7th EUROPEAN CONGRESS ON TELEPATHOLOGY
&
1st INTERNATIONAL CONGRESS ON VIRTUAL MICROSCOPY

POZNAN, JULY 8-11, 2004

Under the honorary patronage of:

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PROGRAMME
&
ABSTRACT BOOK

Poznan Scientific Center (PON) Polish Academy of Sciences (PAN)
ul. Wieniawskiego 17/19, 61-713 Poznan

GENERAL INFORMATION

Conference venue
Poznanski Osrodek Nauki (PON) Polskiej Akademii Nauk (PAN)
Poznan Scientific Center (PON) Polish Academy of Sciences (PAN)
ul. Wieniawskiego 17/19, 61-713 Poznan
phone: (+48 61) 852-85-03

Registration
Conference Hall - Registration desk
Poznan Scientific Center (PON) Polish Academy of Sciences (PAN)
ul. Wieniawskiego 17/19, 61-713 Poznan

Secretariat
Weronika Bryl
Katarzyna Szymanska
Edyta Zieciak

Preparation of oral presentation
Speakers are requested to bring their materials to the lecture room during the break preceeding their sessions

Internet Café
Conference Hall
Poznan Sciences Center (PON) Polish Academy of Sciences (PAN)
ul. Wieniawskiego 17/19, 61-713 Poznan

Group photo
Saturday, July 10, 2004, 12:00

Meals
Lunch and Coffee at scheduled breaks

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Prof. Janusz Szymas

INTERNATIONAL ACADEMY OF TELEPATHOLOGY

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Tsuchihashi Y, Kyoto, Japan
van Diest P, Amsterdam, The Netherlands
Weinberg DS, Boston, USA
Weinstein RW, Tucson, USA
Williams BH, Washington, USA
Williams RA, Fitzroy, Australia
Wottoon G, Brisbane, Australi

PROGRAMME

Thursday, July 8, 2004

15:00 - 18:00 **TELEPATHOLOGY WORKSHOPS:** NIKON, OLYMPUS, ZEISS, IBM
19:00 **OPENING CEREMONY**

WELCOMES

WELCOME LECTURE

REINVENTION OF LIGHT MICROSCOPY: A NOVEL ARRAY MICROSCOPE FOR ULTRARAPID VIRTUAL SLIDE PROCESSING AND TELEPATHOLOGY.
R.S. Weinstein, M.R. Descour, Ch. Liang, P.H. Bartels
Tucson, Arizona

WELCOME RECEPTION

Friday, July 9, 2004

MORNING LECTURE

9:00 - 9:30 TELEPATHOLOGY: BARRIERS TO A BRIGHT FUTURE
B. Williams
Washington D.C.

9:30 - 9:50 ACADEMIC NETWORKS FOR TELEMEDICINE - A "PIONIER" EXAMPLE
A. Binczewski, C. Mazurek, M. Stroinski, J. Weglarz
Poznan

SESSION I - TELEPATHOLOGY CONSULTATIONS CENTERS
Chairs: K. Kayser, J. Szymas

9:50 - 10:10 UICC-TELEPATHOLOGY CONSULTATION CENTER - AN UP DATE AND AN OUTLOOK
M. Dietel
Berlin

10:10 - 10:30 AFIP TELEPATHOLOGY - WHERE ARE WE GOING?
B. Williams, F. Mullick, A. Nelson
Washington D.C.

10:30 - 10:50 CAFÉ BREAK

SESSION II - TELEPATHOLOGY AS DIAGNOSTIC AID
Chairs: B. Williams, M. Dietel

10:50 - 11:05 TELEPATHOLOGY IN SOUTH EAST ASIAN COUNTRIES: PAST, PRESENT AND FUTURE
T. Kuakpaetoon, G. Stauch, K.D. Kunze, M. Oberholzer, K. Atisook, C. Vathana, B. Samountry
Bangkok, Aurich, Dresden, Basel, Phnom Penh, Vientiane

11:05 - 11:20 IRANIAN AND GERMAN EXPERIENCE IN TELEPATHOLOGY: COMPARISON OF UICC-TPCC AND IPATH BY APPLICATION OF INNOVATIVE SCORING SYSTEMS
M. Mireskandari, G. Kayser, T. Schrader, P. Hufnagl, K. Kayser
Kerman, Freiburg, Berlin

11:20-11:35 CONSULTATION TELEPATHOLOGY IN DEVELOPING COUNTRIES. DIAGNOSTIC ACCURACY IN THE PHNOM PENH-PROJECT
J. Woziwodzki, G. Stauch, K.D. Kunze, G. Haroske, M. Oberholzer, T. Kuakpaetoon, Ch. Vathana, C. Haener
Aurich, Dresden, Basel, Phnom Penh

11:35-11:50 UPDATE ON TELEPATHOLOGY/TELEMEDICINE PROJECTS AT UNIVERSITY OF TRANSKEI, SOUTH AFRICA
L. Banach
Umtata

11:50-12:05 TELEMEDICINE NETWORK IN THE EUREGIO POMERANIA
J. Dräger, W. Diemer, H.-H. Ehricke, N. Hosten, M. Staemmler , E. Wolf
Stralsund, Greifswald

12:05-13:05 LUNCH

SESSION III - FROZEN SECTION TELEPATHOLOGY
Chairs: K.D. Kunze, J. Woziwodzki

13:05-13:20 FROZEN SECTION TELEPATHOLOGY, EXPERIENCES AND RECOMMENDATIONS FOR NEXT GENERATION EQUIPMENT
P. Schwarzmann, W. Nathrath, C. Chmelar, H. Fuerst, H.P. Muehlig, K. M. Mueller, A.Linder, G. Rieck, P. Fritz, G. Friedel
Stuttgart, Munich, Hemer, Gerlingen

13:20-13:35 REMOTE MICROSCOPY OF FROZEN SECTIONS PRELIMINARY RESULTS OF A STUDY ON RELIABILITY, REPRODUCIBILITY AND INTEROBSERVER VARIABILITY
S. von Gerlach, A. Schulzl, A. Battmann
Giessen

