing of CISOS and CITIs activities, a electronic health record based in open source solutions, including a study of viability for PACS.

KL-13

Digital pathology as teaching and testing system in pre- and postgraduate courses

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Abstract

Aims: A major objective of this survey is to provide a comprehensive vision of the most recent implementation of digital slides and virtual microscopy for the medical didactic. At the medical graduate level, we have implemented digital slides into pathology curriculum courses.

Methods: This is being accomplished by use of relatively inexpensive, low throughput virtual slide processors, or home made systems. They are of limited value in the routine practice of pathology, because of their low processing rates but useful for education.

Results: Viewer permits examination of the whole digital slide by intuitive and user-friendly interface. By viewing a digital slide it is possible to search for areas of interest and to examine the entire specimen at all magnifications. In combination with clinical and radiological data the construction of the virtual cases is possible. Pathology courses at a number of medical schools have embraced digital slides and have substituted virtual microscopy for traditional light microscopy. To date in the Poland at least three of twelve Medical Universities use now virtual slides for laboratory exercises. Tools have been developed providing access to digital slides located at institute's web portals. Digital slides have been also validated for use in tests. In postgraduate training digital slides have been validated for use in pathology specialty certification examinations.

Discussion/Conclusion: Some National Boards of Pathology have incorporated virtual microscopy into its certification tests. Pathologists taking pathology recertification examinations in the future will be tested with digital slides. Also, it is anticipated that digital slides will be used for proficiency testing of pathologists, as well as medical technologists, in the future. Such activity boosts national and international cooperation, consistency of didactic processes, dedicated international servers and reference databases, which allow continuous education in pathology. This rapid diffusion of digital pathology and growing acceptance of virtual microscopy as a substitute for traditional light microscopy, by a wide range of users in the field of education, underlines the effectiveness and convenience of virtual microscopy. It seems plausible that conventional light microscopes would become largely obsolete in medical schools. It also seems that virtual microscopy becomes a standard of doing medical microscopy in the future, which is regarded as likely to happen, so we have to prepare next generation of pathologists namely digital pathologists. Main contributions, advantages, and drawbacks of the current implementation methods of digital pathology are presented and discussed, as well the outlook for future.

KL-14

Need, feasibility and sustainability in two projects of telepathology in developing countries, Africa and South East Asia

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Abstract

For setting medical projects and especially pathology and cytology projects in developing countries, three essentials should be considered:
1. Need
2. Feasibility and
3. Sustainability

Need could be defined by the actual number of investigations in relation to number of patients, number of departments, workload and possibilities for special investigations. It can be also defined by human resources: number of pathologists on service, experience of pathologists and training of technicians in routine work and special investigations.
Need is also depended on the general treatment options, which clinicians can provide to patients.

Feasibility is depending mostly on financial resources either of the institutions themselves or of the patients. It is also depending in case of pathology by access to special chemicals and to information sources. Feasibility is also depending on close cooperation with clinicians: clinical information, radiology, biochemistry, endoscopies and so on.

Sustainability can be provided by collaboration with specialists from abroad such as Telepathology. Also, cooperation with other departments of pathology can help to sustain the project. Participating in continuous domestic and international training programs as well as in participation in international meetings and congresses will provide continuous work for local pathologists.

The authors will show two examples of Telepathology departments in Peramiho, Tanzania, recently settled and in Phnom Penh, Cambodia, over 6 years settled their need, feasibility and sustainability.

KL-15

Telemedicine: The art of the workaround

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Abstract

Introduction: Anyone who has worked in telemedicine over the last ten years likely has a shared experience – that of all of the pieces never quite fitting together properly. In computer circles, a "workaround" is defined as a temporary fix which is used to overcome hardware, programming, communications, or integration problems –- however in telemedicine, workarounds often become permanent solutions. Each upgrade, or worse yet, each new wave of technology often brings a host of new issues with it.

Cycles of technology: The AFIP Telemedicine Department has been in continuous operation since 1993, and has gone through three cycles of technology – static images, robotic microscopy, and today, slide scanning. Each cycle has required its share of workarounds – some minor and some of significant complexity. In the early days, primitive cameras required technology workarounds, often just to capture an image. In a time when laboratory information systems did not even consider the possibility of the electronic patient record, telemedicine visionaries cobbled together COTS PACS and database systems (Filemaker Pro, anyone?) in order to warehouse digital cases for retrieval. The requirements of incorporating these systems (and those that have followed) with organization-level legacy systems often required significant workarounds in the areas of data conversion and retrieval. And to this day, the hubris of system developers continues to result in proprietary image and data formats, forcing communications workarounds on programs whose end users employ more than one type of imaging system.

Conclusion: This lecture will illustrate many of the common historical and present-day workarounds employed in telemedicine programs, highlight some of the unique problems and solutions used by the AFIP's Department of Telemedicine, and attempt to illustrate an experience common to us all.

KL-16

The importance of optical optimization in whole slide imaging (WSI) and digital pathology imaging

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Abstract

Introduction: In the last 10 years, the WSI has seen impressive progress not only in image quality and scanning speed but also as variety systems available to pathologists. However, we have noticed that most systems have relatively simple optics axes and rely on software to optimize image quality and color balance. While much can be done in software, this study examines the importance of optics, in particular optical filters, in WSI.

Optical resolution is a function of the wavelength of light used and the numerical aperture of the lens system (Resolution = (f) wavelength / 2 NA). When illumining light is not conditioned correctly with filters, there is a tendency for the wavelength to shift to longer values (more red) because of the characteristics of the lamps in common usage. Most microscopes (but remarkably few WSI devices) correct for this with ND filter for brightness and Blue filter (depends on the light source) for color correction.

Material and methods: Using H&E slides research microscopes (Axiophot, Carl Zeiss MicroImaging, Inc. NY. Eclipse 50i., Nikon Inc. NY) at 20x, an attached digital camera (SPOT RT741 Slider Color, Diagnosis Instruments., MI USA), and a filter set, we examined the effect of filters and software enhancement on digital image quality. The focus value (as evaluated by focus evaluation software developed in house and SPOT imaging Software v4.6) was used as a proxy for image quality.

Results: Resolution of tissue features was best with the use of both the Blue and ND filters (in addition to software enhancement). Images without filters but with software enhancement while superficially good, lacked some details of specimen morphology and where unclear compared with the images with filters.

Conclusions: The results indicate that the appropriate use of optical filters could measurably improve the appearance and resolution of WSI images.

ORAL PRESENTATIONS

OP-1

Object orientated automated image analysis: Quantitative and qualitative estimation of inflammation in mouse lung

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Abstract

Introduction: Historically, histopathology evaluation is performed by a pathologist generating a qualitative assessment on thin tissue sections on glass slides. In the past decade, there has been a growing interest for tools able to reduce human subjectivity and improve workload. Whole slide scanning technology combined with object orientated image analysis can offer the capacity of generating fast and reliable results. In the present study, we combined the use of these emerging technologies to characterise a mouse model for chronic asthma.

Methods: We monitored the inflammatory changes over five weeks by measuring the number of neutrophils and eosinophils present in the tissue, as well as, the bronchiolar associated lymphoid tissue (BALT) area on whole lungs sections.

Results: We showed that inflammation assessment could be automated efficiently and reliably. In comparison to human evaluation performed on the same set of sections, computer generated data was more descriptive and fully quantitative. Moreover optimisation of our detection parameters allowed us to be to more sensitive and to generate data in a larger dynamic range to traditional experimental evaluation, such as bronchiolar lavage (BAL) inflammatory cell counts obtained by flow cytometry. We also took advantage of the fact that we could increase the number of samples to be analysed within a day. Such optimisation allowed us to determine the best study design and experimental conditions in order to increase statistical significance between groups.

Conclusion: We showed that combination of whole slide digital scanning and image analysis could be fully automated and deliver more descriptive and biologically relevant data over traditional methods evaluating histopathological pulmonary changes observed in this mouse model of chronic asthma.

Keywords: Definiens eCognition, object orientated image analysis, whole slide scanning, mouse model of chronic asthma.

OP-2

Telepathology in emerging countries pilot project between Italy and Egypt

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Abstract

Introduction: Pathological examination includes gross & microscopic examinations at different magnification. Through the steps of examination, we obtain many images that can be used for telepathology. Telepathology is the practice of pathology at a distance, viewing images on a monitor rather than directly through a light microscope. It can be used for primary diagnosis, second opinion, quality assurance and distance learning. Telepathology is classified into Static, Dynamic, Hybrid and Whole Slide Imaging [WSI]. We have a successful experience in Egypt in applying the static & dynamic techniques in a pilot project between the Italian Hospital in Cairo [NPO] and the Civico Hospital in Palermo.

Methods: This project began in 2003 and continued till now. From the second year 2004, Ospedale S. Giovanni e Paolo Hospital in Venice, Charing Cross Hospital in London and the University of Pittsburgh Medical Centre Health System [UPMC] in USA participated actively in our project. During the past 5 years we consulted on many problematic pathological cases with these different specialized pathological centres in Italy, UK & USA.

Results: In addition to the highly specialized scientific value of consulting on the cases and exchanging knowledge, we saved a lot of time & money and succeeded in providing our patients with a better medical service.

Discussion/Conclusion: We are now in the process of establishing a Digital Telepathology Centre [DTC] in the pathology department, Cairo University using the latest technique of telepathology which is Whole Slide Imaging [WSI]. We believe that it will help us to improve and extend diagnosis for our difficult pathological cases and will facilitate increased E-learning opportunities for staff and students both in Egypt and in the longer term in the wider Eastern Mediterranean.

Keywords: Telepathology, Egypt, Italy.

OP-3

Dynamic active telepathology over National Health Laboratory System (NHLS) network, South Africa. Feasibility pilot study using Nikon Coolscope

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Abstract

Introduction: Telepathology recently entered a new era with introduction of digital microscopes combined with Internet technology. The microscope allows viewing real time of whole slide (macro) as well as different chosen fields in four different magnifications.

Methods: Three Nikon Coolscope were installed in NHLS laboratories in Mthatha, East London and Port Elizabeth. All these microscopes are connected to NHLS server allowing real time viewing of the full slide at any time of the day using Internet browser. Viewing is possible from any PC connected to NHLS Intranet. Challenge was to be able to view slides from other than NHLS computers due to NHLS IT Department network security measures. This was solved by installing NHLS Virtual Private Network server. About 60 cases were viewed by pathologists in Cape Town (Stellenbosh University) and Pretoria (MEDUNSA).

Results: All users assessed the system as a helpful tool allowing easy access to cases needed consultation or second opinion. The quality of images was very good.

Discussion/Conclusion: Our experience with Nikon Coolscope is positive. It is occurred to be an excellent tool for remote small histopathology departments lacking specialists in such areas as dermatopathology, oncology, and haematopathology. Further studies are needed especially in the scope of full utilization of the microscopes installed and impact on laboratory services.

Keywords: Internet Telepathology, Dynamic, Coolscope, Digital Microscope.

OP-4

Colour model analysis for microscopic image processing

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Abstract

Aims: This article presents a comparative study between different colour models (RGB, HSI and CIEL*a*b*) applied to very large microscopic image analysis. Such analysis of different colour models is needed in order to carry out a successful detection and therefore a classification of different regions of interest (ROIs) within the image.

Methods: All colour models have their advantages and drawbacks. It is necessary to identify which colour model is suitable to represent and reproduce the ROI under consideration for each tissue type and WSI modality. This may be done by analysing the distance colour formulae applied between two colours. The distance considered within this study are: the Euclidean distance for the RGB model, the NBS colour distance formulae for HSI model and the CIEDE2000 for the CIEL*a*b*, colour model. Moreover, another aspect to be considered is how to deal with the colour coordinates, that is as a vector or in a marginal way.

Results : The results applied to microscopic images show that the Euclidean and NBS vector distance for the RGB and HSI model respectively distinguish between different ROIs but the vector CIEDE2000 distance for the CIEL*a*b* model reproduces in a better way the original colour. However, the computational cost of the last one is higher than the other two colour models.

Discussion/Conclusion: Successful detection and therefore a classification of different regions of interest within an image allows both distinguishing possible ROIs and retrieving their proper colour for further ROI analysis. This analysis is not commonly done in many biomedical applications that deal with colour images. Other important aspect is the computational cost of the different processing algorithms according to the colour model. This work takes these aspects into consideration to choose the best colour model tailored to the microscopic stain and tissue type under consideration and to obtain a successful processing of the histological image.

Keywords: Microscopic Image Processing, Whole Slide Colour Imaging, Colour Distances and Models.

OP-5

Benefice of virtual microscopy on prostatic biopsy cores examination

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Abstract

Introduction: Pathological examination of biopsy cores provides critical features in the management of prostatic adenocarcinomas. We evaluated the benefit of virtual microscopy in pathological examination of biopsies cores in prostatic adenocarcinomas.

Materials and methods: 1800 prostate needle biopsies from 150 consecutive patients were digitized using Olympus BX51 scan. Initial histological data were reviewed by two independent pathologists (PC and EC). Total length of biopsy cores, number of positive biopsy cores, length of tumour by biopsy cores, percentages of tumoral invasion on total biopsy cores, and percentage of Gleason 3/4/5 cancer were measured .Total Gleason score was attributed according ISUP 2005. Optically reviewed data were compared with digits numerical findings. Preliminary results are reported on 840 biopsy cores (70 patients).

Results: Mean age was 61.2 (from 48 to 75). PSA varied from 2ng/mL to 28ng/ml, with a mean value of 8ng/mL. Twelve biopsy cores were available for each patient. After digitisation and centralized reviewing of the biopsies, the median number of cores involved with prostate cancer was similar (3.5 per patient). When comparing optical and numeric measurement, total length of biopsies and total length of tumour infiltration on biopsy cores showed no significant difference (respectively 39.5 mm and 12.7 mm for optical, versus 40.2 mm and 12.65 mm for numeric measurement). The mean standard deviation between the total tumoral length invasion optically or numerically measured was 2.74 mm. For a single biopsy, the mean variation between optical and digitalized measurement of tumoral infiltration was 0.83mm. Compared with the numerical reviewing, optical examination underestimated Gleason grading in 27%. It overestimated the Gleason scoring in 11% of cases.

Discussion: Concerning tumoral core lengths, numerical analysis allow minor adjustment in pathological findings. Variations in Gleason grading are relevant with data already published in the literature concerning reproducibility of pathologic findings. Nevertheless, our results suggest that digitalisation of prostate biopsy cores offers more precision for Gleason grading. Digitisation of prostate biopsy cores in the management of prostate adenocarcinomas must be evaluated on larger series.

OP-6

Image quality improvement algorithm for digital histology slides

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Abstract

Introduction: Digital Pathology slide scanning, viewing, managing, reporting and archiving—is gaining acceptance in clinical laboratories, research facilities and medical centres. Digital pathology is commonly thought of as a technology that replaces current workflow tasks but does not offer improvements that facilitate the work of the pathologist. This paper presents an algorithm that is designed to advance the pathologist's review of digital slides beyond what is possible with a conventional microscope.