13:35-13:50 PITFALLS AND SPECIAL PROBLEMS WITH FROZEN SECTION EXAMINATION VIA TELEPATHOLOGY
G. Rieck, U. Stachetzki, T. Stoffels, K. Juncker, A.Linder, K. M. Muller
Saalfeld, Bochum, Hemer

SESSION IV - OPEN TELEPATHOLOGY SYSTEMS
Chairs: Y. Tsuchihashi, G. Haroske

13:50-14:05 TELEMIC THE FIRST OPEN SYSTEM FOR TELEPATHOLOGY
J. Szymas, G. Wolf
Poznan, Berlin

14:05-14:20 XML TOOLS IN IPATH FOR INTERINSTITUTIONAL PATIENT RECORDS IN BREAST CANCER MANAGEMENT
G. Haroske, K. Brauchli- Haase, M. Oberholzer
Dresden, Basel

14:20-14:35 DEVELOPMENT AND FIELD TEST OF A NEW AGE STANDERDIZED TELEPATHOLOGY SYSTEM USING A BROAD BAND INTERNET AND SECURITY FUNCTION BY AN IC CARD
Y. Tsuchihashi, T. Shiraishi, M. Ohshiro, Y. Kanno , M. Togano, I. Tofukuji, K. Nakasato, H. Akiyama, T. Yamada
Kyoto, Mie, Nago, Kawasaki, Takasaki, Tokyo

14:35-14:50 TIMAN: AN OPEN SOURCE SYSTEM FOR TISSUE MICROARRAY MANAGEMENT
V. Della Mea, I.Bin, R.Spizzo, M. Pestrin, C.Di Loreto
Udine

14:50-15:10 CAFÉ BREAK

SESSION V - CELL-BASED TELEPATHOLOGY
Chairs: J. Klossa, V. Della Mea

15:10-15:25 THE REGIONAL PROGRAMME FOR DIGITAL QUALITY CONTROL IN CERVICOVAGINAL SCREENING
C. A. Beltrami, V. Della Mea, F. Viel, L. Zanier
Udine

15:25-15:40 REMOTE PATHOLOGY ASSISTANCE FOR CERVIC CANCER SCREENING IN CAMBODIA. A REAL SIZE, PROOF OF THE TELEMEDECINE CONCEPT
P. Roignot, O. Perret, D. Krief, J. Cohen, E Martin, M. Pluot
Dijon, Paris

15:40-15:55 VIDEOCELL: A TELECONSENSUAL APPROACH FOR CELL SEMIOLOGY AIMED AT DEVELOPING AUTOMATED CLASSIFICATION TOOLS; APPLICATION TO PERIPHERAL BLOOD CELLS
J. Klossa, .I. Angulo, J.Ch. Cordier, G. Flandrin, E. Jullien, G. Moebst, M.A. Luengo
Neuilly, Fontainebleau, Rouen, Paris

15:55-16:10 THE INSTRUMENT FOR AUTOMATED SCREENING OF PERIPHERAL BLOOD CELLS (ASPBC): TELEMEDICINE APPLICATIONS
V.Sazonov, I. Ivanova, A. Vinogradov, N. Verdenskaya, G. Kozinets, V. Pogorelov
Moscow

SESSION VI - ORGAN-RELATED TELEPATHOLOGY
Chairs: B. Molnar, J. Slodkowska

16:15-16:30 TELEPATHOLOGY CONSULATIONS OF DISPERSED/DIFFUSE LUNG LESIONS - APPLICATION AND COMPARISON OF VARIOUS METHODS
J. Slodkowska, K. Kayser, M. Wojciechowski, F. Galateau Salle, K. Siemiatkowska, H. Poper
Warsaw, Berlin, Cote de Nacre, Bydgoszcz, Graz

16:30-16:45 THE CREATION OF A LUNG PATHOLOGY ONTOLOGY BASED ON UMLS FOR IMAGE RETRIEVAL
T. Schrader, T. Leuthold, S. Niepage, E. Paslaru, K. Saeger, P. Hufnagl
Berlin

16:45-17:00 AUTOMATED CLASSIFICATION OF GASTRIC BIOPSY SAMPLES USING DIGITAL SLIDE AND VIRTUAL MICROSCOPY
L. Ficsor, B. Molnar, P. Gombas, Z. Tulassay
Budapest

17:00-17:15 THREE-DIMENSIONAL RECONSTRUCTION AND ANALYSIS OF GASTRIC BIOPSY SPECIMEN
B. Molnar, A. Tagscherer , G. Csendes, V.S. Varga, Z. Tulassay
Budapest

17:15 -17:30 TELEPATHOLOGY IN TRANSPLANTATION PATHOLOGY: A RETROSPECTIVE STUDY
F. Demichelis
Trento

17:30-17:45 ULTRASTRUCTURAL TELEPATHOLOGY-AN APPLICATION OF REMOTE ELECTRON MICROSCOPY VIA INTERNET
J. Schroeder, P. Buescher, F. Hofstaedter
Muenster, Regensburg

17:45-18:00 DYNAMIC TELEMACROPATHOLOGY WITH INTERNET CAMERAS
A.D. Varnai, D. Bollmann, O. Bollmann, O. Hahn, R. Bollmann
Bonn-Duisdorf, Bonn

18:00 BUSINESS MEETING OF INTERNATIONAL ACADEMY OF TELEPATHOLOGY

Saturday, July 10, 2004

MORNING LECTURES

9:00-9:30 VIRTUAL MICROSCOPY - THE FUTURE IN SURGICAL PATHOLOGY
M. Dietel
Berlin

9:30:10:00 THE TMAS-EXPLORER PLATFORM : AN INTEGRATED TOOL INCLUDING A VIRTUAL TMA CONCEPT
F. Giroud, J.S. Lafontaine, M.P. Mobtmasson, R. Heus, J. Bourbeillon, C. Garbay
La Tronche, Montpellier