Methods and results: Review of digital slides on a virtual microscope today is not very different from review of glass slides on a conventional microscope. Given the stained histology tissue on the digital slide, a diagnosis is decided while panning and zooming about the image. The pathologist works with the slides provided. An algorithm, named IQ for Image Quality (IQ Image Enhancement Algorithm ©Aperio Technologies, Inc. 2008, Patents Pending), has been developed that enables the pathologist to adjust the stains to preferential settings with the goal of improving the visualization of the image and therefore the speed, accuracy and certainty in diagnosis. IQ operates in real time, processing and presenting the results synchronously as the pathologist navigates the image.

Discussion: IQ is founded on the concepts presented in [1] using colour deconvolution to separate the composite image into its individual stain images. Rather than quantifying the stains, however, IQ provides image adjustment controls for each of the stain images and then recombines them back into a new composite image. Figure 1 illustrates this with an H&E sample where the original image is decomposed into its Haematoxylin image (and adjusted) as well as into its Eosin image (and adjusted) then recombined into the image presented to the pathologist.
IQ adjustments can be defined once for a given sample/stain pair and stored. The virtual microscope could then automatically apply the settings when that sample/stain is viewed. The definition is performed with an interactive GUI control that displays the effects of stain adjustments on either the selected individual stain image or the composite image in real time. The user may adjust the concentration or dilution of a stain, may opt to accentuate the cellular detail, modify the intensity of all stains, or remap the stain colours. Figure 2 presents the GUI operating on the Haematoxylin image of a triple stained H, E and DAB sample.
IQ provides another opportunity not available with conventional microscopy. A sample may be stained as an H&E with a single marker and each stain image can be extracted, adjusted, and recombined into stain pairs: an H&E image and an H&DAB image. They can be reviewed side by side as illustrated in figure 3.

Conclusions: Virtual microscopy is a fertile field for the development of new techniques to enhance and view digital slides. The IQ algorithm provides one method that enables the pathologist to tune the stain to personal preferences, to accentual features of interest, to compensate for stain variations and poor staining and to view the individual stain images or combined stain images.

Keywords: Colour deconvolution, image processing, visualization, digital pathology, virtual microscopy, histology, immunohistochemistry.

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OP-7

Experience the benefits of a digital environment: digital pathology is here

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Abstract

Digital Pathology is an environment for the management and interpretation of pathology information that is enabled by the digitization of a glass slide. It provides pathologists with instant access to patient and case information as well as instant interactive secondary consultations. Digital pathology can also allow pathologists to present cases easily at tumor boards with high quality slides, use automatic image analysis algorithms for quality control, detect rare events and provide reliable quantitative measurements.

Digital pathology creates new opportunities for the labs for a more efficient workflow and to create new businesses proving new digital pathology services to pathologists. This presentation will provide an understanding of what it will take to implement digital pathology in your lab. Topics of discussion will include workflow, slide scanners, digital pathology information management software, barcodes, LIS integration, PACS, IT infrastructure, digital storage, HIPAA, CFR 21 Part 11, CLIA regulations, FDA regulations, skill sets, operating costs, and new services.

Ole Eichhorn, CTO, Aperio

Ole Eichhorn has more than 25 years of experience as a software engineer, architect, and manager. He has been involved in three prior start-up ventures, including PayPal, where he served as vice president/engineering; Intuit, where he was GM of Intuit's web finance subsidiary; and Digital Insight, where he held the position of vice president/engineering. Prior to that, he was vice president/development and director of technology for XP Systems.

OP-8

Mammaglobin: A novel tumor marker for breast cancer

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Abstract

Background: Breast cancer is a major problem among females all over the world. Despite apparent curative resection, subsequent development of metastatic spread presents a major clinical problem in about 30% of all breast cancer patients.

Aim: To investigate the clinical reliability of mammaglobin m-RNA (MAG m-RNA) as a marker of circulating cancer cells in breast cancer patients and to study the relevance of its expression in blood and expression of its protein in breast tissues, with the pathological parameters and its value in evaluating efficiency of treatment. Also, the usefulness of image processing techniques in immunohistochemistry is evaluated.

Method: This study was conducted on 48 breast cancer patients and 28 controls (10 healthy controls and 18 patients controls: 6 with fibroadenoma, 4 with uterine carcinoma, 4 with ovarian carcinoma and 4 with cancer colon). For histopathological study, the healthy control group included the normal breast tissue adjacent to fibroadenoma. All breast cancer patients were of the infiltrating duct carcinoma type and 10 of them had associated areas of intraduct carcinoma. The patient group was classified into 26 patients with localized breast cancer and 22 patients with metastases (9 patients had axillary lymph node metastases and 13 patients had distant metastases). Breast cancer patients were reclassified according to the histologic grade into grade I (8 patients), grade II (26 patients) and grade III (14 patients). All individuals included in this study were subjected to detection of MAG m-RNA in circulating tumour cells in peripheral blood using nested PCR technique. Breast tissue expression of MAG was investigated using immunohistochemistry. Blood and tissue MAG expression were correlated with oestrogen receptor and Ki-67 proliferation index.
Ki-67 immunostaining was evaluated using Leica Image Processing and Analysis System. In each case, the analysis was done on areas expressing quantitatively the highest number of immunoreactive nuclei (10-20 microscopic fields at X400 magnification were measured for each case). The results were expressed as Ki-67 proliferation index which is defined as the percentage of positively stained nuclei divided by the total number of the counted nuclei. Ki-67 proliferation index was either ≤20 or >20.

Results: Circulating MAG m-RNA is a highly specific (100%) tumour marker. The detection rate was significantly associated with the histologic grades, ER positivity and low proliferative rate of tumours. The detection rate decline after receiving chemotherapy. Immunohistochemically, the pattern of expression of MAG in breast cancer tissues was characteristically different than that in non-cancer tissues (being diffuse cytoplasmic in the former and scattered in the latter). MAG overexpression in breast tissue was significantly higher in low grade tumours (I and II) than in high grade ones (III). The strong staining intensity was more frequently detected in low grade tumours. Also MAG expression in breast tissue was significantly correlated with ER positivity and low Ki-67 proliferation index of the tumours.

Conclusion: MAG is a promising specific tumour marker of breast cancer that could predict the prognosis of breast cancer and its response to hormonal treatment. Ki67 (proliferative activity) is an important criterion for assessment of prognosis and therapy of malignant tumours and its evaluation is reliable with image processing techniques.

Key Words: Breast carcinoma- Immunohistochemistry- PCR- Mammaglobin- Oestrogen receptor- Ki-67, image processing.

OP-9

Virtual microscope interface to high resolution histological images

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Abstract

Introduction: The Hypertext atlas of Dermatopathology, the Atlas of Fetal and Neonatal Pathology and Hypertext atlas of Pathology (this one in Czech only) are available at www.muni.cz/atlases. These atlases of–fer many clinical, macroscopic and microscopic images, together with short introductory texts. Most of the images are annotated and arrows pointing to the important parts of the image can be ac–tivated.

Material and Methods: Leica DMLA microscope with motorized stage is used to obtain image parts, which are stitched to–gether to one high resolution image. Individual image parts can be taken in more focusing planes and pan-focus algorithm can be used to create an image with increased image depth. Alternatively image stacks can be saved and high resolution images in several focusing planes can be created. Both these methods are useful to overcome image artefacts caused by uneven slides.

Results: The Virtual Microscope interface is used for the access to such histological images. The virtual mi–croscope is programmed in JavaScript only, works in Firefox/Mozilla and MSIE browsers without need to install any additional software.
The browser loads proper parts of image according to the viewport, magnification and focusing lev–el. It reacts to user's actions through catching events, calculates the names of corresponding new im–age tiles, which are loaded and added into the DOM of the image being displayed. The image parts, which got out of he viewport, are released from memory. The virtual microscope interface works rea–sonably smooth.

Discussion: Our atlases are continuously upgraded and expanded. In addition to above mentioned Atlas of Dermatopathology and Atlas of Fetopathology and Neonatal Pathology we are preparing new atlases (of mus-cle pathology and bone marrow biopsy). In future image sharing of our images will be possible as well, so that other teachers will be able to include links to images in our atlases, comment them according to their taste and still have access to all the features of the virtual microscope.

Keywords: fetal pathology, atlas, multimedia, Internet.

Acknowledgements: This work was supported by Project MediGRID (1ET202090537) of the Information Society pro–gram.

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OP-10

Organizational model for a telepathology system

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Abstract

Introduction: The technological development of Telemedicine has performed important progress, assuming a diagnostic relief role inside of the processes. Among the fields in fast evolution, Telepathology is placed between those of greater interest. Up to some years ago, Telepathology allowed to observe at a distance and in real time, histological or cytological slides through Internet, using a motorized microscope (dynamic telepathology). Currently, Telepathology has completed an important step in ahead being possible to digitize completely a slide and to store it. This allows observing the whole surface of histological or cytological slides from remote with a customary PC, without human intervention (virtual slide).

Methods/Results: In order to obtain an effective telepathology system, the best choice an "hybrid system" composed by motorized microscopes, with remote control, and a scanner for slide digitization, in order to achieve the best characteristics from each system without respective disadvantages. This choice has been applied to Rovigo province sanitary structures, in particular Rovigo, Adria and Trecenta hospitals. For storage purpose it has been used a NAS (Network Attached Storage) device (50 TB capacity - 1 Gb/s transfer rate). The previously described system is completely integrated with the CPOE (Computerized Physician Order Entry) based Hospital information System.
Thanks to complete slides digitization and the use of Image Server with high computational performances, it will be possible to apply filters to acquired images or to apply algorithms for calculating interesting quantities (e.g.: the cellular membrane distribution and continuity). These techniques adequately developed, tested and standardized will be the base for Computer Aided Diagnosis (CAD) introduction.

Discussion/Conclusion: Authors report an organizational model practicable and applicable to a territory in which three hospitals operate. Essential prerequisite in order to arrange an efficient telepathology system turns out to be one structured data transmission network, equipped with elevated guaranteed bandwidth, and one consolidated experience in the registration and management of digital images.

Key words: telepathology, telemedicine, virtual slide telepathology, dynamic telepathology.

OP-11

Practical aspects to consider when adopting a digital pathology solution

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Abstract

This presentation will focus on a discussion of the practical aspects to consider when adopting a digital pathology solution.

- Specifically the followings factors will be reviewed:
- Physical size, components and requirements for a system
- Image quality, analysis and management including retrieval, archiving, transmission, and storage of images
- Ease of use of the system and its software as they relate to routine laboratory work flow
- Information technology factors such as size of image, storage and transmission of images, file types, image formats and compression.

Finally the presenter will compare Bioimagene's Pathiam software and iScan system to the ideal requirements listed above.

OP-12

Towards the fully digitalized surgical pathological laboratory: integration of digital microscopy diagnostics, textual reporting and remote consultation using digital networks

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Abstract

Background: Important evolution in surgical pathology diagnostics can be observed in more consecutive steps regarding the routine workflow. Increase of information contain in reporting is a composite process. Both the textual data contents' requirement and graphical storage-and-transfer practice is anticipated in the fully digital pathology laboratory practice. The aim of the study is to evaluate this technology in a routine setting presenting existing example.

Methods: In the daily routine practice in a large hospital pathology department 80-120 new cases will be reported using 100-300 slides. Cases interesting by any aspect will be scanned and than upload on a digital slide server. During the diagnostic process 1.) sophisticated institutional database (with clinical data, other diagnostic modalities, pathology antecedents etc.), 2.) slide/smear archive and 3.) teleconsultation connection will be applied in one unit.

Results: Using integrated textual/graphical database speed, accuracy, actuality and prognostic power of reporting will be increased. The virtual microscopy analysis provides objective measurement data incorporated in the reports. Outside observers may perform an external quality control by routine consultation as well. Hospital information system enables precise case history analyses, impossible using non-digital networking tool previously. Both teaching subdivisions and decision making boards gains constant and indexed case databases of all required information as well.

Conclusions: The digital histology laboratory technology will convert traditional workflow in the next period. Realization depends not only on technical development but also on more complex planning of human organization, on details of way of changes and optimal use of existing divisional resources.

OP-13

Telediagnostics of intraoperative biopsies of mammary carcinoma

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Abstract

Introduction: Intraoperative frozen-section examination must be performed for all neoplastic and non-neoplastic lesions of the mammary gland. Intraoperative biopsy allows the surgeon to select the extent of surgical intervention, which largely determines the prognosis for the patient with breast cancer. The introduction of telepathology into the health care system has expanded the diagnostic potential of urgent (express) frozen section examinations and made it possible to use the expertise of best-qualified pathologists, regardless of their location.

Methods: We think that it is of current interest to summarize the experience of the on-line telediagnostics of 138 intraoperative biopsies of malignant mammary neoplasms performed at the Pathology Department of the Medical Center of the General Management Department of the President of the Russian Federation.

Results: Non-infiltrating carcinoma was found in 5, and infiltrating carcinoma in 133 of the evaluated cases. False negative diagnosis (hypodiagnosis) of carcinoma was made in 5 observations (noninfiltrating – 2, infiltrating – 3), false positive diagnosis (hyperdiagnosis) was made in 5 cases (cystic disease – 2, epitheliosis – 1, fibroadenoma – 1, intraductal papilloma – 1).
Traditional microscopy of the cryostat sections of intraoperative biopsies of malignant mammary neoplasms confirmed the initial histological diagnosis in 130 cases (94.2%). In 3 (2.2%) cases, the diagnosis was corrected upon intraoperative telediagnostics. In 5 (3.6%) cases, misdiagnosis had been confirmed by telediagnosis, as was only established by the microscopic evaluation of the paraffin-embedded sections.
As shown by the quality analysis of the intraoperative biopsy morphologic diagnostics performed directly in the surgery block, the average accuracy of diagnosis was 89.6% for breast carcinoma, with 96.4% for infiltrating carcinoma and 62.5% for noninfiltrating carcinoma.

Conclusion: The use of telediagnosis improved the average accuracy up to 93.2%, with the accuracy of diagnostics of noninfiltrating carcinoma remaining unchanged and that of infiltrating carcinoma increasing up to 98.5%.
On-line telediagnostics can be recommended for evaluation of intraoperative biopsies of neoplastic and non-neoplastic lesions of the mammary gland, as a means to improve the quality of morphologic diagnostics. Telediagnostics was most helpful in case of uncommon mammary carcinomas that were also difficult to diagnose by traditional optical microscopy and required discussion of the histological picture and consultative support by colleagues.

OP-14

A software package demonstrating the utility of JPEG2000 and JPIP as an efficient means of using virtual slides in DICOM

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Abstract

Introduction: Large-scale utilization of virtual microscopy requires compatibility with DICOM, which is currently recognized as the standard specification for digital imaging in clinical medicine. Direct application of conventional DICOM-based systems in virtual microscopy is currently impossible, mainly because virtual slides (also known as whole-slide images) exceed the specification's image object size limit (2 gigabytes). One solution is to utilize the JPEG2000 standard, a well-suited image format for virtual microscopy, which is partly included in DICOM with Supplements 61 (lossless and lossy compression), 105 (multi-component transformations), and 106 (the JPEG2000 Interactive Protocol, JPIP). By using the JPIP protocol, image pixel data can be transmitted apart from patient data, and thus the DICOM image size limits can be overcome. Moreover, since the image and patient data are not connected, virtual slides are readily interchangeable with non-DICOM systems.