10:00-10:20 CAFÉ BREAK

SESSION VII - VIRTUAL HISTOLOGICAL LABORATORY
Chairs: M. Dietel, F. Giroud

10:20-10:35 STRATEGY OF A PATHOLOGY DEPARTMENT IN RESPECT TO VIRTUAL MICROSCOPY
Y. Collan, L. Talve
Turku

10:35-10:50 THE VIRTUAL INSTITUTE OF PATHOLOGY AS AN ORGANIZATIONAL STRUCTURE FOR DIAGNOSTIC AND CONSULTATIVE STATIC TELEPATHOLOGY
G. Haroske, M. Hubler, N. Aurwitz, M. Oberholzer, G.Stauch, K.D. Kunze
Dresden, Basel

11:05-11:20 DEVELOPMENT AND EVALUATION OF THE DIGITAL HISTOLOGY LABORATORY IN ROUTINE WORKFLOW
P. Gombas, B. Molnar, V.S. Varga, A. Tagscherer, G. Csendes, V. Kamaras, T. Virag
Budapest

11:20-11:35 MATCHSLIDE: OPTIMIZING VIRTUAL SLIDE DATAFLOW
J. Klossa, J.Ch. Cordier, G. Flandrin, P. Horain, D. Ouagne, B. Parrein, V. Leymarie, M. Tarin
Neuilly, Rouen, Paris, Evry, Strasbourg

12:00-13:00 LUNCH

SESSION VIII - VIRTUAL SLIDES
Chairs: Y. Collan, P. Gombas

13:00-13:15 THE VIRTUAL PATHOLOGY SLIDE SOFTWARE SUITE
S. Costello, D. Johnston, P. A. Dervan, D.G. O' Shea
Dublin

13:15-13:30 EXPERIENCES IN THE PRODUCTION OF DIGITAL SLIDES BY AN AUTOMATED HIGH-RESOLUTION
V.S. Varga, B. Molnar, A. Tagscherer, T. Virag
Budapest

13:30-13:45 TELESLIDE: A MULTIPURPOSE COLLABORATIVE PLATFORM DEDICATED TO MORPHOLOGICAL STUDIES
J. Klossa, Ch. Le Bozec, E. Martin, J.Ch. Cordiey, D. Lusina, S.M. Martelli, X. Troussard
Neuilly, Rouen, Meulan, Caen

13:45-14:00 USEFUL TOOLS FOR THE DIGITAL VIRTUAL MICROSCOPE; IMPLEMENTATION OF THE DIAGNOSTIC PATH
T. Schrader, S. Niepage, T. Leuthold, S. Hellmig, K. Saeger
Berlin

14:00-14:15 VIRTUAL SLIDES - MOTIVATION, APPLICATION AND TECHNOLOGY
P. Schwarzmann
Stuttgart

14:15-14:30 POTENCY OF DIGITAL PATHOLOGY IN HUNGARY
P. Gombas
Budapest

14:30-14:45 THE ESLIDE SYSTEM FOR DIGITAL SLIDE ACQUISITION AND VISUALISATION: IMAGE PROCESSING ASPECTS
F.Viel, V. Della Mea, C.A. Beltrami
Udine

14:45-15:00 WORKING WITH VIRTUAL SLIDES: DICOM-3 AS A STANDARD IN PATHOLOGY IMAGES
M. Garcia-Rojo, J. Garcia, C. Royo, M. Carbajo
Ciudad Real, Toledo

15:00-15:15 PRELIMINARY DIAGNOSTIC ASSESSMENT OF THE DIGITAL SLIDE TECHNOLOGY
V. Della Mea, F. Demichelis, F. Viel, P. Dalla Palma, C.A. Beltrami
Udine, Trento

15:15-15:35 CAFÉ BREAK

SESSION IX - E-TEACHING AND ELECTRONIC PUBLICATION
Chairs: D. Bauer, F. Demichelis

15:45-16:05 APPLICATIONS OF VIRTUAL MICROSCOPY IN PATHOLOGY: TELEPATHOLOGY, PATHOLOGY EDUCATION, PROFICIENCY TESTING
A. Marchevsky
Los Angeles (California)

16:05-16:20 TEACHING WITH VIRTUAL SLIDES
Katharina Glatz, Dieter Glatz, Michael .J. Mihatsch
Basel

16:20-16:35 NEW TEACHING TECHNOLOGIES IN PATHOLOGY:
EXPERIMENTATION AND APPLICATIONS AT THE UNIVERSITY OF MILAN
D. Bauer, I. Pinelli
Milano

16:35-16:50 A VIRTUAL TEXTBOOK ON SURGICAL PATHOLOGY
C. Clemente, Ch. Alberti, S. Manara, A. Ferrari, S. Rao, A. Clemente
Milano

16:50-17:05 ANALYSIS OF PUBLICATION OUTPUT IN TELEMEDICINE
P. Moser, M. Nager, G. Mikuz, Ch. Kolbitsch, I.H. Lorenz
Innsbruck

18:00 DINNER

Sunday, July 11, 2004

MORNING LECTURES

9:00-9:30 SAMPLING: THEORY AND PRACTICE
K. Kayser, G. Kayser, P. Hufnagl
Berlin, Freiburg

9:30-10:00 IMAGE AND VIDEO CODING FOR TELEMEDICAL SERVICES
M. Domanski
Poznan

SESSION X - IMAGES DATA FOR TELEPATHOLOGY
Chairs: K. Kayser, M. Domański

10:00-10:15 WIDE FIELD IMAGE CAPTURE - QUICKLY AND EASILY IN BOTH
FLUORESCENCE AND TRANSMITTED LIGHT USING THE TISSUEscope
T. Nicklee, D. Hedley, S. Damaskinos
Toronto, Waterloo (Ontario)

10:15-10:30 MULTIPLE CLASSIFIERS FOR LEARNING FROM PICTORIAL INFORMATION
K. Krawiec, J. Stefanowski, R. Slowinski
Poznan

10:30-10:45 EXPRESSIONARY DATA FROM TISSUE MICROARRAY EXPERIMENTS:
ANALYSIS AND GRAPHICAL REPRESENTATION
F. Demichelis, R. Dell' Anna, A. Sboner, D. Aldovini, P. Dalla Palma, D. Di Vizio, S. Brugnara, A. Ferro, E. Galligioni, A. Lucenti
Trento, Boston

10:45-11:00 DICOM INTERCHANGE FORMAT FOR PATHOLOGY
Ch.Le Bozec, M. Thieu, E. Zapletal, M.Ch. Jaulent, J. Hemet, E. Martin
Paris

11:00-11:15 DICOM BASED PACS AND TELEPATHOLOGY INTEGRATED WITH PATHOLOGY LABORATORY INFORMATION SYSTEM USING INTERNET TECHNOLOGIES
I. Milosavljevic, P. Kostic
Belgrade

11:15-11:30 SHARED WORK WITH DIGITAL MICROSCOPES
S.V. Buravkov
Moscow

11:30-11:50 CAFÉ BREAK

SESSION XI - E-RECORD AND DATA BASE FOR TELEPATHOLOGY
Chairs: S. Seiwerth, E. Martin

11:50-12:05 COMPUTER ASSISTED STANDARDIZED REPORT
E. Martin, J. Hemet, J.Ch. Cordier, T. Carlu, E. Paulin
Paris, Rouen, Neuilly

12:05-12:20 THE PATHOLOGIST AND THE ELECTRONIC HEALTH RECORD
J.M. Guinebretiere, Ch. Le Bozec, D. Henin, E. Martin
St-Cloud, Paris

12:20-12:35 SPECIFICATIONS AND IMPLEMENTATION OF A NEW EXCHANGE FORMAT TO SUPPORT COMPUTERIZED CONSENSUS IN PATHOLOGY
E. Zapletal, Ch. Le Bozec, M.Ch. Jaulent, J. Klossa, E. Martin
Paris, Neuilly

12:35-12:50 THE ADICAP EXCHANGE PLATFORM : COMPUTING TOOLS SERVING PATHOLOGISTS NEEDS
E. Martin, J. Hémet, J.Ch. Cordier
Paris, Rouen

12:50-13:05 ELECTRONIC AUTOMATED MORPHOMETRY USER SYSTEM (EAMUS) CONCEPT AND FIRST RESULTS
G. Kayser, D. Radziszowski, R. Sommer, M. Maeurer, K. Kayser
Freiburg, Krakow, Berlin, Mainz

13:05-13:20 FROM IMAGE DATABANK TO WEB-BASED DATABANK
S. Seiwerth
Zagreb

13:20-13:35 FUNCTION DATABASE: A USEFUL TOOL FOR OPTIMISING IMAGE-BASED RESEARCH DATA
G. Kayser, M. Werner, K. Kayser
Freiburg, Berlin

CLOSING CEREMONY

14:00 LUNCH

ABSTRACTS

UPDATE ON TELEPATHOLOGY/ TELEMEDICINE PROJECTS AT UNIVERSITY OF TRANSKEI, SOUTH AFRICA

L. Banach[1]

[1]*Department of Pathology, University of Transkei, Umtata and National Health Laboratory Services, Johannesburg, South Africa*

Telemedicine Unit at University of Transkei during last two years was involved in creation of Internet based telemedicine server.
The server was installed last year in collaboration with Pathology Department, University of Basel, Switzerland. The server uses open source software, I-Path: http://telemed.utr.ac.za
It is used for telepathology, teledermatology, teleradiology in Eastern Cape Province and also for teaching of medical students at University of Transkei.
Experiences and future developments of this service will be discussed.

NEW TEACHING TECHNOLOGIES IN PATHOLOGY: EXPERIMENTATION AND APPLICATIONS AT THE UNIVERSITY OF MILAN

Dario Bauer[1], Iris Pinelli[2]

[1] *University of Milan - Dept. of Medicine, Surgery and Dentistry, Milano*
[2] *CTU - University of Milan, Milano*

The field of pathological anatomy is particularly suited to the use of new computer technologies. In the last few years the applications of multimedia technologies have also been extended to the teaching field with the introduction of e-learning, the new way of transmitting knowledge. E-learning first appeared in the Italian universities in the middle of the 1990s, when the technology developed for "the internet" started to be applied to distance learning: this implied both multimedia support to content but also new means of communication (1 to 1; 1 to many; many to many: asynchronously and synchronously). A part from few pioneer well designed experimentations, initially these applications were not particularly adventurous: generally, teachers simply placed some or all of the material used in their courses at the disposal of the students. Recently, however, many Italian universities have started to experiment with more advanced approaches. The latest innovations are mainly focused on the three-year degree courses which have been introduced with the recent Italian university reforms. At the University of Milan, in addition to the six-year degree course in Medicine and Surgery and the five-year degree courses in Dentistry and in Biotechnology, there are now over twenty three-year courses in medical disciplines. Some of these courses are designed for only a small selection of students, others are spread over a number of centres covering a wide area. This is where e-learning should be designed, on the basis of a plan for developing the teaching and learning processes, according to the needs and objectives of each degree. If the guidelines of the whole project have to be developed at an Istitutional level (Faculty + learning technology expert), it is up to the teacher to decide how e-learning can be integrated into his own course. This may vary from various types of back-up material to a complete substitution of face-to-face contact. The whole issue of teacher-student contact is now a matter of choice, ranging from chat, audio or audio-visual contacts to forums and ordinary e-mails. The move towards this new way of teaching and teaching supports necessitates the introduction of courses for teaching staff in the new methodologies, which will enable them to prepare suitable material by themselves. In order to simplify this stage of the procedure, the University has created special services for distance learning (for example the University of Milan's CTU), which provide both methodological e technological support. The success of these teaching supports continues to grow, partly thanks to the spread of broadband Internet connections, whereby it is possible to access still images, moving images and audio simultaneously. From 2004, thanks to the high standards achieved in this field, it will also be possible to use these techniques in the actual degree qualification with distance credits now being recognised as part of the CME programme.