Methods: Although the possibility to use the JPIP protocol has been described in the DICOM standard specification, we are not aware of any open software solutions or libraries supporting it. In this study, we developed a software package to demonstrate the utility of JPEG2000 virtual slides and the JPIP protocol in a DICOM-based Picture Archiving and Communication System (PACS). First, we modified an open source DICOM library (OFFIS DICOM Toolkit) by adding the JPIP support as described in the Supplement 106. The library was used as a basis for our software package, consisting of a virtual slide construction application (JVScomp) and a DICOM client–server application (JVSdicom). JVScomp is our existing JPEG2000 compression application, which we extended to include DICOM functionality. In addition to the actual JPEG2000 image file, JVScomp generates a DICOM file, which contains medical information, image properties, and a JPIP reference to the JPEG2000 image. Accompanied with our existing JPIP server (JVSserv), the server half of JVSdicom provides a proof-of-principle of a DICOM server capable of transmitting DICOM JPEG2000 virtual slides with the JPIP protocol. The client half of JVSdicom interacts with the server as a conventional DICOM client, but it can also invoke an external JPEG2000 virtual slide viewing application when a JPIP reference is received. As a default external viewing application, the software package features our existing JPEG2000 viewer (JVSview).

Results: JVSdicom is designed to be readily usable with commercial-grade DICOM servers. The software package can be obtained for free from our website (http://jvsmicroscope.uta.fi/), which also features a demonstrational DICOM JPIP server.

Conclusion: To our knowledge, the software package described in this study is the first practical solution to overcome the limitations of DICOM in virtual microscopy. Compared to other approaches, such as splitting virtual slide into thousands of small image tiles, which are stored as a DICOM Series (an ongoing DICOM WG-26 project), JPEG2000 (with JPIP) is a well-working alternative, and its utility in DICOM should be explored in detail.

OP-15

High-throughput virtual slide scanning of fluorescence in situ hybridization (FISH)

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Abstract

Introduction: Fluorescence in situ hybridization (FISH) is currently considered to be the most specific and sensitive method for the assessment of HER-2 oncogene amplification in breast cancer. However, darkfield microscopy of FISH is tedious, and archiving of FISH specimens is not possible due to fading of the fluorescense signals. To date multicolour digital image capture of FISH has been used only to generate illustrations to scientific articles. Several automated dot counting software applications have been developed, but their use has been limited due to the difficulty to scan large enough tissue areas at high magnification.

Methods/Results: To overcome these limitations we have developed an effective virtual slide scanning system for breast tumor slides, which were hybridized using the Vysis triple colour FISH probe (HER-2 in green, TOP2A in red, CEP17 in light blue + DAPI counterstain). The scanning system is based on a fully motorized epifluoresence microscope, which is controlled with a PC equipped with OASIS controller card and Surveyor software (Objective Imaging, Cambridge, UK). Each fluorochrome is scanned at six different focal depths. The scanning software (Surveyor) constructs an extended focus image on the fly. This ensures that the gene dots present at different focal depths are properly visualised. Scanning of 10x10 fields using oil-63X objective is fast and takes less than 5 min. Image tiles of each fluorochrome scan are automatically converted into a montage. The montages are stored as a single multilayered JPEG2000 file. Viewing of FISH scans is done using JVSview software, which allows free panning and zooming of each fluorochrome layer individually, or viewing of the layer colours merged with each other. Gene dot counting can be done by transferring screenshots to ImageJ to be automatically analyzed by visual counting (click and count method), or by using a macro script enabling fully automated copy number assessment (see Konsti J et al. J Clin Pathol 2008).

Conclusion: This study shows that virtual slide scanning of multicolour FISH slides is feasible and yields comparable results to visual assessment done via microscope oculars. Virtual slide scanning provides much needed possibilities to archive the diagnostically important slides, and to perform copy number counting off-line on computer screen. The problem of fading fluorescence with FISH specimens can be avoided, and any part of a sample can be re-evaluated for gene copy number if needed.

OP-16

Hypertext atlas of fetal and neonatal pathology

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Abstract

Introduction: Fetal pathology is a stand-alone discipline of pathology dealing with prenatal development, congenital anomalies and pregnancy failure. There has been no learning resource for the pregraduate students which would reflect the current knowledge and praxis of fetal and neonatal pathology. We prepared the Hypertext atlas of fetal and neonatal pathology. The atlas is available for free at www.muni.cz/atlases.

Methods: Leica DMLA microscope with a set of PlanApo lenses (HC Fluotar 5/0.15, HC PlanApo 10/0.30, 20/0.50, 40/0.70, 100/1.30 and a Plan 2/0.07 lenses) equipped with the Nikon DMX-1200 digital camera is used to obtain image parts at the resolution at 1200x1020 pixels, 3x8 bit color. Motorized stage (Merzhäuser) is automatically moved from one image to another. The system is controlled by Lucia DI (LIM, Prague). Images are further digitally processed and virtual slides are created. Nikon Coolpix 8600 on a stand is used to take the macroscopic images.

Results: The atlas was uploaded in 2006 and has been continuously revised and expanded. The atlas exists in Czech and English version.
The main chapters cover the principles and terminology of fetal maldevelopement, chromosomal abnormalities, teratogenic agents, malformation syndromes, congenital defects of the individual organ systems, pathology of twinning and pathology of the placenta and umbilical cord. Concise texts summarize both the gross and microscopic pathology and etiology, pathogenesis, clinical signs and prognosis. Virtual microscope interface is used to access the high resolution histological images. The case studies integrate results of prenatal diagnostic tests, pathologic examination and genetic counselling. Ultrasound video clips have been included in the atlas recently.

Discussion: Digital publication has many advantages, like (almost) unlimited capacity and easy maintenance and updating. Free on-line access is acceptable and comfortable for pre-graduate and post-graduate students who constitute the majority of the registered users. The atlas currently provides a database of more than 300 macroscopic and histological images on fetal pathology.

Conclusions: The Internet atlas of fetal and neonatal pathology is a multimedia textbook for medical students and can be used by teachers of pathology as well. It is also a valuable reference tool for medical disciplines dealing with prenatal medicine. The access is at no cost but requires registration. The atlas is going to be further expanded while keeping the high quality of the images.

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OP-17

Computational pathology: from telepathology to e-learning and diagnostic support in virtual microscopy

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Abstract

Introduction: Telepathology has left its childhood. Its technical development is mature, and its use for primary (frozen section) and secondary (expert consultation) diagnosis has been expanded to a virtual pathology laboratory, which is leaving its technical constraints.
Similar to telepathology, which can be used for e-learning and e-training in pathology, as exemplarily is demonstrated on Digital Lung Pathology (Klaus.Kayser@charite.de) at least two kinds of virtual pathology laboratories will be implemented in the near future: a) those with distributed pathologists and distributed (>=1) laboratories associated to individual biopsy stations/surgical theatres, and b) distributed pathologists, usually associated to one institution and a centralized laboratory, which digitises complete histological slides. Both scenarios are under intensive technical investigations.

Description: The features of virtual pathology comprise a virtual pathology institution (mode a) that accepts a complete case with the patient's history, clinical findings, and (pre-selected) images for first diagnosis. The diagnostic responsibility is that of a conventional institution. The internet serves as platform for information transfer, and open servers such as the iPATH (http://telepath.patho.unibas.ch) or DiagnomX (www.diagnomx.eu) for coordination and performance of the diagnostic procedure. Size and number of transferred images have to be limited, and different magnifications have to be used. The sender needs to posses experiences in image sampling techniques, as long as he cannot submit virtual slides. A group of pathologists is "on duty", or selects one member for a predefined duty period. The diagnostic statement of the pathologist(s) on duty is retransmitted to the sender with full responsibility. A centralized virtual pathology institution (mode b) also depends upon the digitalisation of a complete slide, and the transfer of large sized images to different pathologists working in one institution. The technical performance of complete slide digitalisation has already promoted its use in specialized institutions and will probably fulfil the requirements of a conventional pathology institution in the near future.

Applications: Virtual pathology can be combined with e-learning and e-training that will serve for a powerful daily-work-integrated pathology system. At present, e-learning systems are "stand-alone" solutions distributed on CD or via internet. A characteristic example is the Digital Lung Pathology CD, which includes about 60 different rare and common lung diseases with some features of electronic communication. These features include access to scientific library systems (PubMed), distant measurement servers (EuroQuant), automated immunohistochemistry measurements, or electronic journals such as Diagnostic Pathology, (www.diagnosticpathology.org) or the former Elec J Pathol Histol, (www.pathology-online.org). It combines e-learning and e-training with some acoustic support. A new and complete data base based upon this CD will combine e-learning and e-teaching with the actual workflow in a virtual pathology institution (mode a). Other approaches will include automated measurements via the internet (www.eamus.de), automated image quality assessment (www.diagnomx.eu) and automated diagnosis assistance based upon information acquisition of microscopic images (www.diagnomx.eu). In aggregate, a complete new landscape in diagnostic pathology is arising at the horizon.

OP-18

Issues for application of virtual microscopy to cytoscreening, perspectives based on questionnaire to Japanese cytotechnologists

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Abstract

Introduction: To clarify the issues associated with the applications of virtual microscopy to the daily cytology slide screening, we conducted a survey at a slide conference of cytology.

Methods: The survey was conducted specifically to the Japanese cytology technologists who use microscopes on a routine basis. Virtual slides (VS) were prepared from cytology slides using NanoZoomer (Hamamatsu Photonics, Japan), which is capable of adjusting focus on any part of the slide [1, 2]. Total of ten layers were scanned from the same slides, with 2 micrometer intervals. To simulate the cytology slide screening, no marker points were created. The total data volume of six slides was approximately 25 Giga Bytes. The slides were stored on the Windows 2003 Server, and were made accessible on the web to the cytology technologists.

Results: Most cytotechnologists answered "Satisfied" or "Acceptable" to the VS resolution and drawing speed, and "Dissatisfied" to the operation speed. To the ten layered focus, an answer "insufficient" was slightly more frequent than the answer "sufficient", while no one answered "fewer is acceptable" or "no need for depth". As for the use of cytology slide screening, answers "usable, but requires effort" and "not usable" were about equal in number. In Japanese cytology meeting, unique VS system has been used in slide conferences with marking to the discussion point for years.

Conclusions: Therefore, Japanese cytotechnologists are a relatively well accustomed to the use of VS, and the survey results showed that they regarded VS more positively than we expected. Currently, VS has the acceptable resolution and drawing speed even on the web. Most cytotechnologists regard the focusing capability crucial for cytology slide screening, but the consequent enlargement of data size, longer scanning time, and slower drawing speed are the issues that are yet to be resolved.

Keywords: Virtual slide, Cytoscreening, Cytotechnologist, Focusing ability.

OP-19

Automated region of interest retrieval and classification using spectral analysis

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Abstract

Introduction: This study examined the effect of tissue section thickness and consistency – parameters outside the direct control of the imaging devices themselves – on WSI capture speed and image quality. Preliminary data indicates that thinner, more consistent tissue sectioning (such as those produced by automated tissue sectioning robots) result in significantly faster WSI capture times and better image quality.

Methods: A variety of tissue types (including human breast, mouse embryo, mouse brain, etc.) were sectioned using an (AS-200) Automated Tissue Sectioning System (Kurabo Industries, Osaka Japan) at thicknesses from 2 - 9 um (at one um intervals) and stained with H&E by a standard method. The resulting slides were imaged with 5 different WSI devices (ScanScope CS, Aperio, CA, iScan, BioImagene, CA, DX40, DMetrix, AZ, NanoZoomer, Hamamatsu Photonics K.K., Japan, Mirax Scan, Carl Zeiss Inc., Germany) with sampling periods of 0.43 – 0.69 um/pixel. Slides with different tissue thicknesses were compared for image quality, appropriate number of focus points, and overall scanning speed.

Results: Thinner sections (ie 3 um sections versus 7 um), required significantly fewer focus points and had significantly lower (10-15%) capture times. Improvement was seen with all devices and tissues tested. Furthermore, a panel of experienced pathologist judged image quality to be significantly better (for example, with better apparent resolution of nucleoli) with the thinner sections.

Conclusion: Automated tissue sectioning is a very new technology; however, the AS-200 seems to be able to produce thinner, more consistent, flatter sections than manual methods at reasonably high throughput. The resulting tissue sections seem to be easier for a WSI system's focusing systems to deal with (compared to manually cut slides). Teaming an automated tissue sectioning device with a WSI device shows promise in producing faster WSI throughput with better image quality.

Key words: Slide quality, Image quality, Whole Slide Imaging.

OP-20

Serendipia: Castilla-La Mancha telepathology network

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Abstract

Aims: The main aims of SERENDIPIA project are:

- Providing all the necessary image acquiring devices and computer equipment needed in a digital Pathology Department.
- Developing an Information System that allows Pathology Departments to storage and manage the reports and its images.
- Developing a WEB application that allows the communication between the different Pathology Departments, sharing reports and images.

Methods: The scope of the first phase of the SERENDIPIA project includes seven hospitals of Castilla-La Mancha region. Three of these hospitals are small hospitals dependent on a reference hospitals. Therefore, the project has to provide all the mechanisms and tools for do the collaborative work between hospitals. With this purpose, Pathology Department is provided with:

- Digital cameras with WIFI technology for autopsy room.
- Digital imaging systems for the grossing room with touch screen and camera remote control.
- High resolution digital cameras adapted to optical microscopes.
- Digital Scanners for creating virtual slide images.

Results: SERENDIPIA project provides all the necessary image acquiring devices needed to cover all kind of images that can be generated in a Pathology Department. In addition, in the SERENDIPIA project an Information System was developed that allows, on the one hand, covering the daily workflow of a Pathology Department (including the storage and managing pathology reports and its images). And on the other hand, the Information System provides a WEB telepathology portal with collaborative tools like second opinion.

Discussion/Conclusion: Castilla-La Mancha has implemented a standard-based solution for acquiring, archiving and communication of Pathology digital images. In addition, Pathology Information System (LIS) has been able to manage the relationship between the reports generated by the pathologist and its corresponding images.
This solution is allowing other specialists, like dermatologist or haematologist, to have access to this kind of images. As well as improving the training of students and medical residents.
By using the teleconsultation ant the distance diagnostics through digital imaging will offset the shortage of specialist in Castilla-La Mancha region.
Finally, by using the medical standard in the development of the SERENDIPIA project will provide, in the future, an interconnection with others telepathology networks for access, exchange, and upgrade electronic medical records through the Internet.

OP-21

Teaching veterinary pathology in 21st century

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Abstract

Introduction: The teaching of pathology within the curriculum of veterinary medicine or human medicine has a dual role. General pathology deals with principles of disease processes as a basis for understanding the reactions of a multi-cellular organism to adverse effects from within the organism itself or from the environment. Organ pathology, building on the principles of general pathology, explains the malfunctions of individual organ systems and relates them to disease processes of a patient as a whole. Pathology is heavily image dependent, didactically best taught in a highly interactive manner.