THE REGIONAL PROGRAMME FOR DIGITAL QUALITY CONTROL IN CERVICOVAGINAL SCREENING

C. A. Beltrami[1], Vincenzo Della Mea[2], F Viel[1], L. Zanier[3]

[1] *Dept. of Medical Morphological Research, University of Udine, Udine*
[2] *Dept. of Mathematics and Computer Science, University of Udine, Udine*
[3] *Regional Health Care Authority of Friuli ? Venezia Giulia, Udine*

Introduction: The Regional Health Care Authority of Friuli Venezia Giulia (ARS) has activated, a couple of years ago, a regional programme for cervico-vaginal cytologic screening, which involves six Pathology Institutes for a total of about 40 professionals (including pathologists, biologists and cytotechnicians). A crucial component of the screening programme is the quality control, in order to ensure the quality of the diagnostic process underlying the screening. The basic mechanism for quality assurance in cervico-vaginal cytologic screeening is the proficiency testing of the cytotechnicians. This occurs by letting subjects diagnose panel-selected slides, and then evaluating answers. The QUATE european project developed a methodology for doing that; another example is the NEQAS UK programme. However, both approaches are difficult to apply at a large level, due to uniqueness and fragility of glass slides. A solution might come from the novel technology of digital slides, as we recently proposed (1). The solution there described has been proposed to ARS, which is now going to support and implement it in a joint effort here explained.

Material and methods: ARS quality control programme involves the selection of glass slides from case categories on which the region screening appears to be weak (from statistical analyses carried out on the report database). Such slides are then further selected by an expert panel, and the latter set is circulated among the institutions, where each professional should diagnose them. The cycle is concluded by a joint slide seminar, during which the cases having had lower diagnostic agreement are analysed. A complete quality control cycle lasts one year, mainly due to the specimen circulation; this can be solved by means of digital slides, provided that they are adequate for diagnostic purposes. Furthermore, digital slides allow to collect data on the subject behaviour during the slide examination, which may help in understanding errors. The steps of the project are as follows:

- development of acquisition and visualisation software;
- preliminary validation of diagnostic quality;
- acquisition of a test set of cases among those selected by the expert panel;
- first digital quality control cycle, with collection of diagnoses and data on the diagnostic process;
- joint slide seminar (as in the regular way) to discuss the real glass slides;
- routine implementation of the digital quality control method, with storage of the previously used digital slides in a repository for e-learning and continuing education.

Results: At present, the prototype software has been developed and is being used for acquiring the test case set. A preliminary evaluation of diagnostic performance has been already made on a limited number of cases and cytotechnicians (2).

Discussion: At first glance, digital slides appear adequate for quality control, even though the time needed for diagnosis is higher than that needed for traditional slides. However, most of the quality control activities and even continuing education might be made individually, in the preferred moment, thus reducing the problems now caused by the need for fast circulation of the specimens and final meetings.

References: 1) Demichelis F, Della Mea V, Forti S, et al. Digital storage of glass slides for quality assurance in histopathology and cytopathology. J Telemed Telecare 2002;8:138-42

2) V.Della Mea, F.Demichelis, F.Viel, P.Dalla Palma, C.A.Beltrami. Assessment of adequacy of digital slides in a diagnostic setting. Submitted for publication.

ACADEMIC NETWORKS FOR TELEMEDICINE - A "PIONIER" EXAMPLE

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Telemedicine services create great opportunities for supporting human health with advanced technologies once again. During last years these are networking and computational technologies, which are expected to be helpful and even essential for new applications and services in the medicine. Poland has an outstanding chance to improve the impact of them for day to day support of patients first and foremost, but also for physicians. In this paper we present examples of synergy between the development of IT infrastructure for research and education, and the development of telemedicine services in Poland. The program of development of information infrastructure for academic society – PIONIER "Polish Optical Internet – Advanced Applications, Services and Technologies for the Information Society" was launched in 2000. The program outlines the research, developments and deployments areas for research IT infrastructure in Poland, for 2001-2005. It is the continuation of the long-term initiative of building this infrastructure in Poland led by the State Committee for Scientific Research (KBN), which resulted in 21 optical metropolitan area networks (MAN).
PIONIER is mainly addressed to scientific and educational areas, with the possibility to extend to national and local governments. We will present the current state of the project with respect to its following paradigms:

- to provide advanced networking infrastructure (namely optical, terabit scalable fiber networks connecting all education and research centers in Poland, thus providing a platform for advanced applications and research infrastructures;
- to build advanced research infrastructures such as specialized networks, High Performance Computer centers, data storage centers, distance learning facilities;
- to enable advanced services and application including digital libraries, computations, geographic information systems, resource management, telemedicine and others;
- to improve the international research collaboration by the means of ensuring access to latest technology developments in IT area.

The PIONIER program gave an opportunity for several interdisciplinary pilot projects to be started also in telemedicine area. In the paper we describe the pilot application based on IT technologies, broadband MANs, and the PIONIER network of building the dedicated connection (Łódź-Poznań) for telepathology. Next, we present the cooperation between the PIONIER network and the pan-European research network GÉANT. On this basis, we conclude with the technical conception of the realization of the European dedicated broadband virtual network (e.g. 1 Gb/s) for telepathology.

SHARED WORK WITH DIGITAL MICROSCOPES

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The development of computer techniques, increase of computer power, and expansion of peripheral computer devices enables now to tell that there comes an era of computerization of morphological researches. All modern microscopes, from light to electron, have the facilities to capture of the images and save them in one of electronic formats. The preservation of the large image archives allows to use them for the purpose of medical student education, as well as for the continued education of general practitioners. At the same time microscopic services also become completely digital. It provides not only to operate the microscopes, but also more precisely support various modes of their work. Remarkable features of today microscopes are that they become really networking devices, which could be used both in local network and in the Internet, permitting organization of the remote consultation of histological preparations, which takes place in telepathology.

In present work we have tried to explore modern telecommunication technologies to manage remotely the digital scanning electron microscope «Tescan», equipped with X-ray energy spectrometer «Oxford Instruments Analytical INCAEnergy 200» (Great Britain) to carry out shared scientific work between two institutions connected with high speed fiber optic link. Blood smears prepared for scanning microscopy could be seen simultaneously by both sides using transmission of microscope computer desktop to remote user by means of remote administration program.

Wide spread introduction new telecommunication technologies in medicine especially remarkable in Russian Federation have prepared conditions for joined scientific work. The situation in scientific field is resembled to remote telemedicine consultations in clinical practice. The highest qualified scientific specialists are still located in large cities including high-tech equipment. At the same time experimental basis (especially in fields like geographic and ecological pathology) are remained in remote areas. In the last several years the system of expeditions was applied for gathering the experimental material. Unfortunately now it became time and money consuming things.

Our recent results show that the approach used in this investigation seems to be very perspective not only for Russia but also for international scientific cooperation.

A VIRTUAL TEXTBOOK ON SURGICAL PATHOLOGY

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Digital microscopy for educational purposes, i.e. in universities or as reference for physicians, is still not commonly used and accessed. To this day most of the official resources of pathologists are still printed on huge books, expensive and sometimes hard to consult, with much text and little images which show just a tiny and preselected part of the whole slide. This is so true that authors have started to put cd-roms in, containing larger and better quality images to illustrate the text presented in the book.
In fact images are so important in the field of pathology that, given the means, the whole structure of the book should be changed: the objective should not be a huge book with a couple cd-roms, but a large collection of images, with a brief explanation for each, and a list of links to allow the reader to deepen his knowledge of the particular subject.
Now we have the instruments to realize this ambitious project. The technology of digital microscopy already allows us to produce archives of high quality images, which can be easily accessed through the web. We only need to concentrate on an efficient way of associating explanations to these images, and to navigate them easily.
The advantages of this approach are quite self-evident. The number of images on the internet site can be huge, and the information can be always kept up to date. Thanks to the recent advances in virtual slide technology one can view the images as if really being on a microscope, with a better quality in comparison with the static image. And finally one can easily search the database, simply inserting keywords in an internal search engine.
At the hospital “Casa di Cura S.PioX” we have started working at this type of project, using the virtual microscopy system of OLYMPUS ITALIA, based on the BX61 microscope. The system allows us to insert virtual slides in a website, as Java Applets. The digital archive will be stored in a server, and will be soon available on the net, though still in development stage.

STRATEGY OF A PATHOLOGY DEPARTMENT IN RESPECT TO VIRTUAL MICROSCOPY

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The potential of virtual microscopy is theoretically enormous. However, the fast developmental trends and uncertainties associated with the directions of development make it very difficult for a pathology department to plan an expectable strategy in respect to virtual microscopy.

Our department approached the problem by requesting the opinions of our dominantly very experienced pathologists on their views of uses of virtual microscopy. Most of these pathologist do diagnostic work on a daily basis and use light, fluorescent and electron microscopy for the purpose and heavily rely on the service of the histopathology laboratory in staining and immunohistochemistry. These pathologists could not foresee the emergence of virtual microscopy as a substitute to traditional microscopic techniques in the diagnostic work in the near future. Pathologists in training were not as pessimistic, but even they felt that the virtual pathology department - if it ever comes - is more than their active working life away. So the diagnostic practice, in the pathologist´s opinion, seem to be based on traditional microscopy for tens of years to come. However, the pathologists readily supported virtual microscopy in several fields not immediately associated to but related to diagnostic work. Demonstrations for larger audience will be efficient and impressive through the help of virtual microscopy. Training, and self-training especially, will greatly benefit from virtual microscopy. The most immediate area of application is in undergraduate education of pathology. Support for suitable programs and instruments was clearly expressed. Use in relation to quality control and auditing was also recommended. Similarly, most pathologists understood that virtual microscopy will be the key to efficient teleconsultation, or other type of telepathology. The request sparked the interest for developing virtual microscopy uses in association with pathology education and training, and produced plans for budgeting the necessary instrumentation for lecture hall use.

THE VIRTUAL PATHOLOGY SLIDE SOFTWARE SUITE

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We have developed an automated slide scanning imaging workstation for high throughput generation of virtual slides at a magnification equivalent to 40x. The system permits automatic publication of Virtual Slides on the web as they are created allowing immediate examination using our VPS (Virtual Pathology Slide) Software.
The VPS is a microscope emulator enabling the examination of pathology slides via the Internet or CD-Rom. A novel feature of the VPS is the ability to record the migratory traces (image viewed, magnification, and examination time) of pathologists examinations on a database located in DCU.

We have performed a successful clinical evaluation of the technology and have demonstrated the VPS Replay Suite. Using migratory trace data stored in the VPS database the VPS Replay Suite allows pathologists to replay their own and others examinations of each slide and review consensus opinion on grade.
In order to elucidate the cognitive and decision-making behaviour of pathologists, a software application was developed, which generates a graphical representation of a diagnostic trace using data stored on the VPS database. This takes the form of 128x128 pixel bitmap image, where each pixel is representative of an individual field of view on a VPS slide, at the highest magnification available. The colour value of each pixel is determined by whether the field of view it represents has been viewed, and if so, at what magnification.

Using image analysis techniques to interrogate the generated bitmap images, potential 'hotspot' areas of tissue maybe located, from which a diagnosis was obtained. It is possible to discern that in some cases, there appears to be a bias in field selection with respect to slide diagnosis. Bias in field selection can be shown to be greater in slides with poor consensus. It is also possible to distinguish Pathologists examination traits as they examine a slide.
This technology has applications in determining the cause of inter-observer variability and will prove a useful tool in external quality assurance studies(EQA). Currently, VPS technology is being utilised by EQUALIS (External Quality Assurance in Laboratory Medicine in Sweden) in a study requiring the generation and deployment of 40 virtual slides depicting 20 liver core biopsies for the performance of a quality assurance study amongst over 40 clinical pathology labs.