Methods/results: For this reason, the IVPZ (Institut für Veterinärpathologie Zürich) and ITP (Institute für Tierpathologie Bern) have invested considerable efforts in new CD-based elearning modules over the past 5 years. The "New Curriculum Veterinary Medicine" now demands an even more active student participation, with at least 20% of their study time devoted to individual study. In August 2005 for the first time a Swiss Federal examination in General Veterinary Pathology was held as online examination based on the elearning modules used in teaching and learning this subject. To meet these needs, and those of advanced students studying for European Board qualifications (European College of Veterinary Pathology, ECVP), we are taking a significant step further and build on the strengths of the OLAT / Doit platform to develop a new integrated online elearning platform in veterinary pathology.

Discussion/Conclusion: This will serve not only all Swiss students of veterinary medicine but in the near future a pan-European audience of veterinary pathologists. In addition students of Animal Sciences (ETHZ) will profit from the elearning platform. In short, the platform will have three major areas: lectures accompanying modules, a veterinary pathology trainer for student self study and an expert forum for communication.

OP-22

Use of image analysis and digital slides in clinical immunohistochemistry (IHC) pathology applications and the impact of region selection on quantitative results

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Abstract

Introduction: Image Analysis and digital slide scanning are changing the way IHC slides are evaluated today. The manual evaluation of IHC slides generally combines the visual selection of tissue regions using morphology combined with an assessment of either staining intensity or percentage of positive cells. Image analysis can support this evaluation by accurately measuring staining intensity and/or quantifying the percent positive cell population in pathologist selected regions of interest. In addition to whole slide scanning for archival purposes, the Automated Cellular Imaging System (ACIS™ III) from Dako provides accurate and consistent measurements of regions of interest on IHC stained pathology slides. The system includes clinical applications for HercepTest (HER2), ER, and PR; all of which are FDA cleared. Image analysis algorithms have been demonstrated to aid in the consistent scoring of IHC slides; moreover, the selection of appropriate tissue regions by a pathologist is essential in obtaining consistent reads in manual or Image Analysis assisted settings.

Methods: A study was conducted to evaluate the impact of region selection on the scoring of ER stained IHC slides. 62 slides were stained with Dako's ER PR pharmDx kit and the percentage of ER positive staining cells was determined multiple times using manual and Image Analysis assisted protocols. For manual reads, the pathologist used the entire tumor area. Using Image Analysis, in addition to a whole tumor area score, a pathologist was instructed to score a slide 5 times selecting 1, 5, 10 and 15 specific tumor regions respectively. The percent positive scores obtained from Image Analysis were compared to the manual assessment.

Results: Good correlation was found between the manual assessment and the image analysis assisted 5, 10 and 15 selected region protocols. The correlation between manual assessment and Image Analysis for single and whole tumor selected region protocols was observed to be lower in high percentage ER positive cell cases. A probable explanation for this could be that the selected regions contained negative areas, which in turn lowered the overall measurement.

Conclusion: Region selection on a digital slide for image analysis is very important in assuring high quality results. Selecting a significant number of regions on a slide using an Image Analysis assisted protocol correlates well with traditional manual scoring and ensures that the heterogeneity of tumor regions is taken into account.

OP-23

The integration of whole slide images as research data in the scientific metadata repository of the Open European Nephrology Science Center

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Abstract

Introduction: The Open European Nephrology Science Center is a metadata repository for research relevant clinical data. Besides the requirements of information retrieval for scientific purpose the legal roles require to protect the patient rights especially to keep the person identity secret. But for the process of data management it is necessary to reference scientific data to specific patient data, e.g. updating of data. A similar problem is the management of Whole Slide Images (WSI) in the clinical environment. From the practical aspect the WSI-Server should be usable from inside and outside of a clinical environment. But WSI files contain personalized data about the patient and under different circumstances it is possible to identify the patient identity using the file information. Usual the main method to name a WSI file is the case number of pathology laboratory information system. But this is important information too. A non-authorized person can use this information to identify the patient.

Methods/Results: A systemic model of WSI management was developed and implemented in the service orientated architecture of OpEN.SC. After an evaluation of different strategies of anonymisation and referencing the WSI to a case of OpEN.SC and vice versa the model of indirect private duplex link was realized. Two webservices are responsible for the process of referencing concerning the legal issues: the data input and request application (DIARA) creates a ReferenceSlideID during the scan process as basis for the file name of the WSI. The data list and request application (DLARA) sends the ReferenceID's after a request for a case or for specific case related images to a requesting system. Various data and file types are stored at the OpEN.SC metadata repository available for scientific purpose. Results: The integration of WSI was a problem due to the limitations of server capacities and the handling of the very large files.

Conclusion: An integrated model of referencing allows storing the images at one image server available for requests from Intranet as well as Internet.

Key words: WSI, Virtual Slides, Scientific Data Management.

OP-24

Virtual health care center in Georgia

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Abstract

Introduction: Application of telemedicine systems to cover distant geographical areas has increased recently. However, the potential usefulness of similar systems for creation of national networks does not seem to be widely appreciated.

Methods: The article describes the "Virtual Health Care Knowledge Center in Georgia" project. It aimed set up of an online integrated web-based platform to provide remote medical consultations and eLearning cycles. The project "Virtual Health Care Knowledge Center in Georgia" was the NATO Networking Infrastructure Grant dedicated for development of telemedicine in non-NATO countries.

Results: The project implemented a pilot to organize the creation of national eHealth network in Georgia and to promote the use of innovative telemedicine and eLearning services in the Georgian healthcare system. At June 2007 it was continued under the NATO Networking Infrastructure Grant "ePathology – Virtual Pathology Center in Georgia as the Continuation of Virtual Health Care Center".

Conclusions: By comparison with the usual health services telemedicine introduces added value and a positive impact at social, economic and cultural levels. Therefore, telemedicine is beginning to have an important impact on many aspects of healthcare in non-NATO countries. When implemented well telemedicine may allow these countries leapfrog over their developed neighbours in successful healthcare delivery.

Keywords: Telepathology, ePathology, Telemedicine, Image, Telemicroscope, Remote diagnosis, Teleconsultation, Second opinion, Virtual microscopy, Distance education, eLearning.

OP-25

Assessment of HER-2/neu expression in breast carcinoma: A comparative approach by automated cellular imaging system (ACIS) and ScanScope Aperio

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Abstract

Introduction: Telepathology (TP) has become a well established tool to deliver histological and cytological diagnosis at a distance and to assess second opinion consultations. The efficiency and reliability of a TP-assisted diagnostics compared to conventional diagnostic procedures are crucial for a broad practical use.

Material and methods: The evaluation of remote diagnosis and consultation in pathology is based on long-standing experiences with an Internet-based TP-system (iPath, http://telemed. ipath.ch). The results are derived from two representative user groups: (1) SHCH (Telepathology at the Sihanouk Center of Hope, Cambodia) and (2) HPF (Histopathology Forum). SHCH is a closed user group for remote diagnosis. It consists of two referring colleagues in Phnom Penh and a panel of established experts from Europe. HPF is a place for discussion of challenging cases in histopathology. It is open for referring pathologists and consultants from different countries. Until now more than 1100 cases have been discussed over the last three years.

Results: To assess the reliability of a store- and forward TP-system between SHCH in Cambodia and consulting pathologists in Europe the original glass slides were reviewed and compared with the TP diagnosis. In the first year of the project (2003) for 179 of 212 specimen (84,4%) the TP diagnosis was completely identical with the review diagnosis on the original glass slide. Eighteen (8,5%) and five (2,4%) specimen showed minor and moderate disagreement, respectively. Only seven cases (3,3%) exhibited a major disagreement.
The analysis of 177 specimen from the ensuing year (2004) revealed an increase to 89,8% for cases with a complete agreement and a decrease to 1,1% for cases with marked diagnostic discordance.
An analysis of the potentially influential factors exhibits that the diagnostic accuracy significantly correlated with the appropriate selection of images ($p<0.001$) and the quality of communication ($p<0.001$).
The discussion of problematic cases in the HPF resulted in a clarification or confirmation of the diagnosis in about 70%. Twenty five percent of the submitted cases were finished with a differential diagnosis or a tentative diagnosis. About five percent of all cases could not be clarified due to inadequate image quality and other reasons.

Conclusions: The results emphasize the efficiency and reliability of a TP service for hospitals in developing countries as well as for second opinion consultations. The main problems of inadequate image selection and communication deficiencies can be overcome or diminished by training and experience.

OP-26

Teaching dental students pathology with use of Webmicroscope - three years experiences

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Abstract

Introduction: We have developed and evaluated a user-friendly online interactive teaching and examination system for pathology.

Methods: Since 2005 all laboratory lessons have moved from microscopy to computer class-room and were replaced by interactive sessions using Internet based WebMicroscope. By accessing full digitized slides on web with a browser and viewer plug-in, computer has perfectly emulated a real microscope. The study material consists of over 300 full digitized slides which comprise 15 entities in basic pathology and 15 entitles in oral pathology. Digitized slides are linked with still macro- and microscopic images, organized with clinical information into "cases", text files, PowerPoint presentations and animations serving additionally as self study material on the web. All laboratory sessions are supervised by pathologists. After completion courses and passing online practical examination in 2005/06, 2006/07 and 2007/08 all dental students of the third term at the Medical University of Poznan were asked to fill a survey to evaluate their acceptance of Webmicroscope. Online teaching and online practical examination was evaluated through students' responses to the questionnaire-based evaluation. Students were asked to complete forms after their examination and full anonymization of data was guarantied. Responses were evaluated on a standardized scale.

Results: A high response rate was achieved (99%). Overall, 98% concordance rate has been achieved after 2005/06 and 2006/07. Satisfaction surveys showed progressive improvement over the past 3 years, as various suggestions were implemented. WebMicroscope as didactic tool during laboratories was rated 9,4 in scale 1-10. All students preferred the online examination over a traditional microscope and paper-and-pencil examination and all felt that the quality of digitized slides was superior to make an accurate diagnosis (rating 8.4 in 2004/05 and 9.0 in 2005/06). With current technology digital slides are technically feasible and available at any time and any place via broadband Internet. Dental students have not only accepted this technology but have indicated enthusiasm for the development of further online teaching resources in pathology.

Conclusion: Because our WebMicroscope provides the convenience of a Web-based resource with high-quality images we believe that viewing slides on this way adds a totally different dimension in teaching pathology. It is allows students to explore whole slides at any magnification and independently discover and identify pathological changes.

OP-27

Telepathology network in the Pomerania: Evaluation and acceptance study of mamma biopsy applied virtual slides

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Abstract

Introduction: In the Euro region Pomerania a large telepathology network has been set up between most pathological institutes over the last years.

Methods: Under the responsibility of the POMERANIA E.V. and help of Government of Mecklenburg-Vorpommern 5 hospitals were joined together. Between these affiliated facilities dynamic Carl Zeiss telepathology systems (Axiopath) were installed in the past for telepathology sessions and intraoperative diagnostic.
For the further improvement of the tumour care of patients we attend to use digital slide technology to speed up remote diagnosis and second-opinion consultation. Before to introduce this modern technology for the routine work, we have perform an evaluation and acceptance study with the participations of pathologists from these locations.
For these study 223 cases of mamma biopsy were used. All biopsies were taken and routinely diagnosed in years 2006 and 2007, during screening action against mamma carcinoma in Mecklenburg-Vorpommern. All original glass slides, included additional stains and immunohistochemistry, were digitized with the MIRAX DESK.
One hundred cases were randomly chosen for this study. The mean number of slides/case was 6.5 and number of slides in individual case has varied from 3 to 17.
Two cohorts of the same virtual slides were presented to the pathologists.
- One set of virtual slides was directly transferred from scanner on the server and visualized with free available MIRAX VIEWER.
- Second set of virtual slides was converted from Mirax in JP2000 format, lossless compressed 1:30 ratio into ECW format and posted on WebMicroscope server. These digitized slides were visualized with a standard Web browser.
Original glass slides and original diagnoses were used as gold standard. Diagnoses and evaluation of image quality and validity of digitized slides were made by experienced and certified pathologists using an ordinary desktop computer. Pathologists were asked to complete formalized forms. Diagnosis accuracy, intraobserver agreement and interobserver coefficients were calculated using standard statistical test.

Results/Conclusion: High overall diagnosis accuracy and high overall score of image quality and satisfaction made digital slide technology ready for the forthcoming screening activity.

OP-28

Search for possibility to use wavelet transform in virtual slides' quality evaluation

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Abstract

Introduction: Quality of digital images obtained by scanning the same histological slide using various scanners may be different. Usually an expert who looks at a picture on a screen assesses its quality.

Amis: In this work we attempt to create an objective method of comparing virtual slides' quality. We also write a computer program to execute the quality analysis for loaded images.

Methods: An experiment is carried out for two sets of 10 slides scanned using 2 different devices. One set of slides was scanned and the images captured and digitized by using a robotic microscope Axioscope2 (Zeiss) equipped with AxioCam Hrc CCD camera. Second set of the same glass slides was made with the use of commercial available DeskScan (Zeiss) with standard equipment. For stitching and conversion a software based on and utilizing advances in aerial and satellite imaging was used.
Wavelet transform is used to make space-frequency analysis of an image. This transform is carried out for different resolution levels to check how the assessment changes while resizing an image. Moreover, for high resolution images only respective fragments of whole images may be taken for the analysis. This makes the computation faster. Parameters which may describe information potential, like specially worked out energy, are calculated for a transformed image.

Results/Conclusion: Choosing a wavelet and other functions or parameters appropriate for virtual slides is a part of this work. Results of the automatic evaluation are compared to opinion expressed by an expert. Then, the parameters are improved to make the automatic evaluation more reliable.

OP-29

A study on the establishment of pathological diagnostic processes and their quantitative analysis

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Abstract

Introduction: In Japan, telepathology systems support many hospitals that do not have full time pathologists and contribute to the improvement in the quality of their clinical medical services.
"OLMICOS" is the most popular telepathology system in Japan. Images and related information can be archived by this system to enable reviewing of the analyzed telepathology cases at a later stage.
Pathologists are not only required to provide a correct diagnosis but also a quick and efficient diagnosis. Therefore, we realized the importance of making all pathological diagnostic processes transparent.

Aims: Hence, we planned to study the actual telepathology records of the OLMICOS cases examined in the Kyoto area and establish methodologies to quantitatively evaluate the efficiency and quality of pathological diagnostic processes.

Methods: In general, a pathologist observes the complete image on a glass slide initially and scans through the images obtained under a low power microscopic objective. When he has identified the region to be magnified in the primary image, he directs the remote microscope to work with the required objective lens and stage coordinates to obtain one or more secondary images. We termed this as the generation of secondary images from a primary image. Procedures of pathological diagnosis are established by repeated combinations of observation and generation of secondary images. These procedures are concluded when the pathologist obtains adequate findings to make a diagnosis. Thus, the captured images together produce a tree diagram that stems from the complete slide image.