TIMAN: AN OPEN SOURCE SYSTEM FOR TISSUE MICROARRAY MANAGEMENT

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Introduction: Tissue Microarray is a novel technique that, by collecting up to hundreds of samples on the same specimen, allows to obtain three main advantages:
- reuse of a scarce resource (the tissue block);
- uniformity in staining;
- decreased antibody quantity used per sample.

However, the technical preparation of a TMA involves the design of the recipient block, which should host all its samples in recognisable positions. Furthermore, after having prepared and stained a number of glass slides from the block, each sample should be analysed and reported in correspondence with its original patient data. This gives some difficulties, due to the large amount of data to be managed in each phase, from TMA design to report.
Aim of the present paper is to describe a specifically developed software for TMA data management, able to help during the whole TMA lifecycle, except image management.
Methods: At present, just two papers describe software for supporting TMA activities (1-2); a preliminarycommunication is available on another system (3). The former are based on off-the-shelf, commercial products, in particular Microsoft Excel and Adobe Photoshop (plus additional software and templates developed by the Authors), and deal with either data and images. We followed a different approach: to develop a multiuser open source system, based on open source software, and preliminarily to deal with just the TMA data, which can be more easily standardised.
Results: After requirement analysis, we developed a prototype system using the following software: MySQL (for database functions), PHP (for data access and interface), Apache (web server). The resulting system, TIMAN (TIssue MicroArray maNagement) is a web-accessible TMA data management system able to cover most of the pathologist' needs, with a feature for eventually exporting data for further analysis. The technologies used for the development make TIMAN highly platform independent and interoperable, either on the server as well as on the client side: the server application has been tested with Windows98, RedHat Linux and MacOSX, while the client interface has been tested with Mozilla 1.2 and Explorer5-6. To test the system, seven tissue microarrays containing XXX cases of XXX have been iserted into the syste.
Discussion: The developed system focuses on data management, leaving image management and processing to other software modules; it is accessible through the network by means of any recent browser. It is intention of the group to release it as open source, as soon as the documentation is ready.
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PRELIMINARY DIAGNOSTIC ASSESSMENT OF THE DIGITAL SLIDE TECHNOLOGY

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Introduction: A digital slide is a digital copy of a whole glass slide (or at least of a large part of it), and is a way to solve some of the problems related to glass slides, in particular those related to their fragility and uniqueness. Being copies of the complete slide, when used with diagnostic aims they also overcome the limitations occurring static telepathology, namely the sampling problem with its consequences in terms of confidence and trust. However, digital slides are very large (hundreds of MB) and manageable with difficulty. In the last very few years, some papers appeared that firstly proposed the digital slide technology (1), and then started to preliminary evaluate it (2,3). In the present paper we report on our preliminary evaluations made to test the diagnostic validity of digital slides.
Material and methods: Two digital slide acquisition and visualisation systems have been developed in Udine and Trento: the former is based on a low cost Olympus microscope with Prior Optiscan motorised stage, while the second is based on a Leica microscope. Both software systems were locally developed. The viewer is a combination of HTML, CSS and Javascript, and is accessedd through a web browser. The systems were used for acquiring a number of digital slides, from which seven have been selected for a trial occurred during the Intl. Academy of Pathology Spring Meeting, held in Trieste, Italy, May 2003. Cases have been diagnosed by 14 volunteers, for a total of 28 diagnoses.
Results: Diagnoses rendered by the users were compared with the gold standard. Case B, C, F and G were misdiagnosed once; case E was misdiagnosed twice. An overall diagnostic accuracy of 77% was obtained. Four out of 6 non concordant diagnoses (on cases B, C, E and twice case E) were rendered by residents in Pathology. Cases F and G were annotated as inadequate by users which misdiagnosed them. Viewing time depends as expected on case size, so is higher for cytologic samples and in general higher than on microscope. It seems also that the user interface is used differently for cytology in respect to histology, due to the different underlying pattern of observation.
Image quality was scored positively in the 80% of cases (12% neutral; 8% negative); user interface was scored positive in 88% of cases. Overall satisfaction of the users was good.
Discussion: Digital slides seems to be adequate for diagnostic uses, as diagnostic failures depended mainly on expertise. As the time needed for diagnosis is higher than at the microscope, the method is not adequate for urgent rendering of diagnosis, although it could be good for any other use, including digital quality control as proposed in (4). A set of digital slides is available on the Web at http://www.telemed.uniud.it/eslides/.
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EXPRESSIONARY DATA FROM TISSUE MICROARRAY EXPERIMENTS: ANALYSIS AND GRAPHICAL REPRESENTATION

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Introduction

Large scale experiments may take advantage from technological support in gathering and handling data to enhance reliable further data analysis. Data quality is definitely a crucial issue. To address these purposes we designed and constructed an integrated web system (bioinfo.itc.it/TMA) to handle Tissue Microarray (TMA) data experiments [1,2], exploiting digital pathology [3] to automate data collection. Our efforts are now voted to data analysis. We present two TMA datasets highlighting two different aspects related to TMA experiments approach: i. investigations on a set of about 10 markers on ovary dataset, aimed both to analyse ovarian gene profiles and intra-markers correlations and to improve the predicting power of the prognostic model; ii. analysis of automated evaluation of expression of immunohistochemical markers in a series of breast carcinoma cases compared to pathologist's evaluation and survival.

Material and methods

The first dataset is composed by 126 ovarian cancers (82 serous papillary, 12 endometrioid, 13 clear cell, 13 indifferentiated, 6 mucinous) and by a set of immunohistochemical markers. Descriptive analysis of the expressionary dataset was performed using graphical heat map and hierarchical agglomerative clustering. The second dataset is made by 158 breast cancers stained with Herceptest®, evaluated both by pathologists and by the image analysis procedure. All the data have been collected through our web system.