Results/Conclusion: Three diagrams illustrating the pathologist's thinking processes are presented. We found that the shapes of these tree diagrams are characterized by the purpose and result of the diagnoses; further, we established certain parameters related to these image tree diagrams and spent time in analyzing the diagnosis. These parameters and their combinations provide hints regarding the type and measuring efficiency of each diagnostic process.

OP-30

Use of virtual slide system for quick frozen intra-operative telepathology diagnosis in Kyoto, Japan

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Abstract

Introduction: We started to use virtual slide (VS) and virtual microscopy (VM) systems for quick frozen intra-operative telepathology diagnosis in Kyoto, Japan.

Methods: In the system we used a digital slide scanner, VASSALO by CLARO Inc. and a broadband optic fibre provided by NTT West Japan Inc. with the best effort capacity of 100Mbps. The client is pathology laboratory of Yamashiro Public hospital, one of the local centre hospital located in the south of Kyoto Prefecture, where fulltime pathologist is not present. The client is connected by VPN to the telepathology centre of our institute located in central Kyoto. As the results of the recent 15 test cases of VS telepathology diagnosis including cases judging negative or positive surgical margins, we could estimate usefulness of VS in intra-operative remote diagnosis.

Results: The time required for the frozen section VS file making was found to be around 10 min when we use X10 objective and if the maximal dimension of the frozen sample is less than 20mm. Good correct focus of VS images was attained in all cases and all the fields of each tissue specimen. Up to now the capacity of best effort B-band appears to be sufficient to attain diagnosis on time in intra-operation. Telepathology diagnosis was achieved within 5 min in most cases using VS viewer provided by CLARO Inc.

Conclusion: The VS telepathology system was found to be superior to the conventional still image telepathology system using a robotic microscope since in the former we can observe much greater image information than in the latter in a certain limited time of intra-operation and in the much more efficient ways. In the near future VS telepathology will replace conventional still image telepathology with a robotic microscope even in quick frozen intra-operative diagnosis.

Keywords: Virtual slide, virtual microscopy, telepathology, intra-operative diagnosis.

OP-31

Speed improvement of automated fluorescent digital slide scanning

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Abstract

Introduction: Fluorescent whole slide imaging became commercially available in the last years. Our goal was to enhance the scanning speed of the MIRAX system by new hardware components and software algorithms. Materials: We used MIRAX Midi and Scan slide scanners with Plan-Apochromat 20x / 0.8NA objective, AxioCam MRm camera with a resolution of 0.32 µm / pixel and a filter changer with fluorescent filters for DAPI, FITC and Rhodamine. The light source was an HXP-120 triggered metal halide lamp.

Methods: The AxioCam MRm can provide 12 bit images but the system stores 8 bit images only. The additional bits are utilized for digital gain. If the digital image is shifted by 1 bit then the exposure time is halved. This way the exposure time can be decreased by a factor of 16 if the image is shifted by 4 bits. As the exposure time is decreased the noise of the image is increased. The user can select what digital gain setting will be used for each channel.
Scanning fish spots and thick samples requires grabbing every field of view in several different focal planes. By an extended focus method all layers can be acquired but not all layers are necessary in every digitized channel. We made individual extended focus setting available for each channel.

Results: The monochrome camera halved scanning time. Four times digital gain provided 33% speed increase. Selectable extended focus settings provided a speed increase from 20% to 50% in three channels depending on the different settings.

Conclusions: The speed of fluorescent scanning could be increased without compromising image quality. Speed could be further increased using binning and a camera with more pixels and higher frame rate. The sample is bleached less because it is exposed for a shorter period.

OP-32

A relationship between slide quality and image quality in whole slide imaging (WSI)

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Abstract

Introduction: This study examined the effect of tissue section thickness and consistency – parameters outside the direct control of the imaging devices themselves – on WSI capture speed and image quality. Preliminary data indicates that thinner, more consistent tissue sectioning (such as those produced by automated tissue sectioning robots) result in significantly faster WSI capture times and better image quality.

Methods: A variety of tissue types (including human breast, mouse embryo, mouse brain, etc.) were sectioned using an (AS-200) Automated Tissue Sectioning System (Kurabo Industries, Osaka Japan) at thicknesses from 2 - 9 um (at one um intervals) and stained with H&E by a standard method. The resulting slides were imaged with 5 different WSI devices (ScanScope CS, Aperio, CA, iScan, BioImagene, CA, DX40, DMetrix, AZ, NanoZoomer, Hamamatsu Photonics K.K., Japan, Mirax Scan, Carl Zeiss Inc., Germany) with sampling periods of 0.43 – 0.69 um/pixel. Slides with different tissue thicknesses were compared for image quality, appropriate number of focus points, and overall scanning speed.

Results: Thinner sections (ie 3 um sections versus 7 um), required significantly fewer focus points and had significantly lower (10-15%) capture times. Improvement was seen with all devices and tissues tested. Furthermore, a panel of experienced pathologist judged image quality to be significantly better (for example, with better apparent resolution of nucleoli) with the thinner sections.

Conclusion: Automated tissue sectioning is a very new technology; however, the AS-200 seems to be able to produce thinner, more consistent, flatter sections than manual methods at reasonably high throughput. The resulting tissue sections seem to be easier for a WSI system's focusing systems to deal with (compared to manually cut slides). Teaming an automated tissue sectioning device with a WSI device shows promise in producing faster WSI throughput with better image quality.

Keywords: Slide quality, Image quality, Whole Slide Imaging.

POSTER PRESENTATIONS

PT-1

Portable telepathology: Methods and tools

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Abstract

Introduction: Telepathology is becoming easier to implement in most pathology departments. In fact e-mail image transmit can be done from almost any pathologist as a simplistic telepathology system. We tried to develop a way to improve capabilities of communication among pathologist with the idea that the system should be affordable for everybody. We took the premise that any pathology department would have microscopes and computers with Internet connection, and selected a few elements to convert them into a telepathology station.

Methods: Needs were reduced to a camera to collect images, a universal microscope adapter for the camera, a device to connect the camera to the computer, and a software for the remote image transmit. We found out a microscope adapter (MaxView Plus) that allowed us connect almost any domestic digital camera to any microscope. The video out signal from the camera was sent to the computer through an Aver Media USB connector. At last, we selected a group of portable applications that were assembled into a USB memory device.
Portable applications are computer programs that can be carried generally on USB flash drives, but also in any other portable device, and used on any (Windows) computer without installation. Besides when unplugging the device, none of personal data is left behind. We selected open-source applications, and based the pathology image transmission to VLC Media Player due to its functionality as streaming server, portability and easiness of use and configuration. Audio transmission was usually done through normal phone lines. We also employed alternatively videoconferencing software, SightSpeed for bi-directional image transmission from microscopes, and conventional cameras allowing visual communication, and also image transmit from gross pathology specimens.

Results: The server equipment was prepared to work in several pathology department form different hospitals. Receptors obtain images without any special equipment, in any Internet connected computer. Most of the time there was not need to implement audio connections because conventional phone calls were available to communicate server and receptors, and in this way all the network bandwidth can be dedicate to achieve maximum image quality, and receptors do not need to install special software.
The biggest trouble we found to put into practice the equipment was security restrictions from net administrators that most hospitals and institution have. The only way to solve these situations is getting in touch with net administrators and obtain permit to translate external IP addresses into our computer, and open necessary ports.

Discussion and Conclusions: Portable telepathology can be a very useful, cost effective, and easy to implement method to increase telepathology equipments. Simplicity and effortless solutions can reach the smallest and poorly equipped pathology departments. Limitations for telepathology systems were high cost of equipments and lack of universality. Internet has changed dramatically telepathology possibilities in means of universality. Now price is not necessary a limitation. The goal for the future can be to change the idea of telepathology as a highly technical subspecialty, and reduce it to a new and broad and fully open way of communication among pathologists

PT-2

A survey on non specialized off-the-shelf JPEG2000 viewers for digital microscopy use

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Abstract

Introduction: Although standardization for image formats in Pathology is still not completed, much interest has been devoted to JPEG2000 as a format to store digital slides. In order to understand how currently available JPEG2000 viewers deal with digital slides (and JPEG2000 in general), we decided to accomplish a survey of available software, that we tested for use in digital pathology.

Methods: Candidate JPEG2000 viewers were identified by searching the Web using the Google search engine. JPEG2000 generic capabilities have been tested by means of conformance files. This involved testing for codestreams Profile 0 and Profile 1, and JPEG2000 files.
Evaluating digital microscopy capabilities were evaluated. For those selected viewers passing the latter test, time needed for opening was recorded, and interface features were examined to understand if and how they could be used for digital microscopy. This included a preliminary analysis of commands related to magnification (i.e., zoom) and image panning. For the latter in particular, the availability of keyboard, wand too, window bars has been recorded.

Results: According to the above mentioned methods, twelve JPEG2000 viewers were identified: kdu_show (KakaduSoftware), JP2View (Mustek), Brava!DesktopIXL (InformativeGraphics), OpenEV (GeoInnovations), XnView (Pierre Gougelet), eFotoXpress Viewer (eFotoExpress), JP2view (OptimiData), ER Viewer (Earth Resource Mapping), IrfanView (Irfan Skiljan), TNTAtas (MicroImages), Vliv (Frederic Delhoume), Stardust Image Viewer (Stardust Software), JVSView (University of Tampere).

Software	Opening Time (seconds)	Magnification	Field navigation		
			Keyboard	Window bars	Panning
Kdu_show	2	yes	yes	yes	yes
OpenEV	9	yes	yes	yes	no
ER Viewer	2	yes	yes	yes	yes
JVSview	2	yes	yes	yes	yes

Discussion: About half viewers were unable to open all conformance JPEG2000 files. Considering large JPEG2000 images like those representing digital slides, only 31% of viewers were able to open both of them, i.e., 4 viewers, of which one is specialised in digital microscopy. All those viewers provided for magnification and field navigation through keyboard and window bars; three out of four also a panning tool, which is really useful for microscopy.

Conclusions: Digital microscopy, even if based on a standard format as JPEG2000, at present cannot rely on standardised software, but specific digital microscopy viewers are to be developed to deal with the large images produced in this field.

PT-3

eSlide: An open source, multi platform system for digital microscopy

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Abstract

Introduction: The present paper describes the design and implementation of a system for acquisition and visualization of digital slides. The system consists of software modules that manage external devices (robotic microscope, auto-focus system and acquisition board), and a viewer.

Methods: Digital slide construction is performed in three phases: i) acquisition of the entire tissue at selected magnification (acquisition objective), ii) digital construction of lower magnification images, and iii) provision of the digital slide with clinical and technical data to be accompanied with, inside a RDF file. The eSlide acquisition module implements an home-made software autofocus algorithm, which includes some routines to ensure focus is not lost during the unsupervised acquisition process.

Results: At present, the acquisition module can be run on Windows (various versions) as well as Mac OSX. Acquisition devices for which a module has been developed include the Scion Firewire cameras series, and cameras for which a standard driver is available (WDM on Windows, Quicktime on Mac OSX). For the Linux version, the development of a module is ongoing for Video4Linux devices.
The viewer runs on any platform able to run Java v.1.5, including Windows, Mac OSX and Linux. The system is also well optimised for large image visualization, as it has been tested on a 30" monitor, with 2560x1600 pixels of resolution.
The overall system has been made available as open source in a first version in 2006, then a 2.0 release, with enhanced features, is being released in these days.
At present, the system is being used for the production of the educational "Cases of the month" at the University of Udine, meant at residents in Pathology as well as pathologists needing continuing education. Such cases are available at the address http://anpat.drmm.uniud.it/.

Conclusion: All software and documentation can be found on the project web site: http://www.eslide.net, together with slide samples.

PT-4

Automated classification of inflammation in colon histological sections based on digital microscopy and advanced image analysis

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Abstract

Introduction: Automated and quantitative histological analysis can improve diagnostic efficacy in colon sections. Our objective was to develop a parameter set for automated classification of aspecific colitis, ulcerative colitis, and Crohn's disease using digital slides, tissue cytometric parameters and virtual microscopy.

Methods: Routinely processed hematoxylin-and-eosin-stained histological sections from specimens that showed normal mucosa (24 cases), aspecific colitis (11 cases), ulcerative colitis (25 cases), and Crohn's disease (9 cases) diagnosed by conventional optical microscopy were scanned and digitized in high resolution (0.24 um/pixel). Thirty-eight cytometric parameters based on morphometry were determined on cells, glands, and superficial epithelium. Fourteen tissue cytometric parameters based on ratios of tissue compartments were counted as well. Leave-one-out discriminant analysis was used for classification of the samples groups.

Results: Cellular morphometric features showed no significant differences in these benign colon alterations. However, gland related morphological differences (Gland Shape) for normal mucosa, ulcerative colitis, aspecific colitis were found ($p<0.01$). 8 of the 14 tissue cytometric related parameters showed significant differences ($p<0.01$). The most discriminatory parameters were the ratio of cell number in glands and in the whole slide, biopsy/gland surface ratio. These differences resulted in 88% overall accuracy in the classification. Crohn's disease could be discriminated only in 56%

Conclusions: Automated virtual microscopy can be used to classify colon mucosa as normal, ulcerative colitis, and aspecific colitis with reasonable accuracy. Further development of dedicated parameter's are necessary to identify Crohn's disease on digital slides.

PT-5

Quantitative analytical technique applied to histopathology of birds infected experimentally by the virus of chicken anemia virus

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Abstract

Introduction: This research was conducted on ten glass slides selected from the histopathologic evaluation chickens.

Methods: Five slides of control´s chickens healthy and five slides of chickens infected experimentally with chicken anemia virus (CAV slide) between one and twenty one days post infection (PI), they were analyzed in magnifications of 200X and 400X. Histopathology showed severe bone marrow hypoplasia to complete aplasia, fully depletion of the erythrocytic and granulocytic series, both accompanied by space occupying adipocytic replacement. Foci of erythropoietic hyperplasia with intense mielopoietic activity, some hemocytoblast increased of size, with large nucleus. A quantitative analytical technique by Positive Pixel Count Algorithm was applied.

Results: It demonstrated that measures area stained of control slides were higher than CAV slides (Average: 61% vs. 25%, respectively). So, the control slides showed strong positivity, due to the presence of bigger quantity of cells of erythrocytic and granulocytic series. The CAV slides of seven days PI had high positivity (average: 94%), it was explained because the chicken anemia virus takes place severe lesions between ten to seventeen days PI, after 21 days PI the cellular regeneration is observed that is evidenced by means of focuses of erythroblastoid cells hyperplasia. This technique demonstrates in a quantitative way the severe decrease of the cellular components of the bone marrow in presence of the infection for CAV, supporting with numeric data the histology image evaluated by the pathologist.

Conclusion: Therefore, it can be used as support to the histopathology of field samples to evaluate the presence of lesions taken place by CAV and this way to improve the quality and efficiency of the veterinary pathology services.

Keywords: chicken anemia virus, quantitative analytical technique, histopathology, chickens.

PT-6

Implementation of the notation BPMN (business process modelling notation) in the modelling of pathology subprocesses

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Abstract

Background: Process orientation is one of the essential elements of quality management systems, including those in use in healthcare. Business proceses in hospitals are very complex and variable. BPMN (Business Process Modelling Notation) is a user-oriented language specifically designed for the modelling of business (organizational) processes. Previous experiences of the use of this notation in the processes modelling within the Pathology in Spain or another country are not known. We present our experience in the elaboration of the conceptual models of Pathology processes, as part of a global programmed surgical patient process, using BPMN.

Methods: With the objective of analyzing the use of BPMN notation in real cases, a multidisciplinary work group was created, including software engineers from the Dep. of Technologies and Information Systems from the University of Castilla-La Mancha and health professionals and administrative staff from the Hospital General de Ciudad Real. The work in collaboration was carried out in six phases: informative meetings, intensive training, process selection, definition of the work method, process describing by hospital experts, and process modelling.

Results: The modelling of the processes of Anatomic Pathology is presented using BPMN. The presented subprocesses are those corresponding to the surgical pathology examination of the samples coming from operating theatre, including the planning and realization of frozen studies.

Conclusions: The modelling of Anatomic Pathology subprocesses has allowed us the creation of an understandable graphical model, where management and improvements are easier to be implemented by health professionals.

Keywords: Pathology, BPMN, Business Process Modelling Notation, Surgical patient.

Acknowledgements: This work was supported in part by grant BR-CCM-2006-03 from the FISCAM (Fundación para la Investigación Sanitaria en Castilla-La Mancha).

PT-7

Reading virtual slide using web viewers. Results of subjective experience with three different solutions

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Abstract

Background: Virtual slides are viewed using interactive software which enables the user to simulate the behaviour of a conventional optical microscope, like adjusting magnifications and navigating to any portion of the image. Nowadays, information about the performance and features of web-based solutions for reading slides in real environments is still scarce. The objective of this study is analyzing the subjective experience of pathologists with virtual slides, comparing the time needed to read slides using different web viewers and different network connections.

Methods: Eight slides were randomly selected (4 biopsies, and 2 cytologies) from Hospital General de Ciudad Real (HGCR) archives. Three different virtual slide web viewing solutions were analyzed: Aperio web server, Olympus NetImage Server, and Aurora mScope. Five pathologists studied to time needed to access images of each virtual slide, selecting a panoramic view, 10 low magnification fields, and 20 high magnification fields.

Results: Aperio viewer is very efficient in overview images. Aurora viewer is especially efficient in lower magnifications (10x). For larger magnifications (20x and 40x) no significant differences were found between different vendors. Olympus was found to be the most user-friendly interface. When comparing Internet with intranet connections, despite being slower, users also felt comfortable using virtual slides through Internet connection.

Conclusions: Available web solutions for virtual slides have different advantages, mainly in functionalities and optimization for different magnifications. Pathologist should select the solutions adapted to their needs.

Keywords: Virtual slide, web viewer, Internet, network bandwidth, speed.

Acknowledgements: This work was supported in part by grant BR-CCM-2006-03 from the FISCAM (Fundación para la Investigación Sanitaria en Castilla-La Mancha).

PT-8

Telepathology and continuous education. Important tools for pathologists of developing countries

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Abstract

Introduction: Education shows that the active participation allows the best development of skills to acquire, and the results are better when the information is well documented. Now, with the digital images and Internet, in the case of the Static Telepathology (ST), is easy to share macroscopic and microscopic photographs. The progress of the technologies enabled a form of Dynamic Telepathology (DT) named "virtual slides", with navigation tools, and can be moved around changing powers as desired, making any personal computer into a digital microscope. The use of these tools in continuous education lead to optimal development of knowledge.

Methods: We reported the experience of Latinoamerican pathologist from La Rioja, a small Province of Argentina, and we mentioned the electronic publications in Virtual Hispanoamerican Congresses of Pathology (VHACP) since 1997 (18 reports in the case of ST) and in two Virtual Slide Congress (VSC). In the 1st (2005) and 2nd (2007) Internet VSCs two of our cases were digitized in Spain (case 1 and 3 respectively).

Results: In these Virtual Slides, the microscopic images can be moved remotely from any computer connected to internet and we should recognize that it will become a most valuable continuing medical education tool in microscopy, probably related to the phrase "a picture is worth more than a thousand words", and we might add: then "what about thousands of images?. Similarly, the autoevaluation test is very important. ST and DT, in support of Virtual Congresses allows learning, teaching and sharing diseases in scientific presentations, and the exchange of views in the forums, are the optimum material for distance education. In addition we received CDs or DVDs and certificates as authors, recognized by European Institutions.

Conclusion: The active participation and the autoevaluation test are the best tools for a continuous medical education in telepathology, not only for pathologists in developing countries but for the entire world.

Keywords: Continuous Education, E-Teaching, E-Learning, Developing Countries, Static Telepathology, Dynamic Telepathology, Virtual Congress, Virtual Slide, Digital microscope.

PT-9

Integration of digital image data to TMA databases for high-throughput analysis of EGFR expression in giant cell tumors of bone (GCTB)

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Abstract

Introduction: Tissue microarrays (TMA) allow for high-throughput biomarker analysis of large number of tumor samples in a cost- and time-efficient way under standardized conditions. However, linking and management of the enormous amount of clinical, pathological, epidemiological and image data of the samples requires database management. Digital TMA slides are ideal to be integrated in such a complex database system.

Methods: In this work we used the comprehensive TMA system developed by 3DHISTECH Ltd. for producing, scanning and analyzing of TMA slides of 450 samples of 275 GCTB cases tested for epidermal growth factor receptor (EGFR) expression. TMA blocks containing 70 or 80 tumor samples of 2 mm diameter each were created using the novel computer driver arrayer, TMA Master, allowing Excel database import and linking of core and patients data. EGFR protein was detected using both the Ventana Confirm (Tucson, AZ, USA; clone: 3C6) mouse monoclonal antibody and the standardized EGFR PharmDx kit (clone:2-18C9), and EGFR gene copy number was tested with FISH (ZytoVision, Bremerhaven, Germany). Immunostained slides were digitalized with the Mirax Scan instrument (3DHISTECH; Zeiss, Gottingen, Germany) and analyzed with the TMA Module software of the Mirax Viewer platform using both empirical scoring and the HistoQuant image analysis software.

Results: 47% of studied GCTB cases were either moderately (2+), or strongly (3+) positive for EGFR, further 25% were weekly positive and only 28% were fully negative, which data were validated with image analysis. Double immunolabeling showed that the EGFR positive cells, located usually adjacent to osteoclasts, were consistent with the potentially malignant stromal cells. Recurrence and transformation into osteosarcoma were significantly more frequent in strongly EGFR positive cases. As opposed to the female predominance of GCTB, EGFR positive cases were significantly more frequent in male patients (M/Fm=1.5).

Conclusion: Our results suggest that about half of the studied GCTB cases are under the influence of EGFR signaling, which may contribute to their growth and progression including recurrence, and/or transformation. The advanced digital technology used in the project proved to be highly efficient in saving us enormous amount of time and effort, while supporting validated scoring and analysis.

Supported by: EuroBoNeT.

PT-10

Tissue microarrays analysis in chondrosarcomas. Light microscopy, immunohistochemistry and xenograft study.

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Abstract

Background: Chondrosarcoma (Chs) is the third most frequent primary malignant tumour of bone and can be primary or secondary, the latter results mainly from the malignant transformation of a benign pre-existing tumour.

Methods: All the cases diagnosed as Chs (primary tumours, recurrences and/or metastasis and xenotransplanted Chs) from the files of our Department were collected. Only cases with paraffin blocks available were selected (Total 32 cases). Six Tissue Microarrays (TMAs) were performed and all the cases and biopsies were distributed into the following groups: a) only paraffin block available from primary and/or metastatic tumours (3 TMAs), b) paraffin block available from primary and/or metastatic tumours as well as from the corresponding Nude mice xenotransplant (2 TMAs), c) only paraffin block available from xenotransplanted Chs (1 TMA). A reclassification of all the cases was performed; in addition, conventional hematoxylin-eosin as well as immunohistochemistry staining (S100, SOX-9, Ki-67, BCL-2, p53, p16, CK, CD99, Survivin and Caveolin) were analyzed in all the TMA.

Results: The distribution of the cases according to the histopathological pattern and the location of tumour were as follows: fourteen Grade I Chs (all primaries), two primary Grade II Chs, ten Grade III Chs (all primaries), five dedifferentiated Chs (four primaries and one primary with metastasis), and two Chs from cell cultures (Ch grade III). One recurrent extraskeletal myxoid Chs was included as a control in the TMA. Although there was heterogeneity in immunohistochemistry results of the different material analyzed, S100, SOX-9, Caveolin and Survivin were more expressed. The number of passages in xenotransplants fluctuated between 1 and 13. Curiously, in Grade I Chs, these implanted tumours hardly grew, and the number of passages did not exceed one.

Conclusions: The study of Chs by means of TMA techniques is very important because it will improve the assessment of different antibodies applied in the immunohistochemical assays. Xenotransplanted tumours in TMA improve knowledge concerning the variability in the morphological pattern shown by these tumours during the evolution in nudes.

Keywords: Tissue microarray, Chondrosarcomas, Immnunohistochemistry, Xenograft.

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PT-11

Quantitative digital microscopy immunohistochemistry evaluation method for breast cancer slides with Mirax

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Abstract

Introduction: Immunohistochemical (IHC) evaluation might be very difficult since minor changes in staining intensity and localization should be noticed and interpreted. In breast cancer IHC has important clinical relevance, because the hormonal and anti-HER2 treatment is built up on the results of IHC. HER2 diagnostics is far more complicated, while the IHC'++' cases need further evaluation by FISH to be able to decide upon the start of anti-HER2 treatment.

Material and Methods: Our aim was to determine the applicability and benefits of a digital microscopy in routine pathological IHC-evaluation. Mirax developed by 3DHistech provides a digital pathology microscopic platform for the evaluation of electronic slides: IH-Lab module handles and inspects the slides parallelly, while HistoQuant automatically performs quantitative evaluation of staining intensity. After routine evaluation by light microscopy the slides (progesterone, estrogen, Ki-67, Her2, p53) are also analyzed by the Mirax platform and the semiquantitative results are compared with the results of the digitalized method.

Results: We define the algorithm to efficiently help the IHC-evaluation by Mirax-platform: number, measure and allocation of applied scoring grids, refinement of IHC-scoring (eg. differentiation within '++' Her2 cases), automation and standardization of quantitative evaluation would be provided.

Conclusion: Digital microscopy can be useful in quantitative and standardized evaluation of IHC to further optimize theranostics.

PT-12

GFAP and alpha1a-AR staining and nuclear morphometry of oligodendrogliomas by confocal microscopy and image analysis. Usuful parameters for predicting survival in oligodendrogliomas

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Abstract

Objective: This study attempts to evaluate the GFAP and alpha1a-AR staining and morphometrical nuclear features of oligodendrogliomas and their prognostic implications as compare to present histopathology classification and their outcome survival.

Study design: Surgical specimens form 24 patients with oligodendrogliomas during the period 1981-2000 were included. These cases were classified into two groups defined by the grade of the neoplasm: Group I: oligodendrogliomas grade II; Group II: oligodendrogliomas grade III and two groups based on the outcome status: Group of the alive cases and group of the death cases. Death rate for the groups were obtained by patients' charts. Descriptive statistics were used to examine the groups with respect to the morphometrical nuclear variables: Area, perimeter, aspect, axis's (major and minor), diameters (max, mean and min.), radius (max. and min.) margination, ratio of perimeter-area, roundness and sizes (length and width). In addition, a immunofluorescence method for GFAP and 1a-AR were performed and their area, density and intensity of staining were analyzed.

Results: Semiautomated quantitative morphometrical results showed that the variables of nuclear area (GII 48.87µm2 vs. GIII 43.45µm2 p-value=0.02), aspect (GII 1.39 vs. GIII 1.55 p-value=0.03), axis minor (GII 6.66µm vs. GIII 6.01µm p-value= 0.003), diameter minor (GII 5.93µm vs. GIII 5.27µm p-value=0.002), radius minor (GII 2.64µm vs. GIII 2.25µm p-value=0,003), perimeter-area (GII 0.0007 vs. GIII 0.0006 p-value=0.04), size width (GII 6.60µm vs. GIII 5.96µm p-value=0,003), and density of alpha1a-AR staining (GII 121.38 vs. GIII 146.03 p-value=0.05) were statistically significant in regard of grade; and that the sum of density of GFAP (p-value=0.01) and the intensity of alpha1a-AR (p-value=0.01) were statistically significant in predicting survival.

Conclusion: These results suggest that some nuclear morphometrical features and the GFAP and alpha1a-AR immunofluorescence staining may be useful parameters for predicting survival in oligodendrogliomas.

Keywords: oligodendroglioma, nuclear morphometry, GFAP, alpha1a-AR, grading, prognosis, outcome survival

PT-13

Tissue microarrays: Applications in study of p16 and p53 alterations in Ewing's cell lines

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Abstract

Background: Tissue microarrays (TMAs) are used to study genomics and proteomics in several tumour tissue samples. Cell lines (CC) are of great importance in the study of the genetic changes in tumours, and some reveal several aspects of tumour oncogenesis. There are few published report on Ewing's tumours with TMAs including original tumours (OT) and corresponding CC.

Methods: We have performed four TMAs, from 3 OT and the corresponding CC of successive in vivo and in vitro tumour passages. Xenotransplant CC in nude mice from OT (XT/OT) was made. Subsequently multiple XT were performed and in vitro XT cell line (CC/XT) was obtained. In vivo re-inoculation of CC/XT (XT/CC) was planned. TMAs with the successive tumour passages that grew in nude mice (XT/OT and XT/CC) were analyzed by morphologic pattern (Hematoxilin/eosin), immunohistochemical staining (CD99, FLI1, p16, p53, ki-67), fluorescent in situ hybridization- FISH- (EWSR1 break apart, p16 and p53 status) and gene fusion types.

Results: Heterogeneous results of the p16, p53 and ki67 in OT, XT/OT, CC/XT and XT/CC were observed. The three cell lines revealed EWS/FLI1 rearrangements. p16 gene was deleted only in one case. The deletion was detected by FISH and confirmed by PCR assays. A p53 alteration was found in the second case with monosomy and subsequently polysomic status of chromosome 17 during the evolution of CC. The PCR study revealed p53 mutation. The third case showed hypermethylation in the promoter of p16. The growth of the tumour in nude mice was more accelerated when the inoculation was performed from the CC/XT, increasing progressively over the passages. The third case did not reveal tumour growth in nude mice after the re-inoculation of CC/XT.

Conclusions: The study of several cores from original tumours and successive tumour passages in TMAs facilitated the analysis of the genetic alteration and protein expression in Ewing's tumours.

Keywords: TMAs, Ewing/PNET cell lines, xenotransplant tumors , p16-p53 alterations

PT-14

Introduction and implementation digital scanning in a routine-based pathology laboratory using the Mirax Scan.

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Abstract

Introduction/Methods: We investigated the effects of introduction and implementation of digital histology in routine histopathology and identified four levels of interest.

Level 1 (2006) was the scanner related topics. Apart from the brand choice, there are threshold, compression, focussing, dirt particles, filling gap and the actually scanned area of the slide. These tests established the trade off between quality of the scan, the scanning time and size of the scan file.
Level 2 (2006-2007) was the laboratory process related topics. The most important aspects were the sample (glass slide, size and number of sections, positioning sections) and the modification of the internal organisation (workflow, instruction staff).
Level 3 (2007) was the digital diagnostics learning process of the pathologist.
Level 4 (2007-2008) was management related topics like ICT structure and costs of scanner and data-storage.

Results: Settings at level 1 were teachable and may differ between different kinds of tissue, but can be defined properly.
Level 2 resulted in a definition of sample requirements and adjustments in the organisation.
At level 3 the pathologists were offered an initial training set and secondary monitoring before routine diagnostic results were generated. High levels of concordance were reached between digital and conventional slides.
At level 4 external hard disks were used before integrated high volume storage capacity was installed.

Conclusion: If carefully integrated, trained and monitored, digital histology can partially replace conventional slides.

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SATELLITE ACTIVITIES

SY-1

OLYMPUS SYMPOSIUM

Virtual microscopy: a tool for the Italian Pathology Society (SIAPEC IAP) activities

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Abstract

Introduction: The Italian Society of Anatomical Pathology and Diagnostic Cytopathology (SIAPeC) represents the Italian division of the International Academy of Pathology (IAP). The association is a scientific and non-profit organisation incorporating all Italian pathologists. The SIAPeC role is to : promote the scientific, technical and cultural development of the operators in Anatomical Pathology and Cytopathology; to ensure that the scientific and professional education and training of the members is up-to date; the establishment of quality and safety standards for laboratory personnel and the creation of reference centres. Other major objectives of the SIAPeC include ensuring the interaction between medical doctors in anatomical pathology and in similar fields as between other international anatomical pathology societies, including the exchange of scientific/technical documents and information.

Methods: Virtual slide technology is used to facilitate e-learning of the members via the SIAPeC's website and for verification of diagnostic concordance. Also, regional and supra-regional tele-pathology networks in Italy have been established to obtain rapid second opinion from specialists.

Results and conclusion: After 10 years of experience in dynamic tele-microscopy and 5 years experience with virtual slides, these technologies have turned out to become an integral part of pathology practice changing professional education and information exchange in a favourably way.

SY-2

OLYMPUS SYMPOSIUM

Automated Tissue Microarray image analysis to identify and quantitatively determine tumour relevant proteins.

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Abstract

Introduction: With the rise of high-throughput technologies and their application in the global analysis of tumour specific alterations of the genome, transcriptome or proteome, a multitude of candidate genes and proteins have been identified. For testing, large and clinically well annotated tumour collections need to be analysed. The tissue microarray (TMA) technique, has been proven to be particularly useful in such large scale testing. The technique permits immunohistochemistry (IHC) experiments to be carried out at well defined standard operating parameters. Problems using this technique arise with both, the misinterpretation introduced during the conventionally practiced, manual analysis by the pathologist and with the subjective component presented by the experimenters due to their varying level of expertise. A method for the automated analysis of TMAs was developed to overcome individual examination errors.

Methods: The TMA slides were digitised using a conventional microscope (for IHC) or a fluorescent s canner (for immunofluorescence - IF). Subsequently these images could be used as 'virtual slides' to perform various analyses. IHC labelled TMAs were analysed both manually and automatically and the results were compared. The method was also applied to tumour-biological research. A novel approach to automated TMA-analysis was developed by the introduction of the multi-fluor immunofluorescent technique. Here, two or more different fluorochrome-tagged antibodies were simultaneously used in IHC experiments to define a digital mask for specific tumour compartments (e.g. epithelial areas are labelled with epithelia-specific antibodies) and automatically analyse a second 'test-antibody' using heterogeneous tumour material. The work was performed at the German Cancer Research Institute (DKFZ) in Heidelberg Germany.

Results: The relevance of the method was demonstrated using a number of different examples, e.g: for expression levels of the anti-apoptotic proteins HMGB1 and c-IAP2 in colorectal carcinoma. The simultaneous use of phosphor-specific antibodies against STAT5 and STAT6, and their unphosphorylated forms respectively can be employed to analyse the activity of cellular components of signalling cascades on tumour-TMAs (e.g. JAK/STAT signalling).

Conclusion: Automated TMA-analysis is a big step towards the standardisation of large scale testing to identify tumour subgroups, which are characteristic of the activation of specific signal transduction pathways.

DAKO SYMPOSIUM
Pathology Workflow and Integration of ACIS III in Dako Link

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Abstract

Dr. Schmid's presentation on "Pathology Workflow and Integration of ACIS III in Dako Link" covers practical issues related to automation and workflow optimization in pathology, with a novel approach emphasizing data and information integration for image analysis. This lecture is of special interest currently, when the international standardization bodies (DICOM, HL7, IHE), are developing standards to inter-operate between different information systems, with the help of industry and pathologists.

Dr. Ing. Joachim Schmid
Director, Imaging & Pathology Workflow, Dako, USA

Joachim joined Dako in June 2006 as the Principal Scientist, Image Analysis. Since the beginning of 2008 he is the director of the Imaging and Pathology Workflow group at the Carpinteria R&D.

Prior to joining Dako Joachim spent 7 years with Tripath Imaging in R&D. He was the director for imaging and developed new imaging products for cytology, IHC quantification, telepathology and image management. He received his doctorate in electrical engineering from the University of Stuttgart. During his doctorate he developed a new telepathology system and worked in the European Union research project EUROPATH.

SY-4

SHORT TRAINING COURSE
The IHE Pathology technical framework: Introducing informatics standards in Pathology

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Course description

For making medical decisions, physicians require that all necessary information about patient, specimens, clinical context, diagnosis and prognosis is both correct and easily available. We address the issue of integrating anatomic pathology department information into the electronic healthcare enterprise to enhance clinical information exchange between anatomic pathologists and clinicians. The pathology workflow from order to report, including specimen processing, simple image acquisition and reporting was modelled in an integration profile "Pathology workflow" in the framework of the IHE (Integrating the Healthcare Enterprise). This Integration Profile relies on ten transactions based on HL7 or DICOM standards. Joint efforts between IHE and DICOM WG26 has resulted in a proposed common model for specimen in anatomic pathology, usable for both HL7 and DICOM transactions. The perspectives of the IHE Pathology working group are to propose some more standard-based Integration Profiles dedicated to manage whole slide images and semantically rich structured reports and to integrate automatons and tissue bank databases to healthcare enterprise.

This training course has a focus on the standardisation process in Pathology and provide an overview about the current technical framework. The course is useful for interested pathologist as well as technicians, developers of software provider.

Topics of the course:
1. Introduction of IHE and the process of standardisation
2. Uses Cases and workflow in Pathology
3. Transactions in Pathology - technical backgroud
4. Implementation & Testphase

SY-5

DAKO SYMPOSIUM
Use of ACIS III in daily use to support the breast panel diagnosis

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Abstract

Immunohistochemistry (IHC) provides great value to the medical diagnostic in surgical pathology. Diagnostic, prognostic and therapeutic decisions are made based in tumor markers expression, and IHC is the easiest way to do these determinations. In the last ten years, several targeted therapies were developed for cancer treatment. The main objective is to improve treatment effectiveness in selected cancer patients based in certain selection criteria, e.g. over-expression or amplification of biomarkers such as HER2/neu. In this talk we will emphasize the importance standardization in the process of tumor marker in breast carcinoma. To make those decisions in a consistent and meaningful manner requires standardization of all steps in the IHC process, since specimen acquisition and fixation, antibody optimization and validation, and interpretation & reporting. IHC results from different labs continue to demonstrate inconsistent quality, apart of the all efforts of the scientific community. Laboratory automation is very important in order to standardize IHC results; it is convenient and can improve the turnaround time. We have increasingly witnessed the importance of standardization in IHC laboratories on a worldwide basis.

Breast carcinoma is the most frequent tumor in women and has a high mortality rate worldwide. The IHC protocols for breast cancer include, at least, hormone receptors and HER2 expression practically in all laboratories of the world. How to report the results can varies according the pathologist, but it will affect the patient's treatment. Although IHC has been the more frequent method for measuring hormone receptor status for over 18 years, it remains unstandardized. There is a widespread concern that inaccuracy in IHC technique and interpretation is leading to an unacceptably high error rate in determining the true hormone receptor status. Similarly, there is considerable concern that both false-negative and false-positive result rates for testing for HER2 status are unacceptably high in current clinical practice. There is a great need for the standardization of these biomarker assay procedures to further enable the highest possible quality of care for newly diagnosed breast cancer patients. The use of an image analysis system can improve the standardization of the results, since validated by other methods. The use of the ACIS for hormone receptors and HER2/neu analysis correlated very well with biochemical/molecular analysis (for HR) and FISH (for Her2/neu analysis) has higher accuracy than the manual method and improve the turnaround time. The ACIS method represents a substantial improvement over the manual method for objective evaluation of the HER-2/neu status.

Dr. Fernando Soares

Dr. Fernando Soares is Full Professor at University of São Paulo, São Paulo, Brazil and Head of the Department of Anatomic Pathology of the research and Medical Hospital A.C. Camargo, São Paulo, Brazil. He also serves as Head of Translational Research at same Hospital.

Dr. Soares's main research expertise is in translational pathology with emphasis in biomarkers in diagnosis and prognosis of the tumors. His clinical expertise is in surgical pathology with emphasis in hematopathology. He is a senior investigator in several grants which have resulted in more than 120 per-reviewed scientific papers in international journals. Dr. Soares is also associate Editor of the upcoming Journal of Hematopathology and former President of the Brazilian Society of Pathology.

// 9TH EUROPEAN CONGRESS ON TELEPATHOLOGY //
3RD INTERNACIONAL CONGRESS ON VIRTUAL MICROSCOPY

Toledo, Spain. 15-17 May 2008

Arriving at the Information Technology Age in Pathology

GENERAL INFORMATION

GENERAL INFORMATION

CONGRESS WEB SITE

http://www.seapcongresos.com/telepathology2008/

CONGRESS VENUE

HOTEL BEATRIZ TOLEDO
Carretera Ávila. Km 2,750
45005 Toledo. SPAIN

The Hotel Beatriz has amazing views of the impressive historical centre of the Imperial City of Toledo. Toledo is situated just 45 minutes from Madrid and its airport, easily accessible by main road and AVE (high speed train).

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Fax: 913 023 926
telepathology2008@pacifico-meetings.com
http://www.pacifico-meetings.com/

IDENTIFICATIONS

The organization of the congress will provide a personal badge with the rest of the documents. All the participants are requested to wear their badges at all times.

EXHIBITION AREA

The Organisation of the 9th European Congress on Telepathology and 3rd International Congress on Virtual Microscopy, will dedicate an area of the Hotel Beatriz to an exhibition, as was done in earlier occasions. The Congress participants will have free entrance to this exhibition This space will be the ideal place to publish and inform about products and services to the visitors.

BUSES

To assist to all the social events, the congress will offer to all the congress participants a bus service from the Hotel.

HOTELS

The official hotels of the congress are:

Hotel Beatriz
Carretera Ávila. Km 2,750. 45005 Toledo. SPAIN.
Telephone- 925 269100

Hotel Pintor el Greco
Alamillos del Tránsito, 13. 45002 Toledo · España
Telephone: 925 28 51 91

Hotel Casona de la Reina
Carrera San Sebastián 26. 45002 Toledo
Telephone: 925 282 129

SOCIAL EVENTS

TOLEDO

Toledo is one of Spain´s historical and scenic treasures. It is set on a hill surrounded, as its circumference, by the Tajo River. It presents as a fortressed city that has been able to combine its historical spirit with modern times.

Economical growth and social development in the capital of Castilla-La Mancha, together with the improvement in transportations, that connects Toledo with Madrid in 20 minutes, by the high speed rail, have given place to a significant increase in population in recent years (about 80,000 inhabitants in 2006).

A broad range of tourist and accommodation resources is available in Toledo, including many hotels, shopping, and leisure facilities. Well known museums, exhibitions, and historical interpretation centres are worth a visit. As an example, Toledo is the subject of some of El Greco's most famous paintings, including The Burial of the Count of Orgaz, exhibited in the Church of Santo Tomé.

It was declared a World Heritage Site by UNESCO in 1986, due to its extensive cultural and monumental heritage as one of the former capitals of the Spanish Empire and place of coexistence of Christian, Jewish and Muslim cultures.

Typical and traditional products are nowadays combined with a modern gastronomy, elaborated by expert cooks, offer a singular and affordable cuisine. You can also buy *mazapán* (sweet marzipan) here. *Bodegones* are taverns with food where you can get *sopa de ajo* (garlic soup), and *tortillas* (omelets).

Toledo's craft tradition in metalworking is legendary. Small bazaars all over the old city, with swords, daggers, suits of armour, wrought iron grating, locks, furniture, and decorative items continue preserving the quality that have made them world famous. Ceramics and pottery are two crafts that have seen their popularity increase from the 16th century to the present-day.

Toledo's perhaps best known festivity is the procession of Corpus Christi, declared of international interest to the tourist, and which will held soon after the 9th European Congress on Telepathology

Some of Toledo's principal attractions are: Islamic Gates & Mezquita de Cristo de la Luz, Museo-Hospital de Santa Cruz, Alcázar (former Roman, Visigoth and Muslim fortresses), The Cathedral (gothic style), Greco's House & Church of Santo Tomé, and the Jewish Quarter.

During the middle age, Toledo hosted the three different mentioned cultures which shared the city in a peaceful way. It was in this period, that the construction of the cathedral was initiated. Walking around Toledo's street you will feel as living in another time. The fortified city has conserved and maintained the original architecture intact, with Medieval, Jewish, and Moorish districts.

TOLEDO VISIT TOUR

(Thursday, May 15th, 2008, 19:30-21.00 h)
Included in the registration fee
The 3 cultures in Toledo

Muslims, Jewish and Christians, who are represented in Toledo, their traditions, cultures, legends, and quarters...
At the beginning of the tour we will have the opportunity of doing a panoramic view surrounded the valley' area, the old bridges of Toledo: Alcantara and Saint Martin, the rural houses of Toledo and the small churches.

Then we will enter in the old city and we will begin the tour from Zocodover Square, which was an Arab market and we will discover some of its buildings, the Cathedral, the synagogues, and the mosques. Also the narrow streets of Toledo, the passé ways or covered street, Becquer's leyends, the convents and the curiosities of this period will be visited.

WELCOME RECEPTION (Thursday, May 15th, 2008, 21:00 h)

Hostal del Cardenal. Toledo (http://www.hostaldelcardenal.com/).

Welcome reception dinner is included in the registration fee for all participants and their registered accompanying persons.

OFFICIAL DINNER
(Friday, May 16th, 2008, 21:00 h)

Cigarral del Santo Ángel Custodio, a well-know Cigarral(*) in Toledo. Including a flamenco show (guitar and castanets players).

A cigarral is a private estate nearby Toledo located on one side of the river Tajo. It is named after the singing cicadas (cigarras in Spanish) found in summertime, and consists of a large, several-storey home with garden and orchard. The house is usually rustic and conventual, with white walls and surrounded by terraces and patios. With beautiful lilacs, lilies, irises and the setting in general, the cigarral is highly valued in the Imperial City of Toledo.

GUITAR AND CASTANET DUO

Interplay of guitar duo, as a classical instrument, Spanish flamenco and two castanets players.

A **limited** number of tickets may be available.

OFFICIAL DINNER BOOKING FEE
(Registered delegates/accompanying persons) . . . . . 30 €
OFFICIAL DINNER TICKET
(Non-Registered persons/extra tickets) . . . . . 150 €

TOLEDO MAP AND ACCOMMODATION

SALAS PARA CONGRESOS Y SEDES ESPECIALES / CONFERENCE HALLS AND SPECIAL VENUES

A-1	Ayuntamiento de Talavera de la Reina
A-2	Ayuntamiento de Torrijos (Palacio de Pedro I de Castilla)
A-3	Biblioteca de Castilla-La Mancha (Alcázar de Toledo)
A-4	Bodegas Martúe La Guardia, S.A.
A-5	Bodegas Osborne
A-6	Caja Castilla La Mancha
A-7	Caja Rural de Toledo
A-8	Cámara de Comercio e Industria de Toledo
A-9	Casa de la Moneda (Consejo Consultivo de Castilla-La Mancha)
A-10	Centro Social Polivalente Santa Mª de Benquerencia
A-11	Cigarral Santo Ángel Custodio
A-12	Cine Sur "Luz del Tajo"
A-13	Colegio de Ingenieros de Caminos Canales y Puertos
A-14	Escuela Superior de Gastronomía y Hostelería de Toledo
A-15	Eventos Monte del Águila, S.L. (Finca "Montealegre")
A-16	Federación Empresarial Toledana
A-17	Finca El Retamar - Bodegas Peces Barba, S.L.
A-18	Finca Loranque
A-19	Fundación Casa Ducal de Medinaceli / Hospital de San Juan Bautista (Hospital Tavera)
A-20	Real Fundación de Toledo
A-21	Teatro de Rojas
A-22	UCLM Campus Tecnológico de la Fábrica de Armas de Toledo
A-23	UCLM Edificio Universitario Madre de Dios
A-24	UCLM Edificio Universitario San Pedro Mártir
A-25	UCLM Escuela de Traductores de Toledo
A-26	UCLM Palacio del Cardenal Lorenzana

HOTELES / HOTELS

B-1	Hotel Abad Toledo ***
B-2	Hotel AC Ciudad de Toledo ****
B-3	Hotel Alba de Layos Golf & Medispa *****
B-4	Hotel Beatriz Toledo ****
B-5	Hotel Cigarral de Caravantes ***
B-6	Hotel Comendador ****
B-7	Hotel Eurico ***
B-8	Hotel Eurostars Toledo ****
B-9	Hotel Casona de la Reyna *** (Grupo Pintor el Greco Hoteles)
B-10	Hotel Pintor El Greco *** (Grupo Pintor el Greco Hoteles)
B-11	Hotel San Juan de los Reyes **** (Grupo Pintor el Greco Hoteles)
B-12	Hotel Hesperia Toledo ****
B-13	Hotel Hilton Buenavista Toledo *****
B-14	Hotel Kris Doméinico ****
B-15	Hotel Las Conchas ***
B-16	Hotel Palacio Eugenia de Montijo *****
B-17	Hotel Silken Cigarral El Bosque *****
B-18	Hotel Toledo Imperial ***
B-19	Parador Nacional de Toledo "Conde de Orgaz" ****
B-20	Villa Nazules Hotel Hípica Spa ****

RESTAURANTES / RESTAURANTS

C-1	El Casón de los López de Toledo
C-2	El Cigarral de las Mercedes
C-3	El Foro de Toledo
C-4	El Palacete
C-5	Finca Los Valdespinos
C-6	Hostal del Cardenal
C-7	Restaurante Adolfo (Grupo Adolfo Restaurantes)
C-8	Restaurante Adolfo Colección (Grupo Adolfo Restaurantes)
C-9	Restaurante La Perdiz (Grupo Adolfo Restaurantes)
C-10	Viñedos Cigarral Santa María (Grupo Adolfo Restaurantes)
C-11	Restaurante Aurelio
C-12	Restaurante Locum
C-13	Restaurante Venta de Aires

CATERING / CATERING

D-1	Alfonso Beltrán Catering
D-2	La Calesa Catering

ORGANIZADORES PROFESIONALES DE CONGRESOS (OPC) / PCO

E-1	Priority Coach & Management S.L.
E-2	Turevent
E-3	Viajes El Corte Inglés

D.M.C. Y OTROS ORGANIZADORES DE EVENTOS / DMC's

F-1	A. A Punto Eventos, S.L.
F-2	Conoce Toledo
F-3	Evocarte
F-4	Internacional de Congresos (Agencia de azafatas)

AGENCIAS DE VIAJE / TRAVEL AGENCIES

G-1	Halcón Viajes
G-2	Viajes Happytour, S.L.

AGENCIAS DE COMUNICACIÓN / COMMUNICATION AGENCIES

H-1	C.P.P. Publicidad, S.L.
H-2	Jer Publicidad y Medios, S.A.
H-3	Mateo: Mateo Comunicación
H-4	Morales Comunicación
H-5	Tangente Publicidad, S.L.

SERVICIOS TURÍSTICOS / TOURIST SERVICES

I-1	Ayuntamiento de Consuegra
I-2	Bernuy Aventuras
I-3	Casma Consultores, S.L.
I-4	Centro de Ocio El Cortijo
I-5	Etur
I-6	Inventa, S.L.
I-7	Wine Time

AUTOBUSES / BUSES

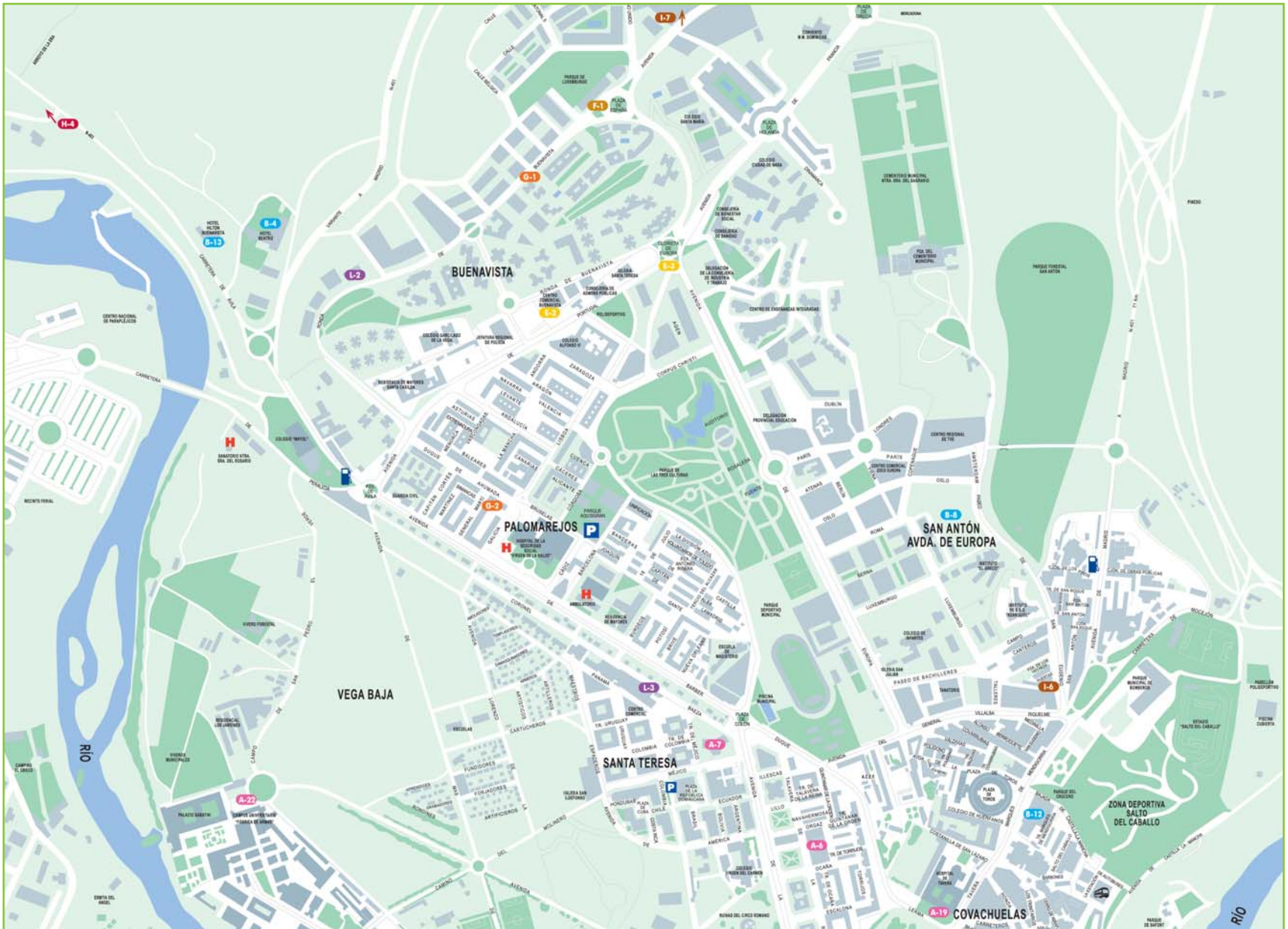
J-1	Rubicar, S.A.
J-2	Unauto, S.L.

REGALO PROFESIONAL / PROFESSIONAL GIFTS

K-1	Mazapanes Santo Tomé

AUDIOVISUALES / AUDIOVISUALS

L-1	Internacional de Congresos
L-2	Report Televisión
L-3	Tecsound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PLANO DE LA CIUDAD DE TOLEDO

TOLEDO CITY MAP

REGISTRATION FORM

REGISTRATION CATEGORIES

	until 31 March 2008	after 31 March 2008
Normal registration fee*	400 EUR ☐	450 EUR ☐
IAT, SEAP, SEIS, SESCAM, UCLM member registration fee*	370 EUR ☐	420 EUR ☐
PhD student / resident / technicians reg. fee*, **	240 EUR ☐	240 EUR ☐
Accompanying reg. fee*	120 EUR ☐	120 EUR ☐

* Registration fees include 7% VAT.
** Only the first 50 PhD student, resident, and technician's registrations are eligible for this special discount

HOTEL BOOKING

Arrival date: **Departure date:**

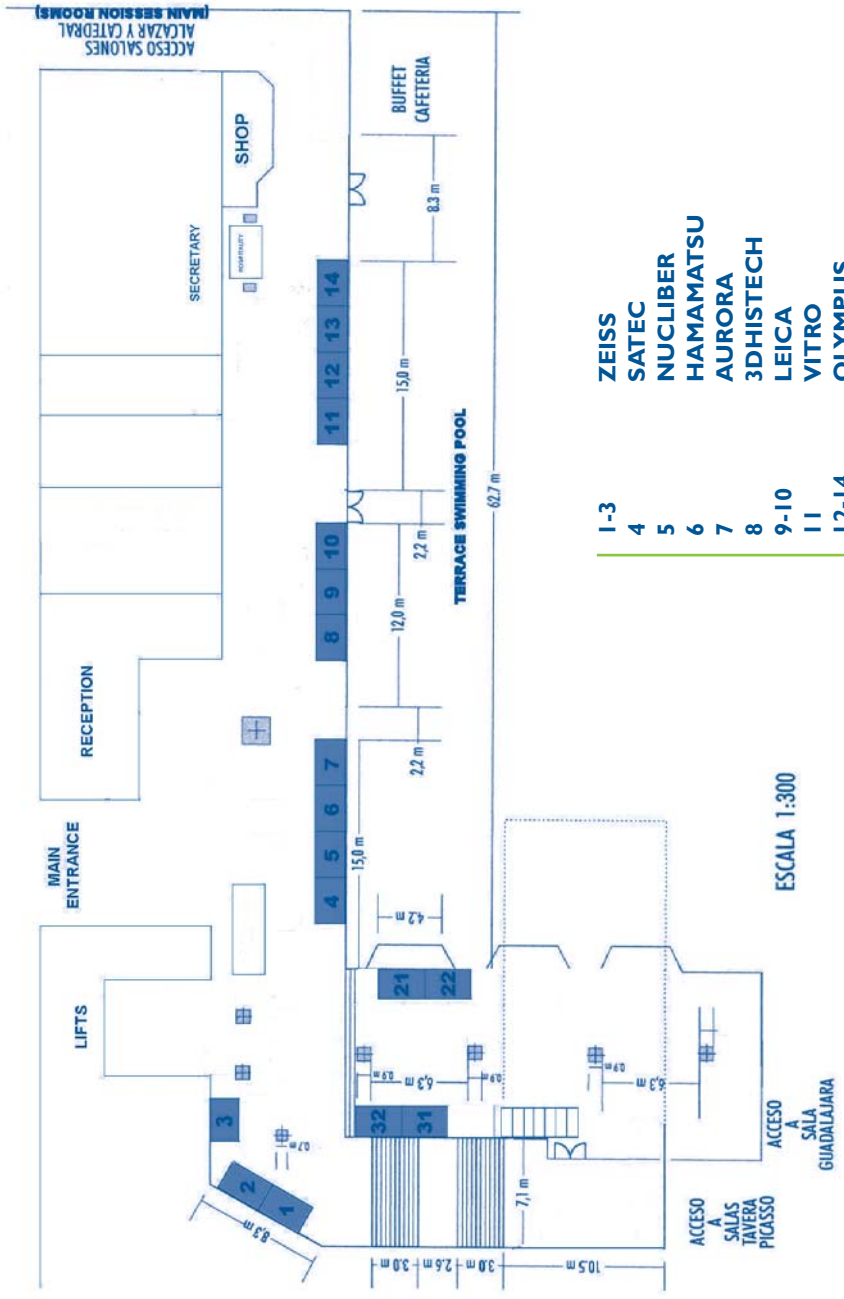
HOTELS	Double room for single use	Double room
HOTEL BEATRIZ (4 *. Congress venue)	106 EUR ☐	117 EUR ☐
HOTEL PINTOR EL GRECO (3*)	66 EUR ☐	85 EUR ☐
HOTEL CASONA DE LA REINA (3*)	62 EUR ☐	76 EUR ☐

Breakfast and VAT included. Prices are per room and nights. Deadline for hotel reservations: April, 15th, 2008

Other Services:

☐ GALA DINNER BOOKING FEE (Registered Delegates and Accomp. Persons) . . . . . 30 euros
☐ GALA DINNER TICKET (Non-Registered persons) . . . . . 150 euros

CONGRESS VENUE ROOM DISTRIBUTION



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7	AURORA
8	3DHISTECH
9-10	LEICA
11	VITRO
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