Results

We identified a set of prognostically significant markers for ovarian cancer. We qualitatively analysed sample similarities on the basis of their gene patterns, looking at the natural groups identified by the clustering algorithm. Automated analysis values on breast cancers were correlated with the pathologists' readings and allowed to stratify patients with different survival.

Discussion

The integrated web system linked to the automatic acquisition environment allows efficient and reliable data collection for TMA experiments. In particular it enhances inter-institutes collaboration and automated data collection, which speeds up experiments and minimizes errors. TMA allows to evaluate and identify in a relatively short time marker sets with prognostic significance. Objectivity and continuous nature of automated evaluation of immunohistochemical markers suggest their massive usage in expressionary studies.

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UICC TELEPATHOLOGY CONSULTATION CENTRE - AN UPDATE

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The morphological diagnosis of tumor specimens with precise tumor typing, staging and grading remains the basis of almost all cancer treatments. Thus, for each tumor case, a histological diagnosis of the highest quality should be the physician's priority. In approx. 10-20% of tumor cases, diagnostic uncertainty remains to some degree, requiring a second opinion in determining the biological behavior , the histogenesis, the grade of dedifferentiation or any other parameter. Facilitating the communication between pathologists and the exchange of cases, telepathology gains more and more importance. To benefit from this technical development, the International Union Against Cancer (UICC) has decided to establish a Telepathology Consultation Center (UICC-TPCC) for interested pathologists around the world. The UICC-TPCC is officially based at the Institute of Pathology, Charité, Berlin.

MATERIAL AND METHODS:
The UICC-TPCC telepathology service is offered via Internet and mediates between the requesting pathologist and the international experts elected by the UICC. Technical speaking the software based on a 3-tier-architecture with a presentation layer, a business and data layer. At the backend a Microsoft SQL-Server is responsible to storage all case, user and communication data. In the middle tier the Microsoft Internet Information Server handles the business and formulary logic programmed with the language ASP (Active Server Pages). The client uses only a normal web browser like Internet Explorer or Netscape 6 to process and present HTML and JavaScript.

RESULTS:
Using telepathology it is possible to provide rapid and inexpensive diagnostic aid to every pathologist in the different places. The TPCC is offering world-wide the possibility to get a second opinion in accordance with the UICC-TNM and WHO-standards.
From 2000 (start of the service) up to now about 700 cases were processed in the Center. During the year 2003 about 255 cases were sent to the UICC Telepathology Consultation Center (21,5 cases per month). On the average the response time was 48 hours. Most frequent topics of these cases were general pathology (98 cases), gynecological pathology (21 cases), soft tissue tumors (20 cases), lung and pleura pathology (30 cases), breast pathology (24 cases) and cytopathology (17 cases). 39 cases were so called „cito"- cases. The expert advice was in 95% within 24 hours.

CONCLUSIONS:
We have positive experiences using telepathology for the solution of diagnostic problems. It is technically possible to offer a second opinion under all circumstances and to perform long distance telediagnoses.
The future development is focused on
1. Improvement of the collaboration with the iPath-Server to exchange the cases.
2. Improvement of the communication process between experts and requesting pathologists.
3. Preparation of the database to enable the cases for other purposes such education.
These results emphasize the importance and value of the telepathology consultation systems.

VIRTUAL MICROSCOPY IN ROUTINE PATHOLOGY

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Due to recent technical developments it becomes more and more feasible to digitalize histological images without any loss of quality. This opens the possibility of new approaches to the organisation of pathology institutes. For this VM has to be integrated into the digital workflow of the institute and the hospital with the aim of an

- improvement of functionality,
- increased efficiency in the diagnostic work,
- all cases, data and slides are always available,
- reduction of costs,
- facilitated archive and documentation,
- ransparency of the diagnostic procedure and
- continuous quality assurance.

Materials and methods: A scalable high-performance RAID storage server which offers 1 TB of disk space on 14 Fibre Channel hard disks from IBM (TotalStorage FAStT600) was employed to store virtual slides. It was attached to an Intel based file server running Windows 2000 Server using two 2 Gb Fibre Channel interfaces. An LTO Ultrium2 Tape Library from IBM (ULT3582) was used for backup. Images were acquired with the HI-SCOPE full slide scanner from 3DHistech, Budapest, Hungary, which scans at a spatial resolution of 0.314 mm/pixel taking hundreds of sub images at a size of 1024 x 768 pixels with a digital camera and a 20x objective. The scanning unit is controlled by the HI-SCOPE software from 3DHistech running under Windows XP on a standard Intel based PC. The scanner passes the virtual slides to the storage server over a dedicated Fast Ethernet network connection.

Virtual slides are viewed by the pathologist using an Intel based 3 GHz IntelliStation M Pro workstation from IBM with 1 GB of RAM. It is equipped with a T221 22.2 inch flat panel monitor with 3840 x 2400 pixels (9.2 Mio pixels) from IBM yielding a screen resolution of 200 dpi. It is possible to display an area of 1.2 x 0.75 mm2 on the flat screen at highest magnification, i.e., a complete biopsy, offering a field of view (FOV) which is more than five times larger compared to the FOV of a standard microscope.

Results: The workflow under current development is described in Fig. 1. It could be shown that the system allows

- speeding up of the diagnostic process,
- simplified coordination of overview and magnified sector (detail image),
- continuous zoom,
- annotations on any microscopic level,
- multilayer visualization, e.g., for immuno histochemistry or in-situ hybridization,
- image analysis during diagnostic work,
- track history, and
- automated documentation

Conclusions: The newly developed workflow was functioning appropriately and could be the basis of a reorganization of the diagnostic process. In the near future some improvements will become reality which will facilitate the introduction even more:

Technical:

- faster connections, e.g. nationwide or gloal ATM networks, ultra rapid satellite systems
- higher resolution of the images
- image database improvement (advanced PACS)
- wireless transmission and faster scanning procedures

Conceptual:

- closer link between surgery and pathology in daily work for a better treatment of patients
- Histological diagnoses should be reviewed by a second pathologist much more often

IMAGE AND VIDEO CODING FOR TELEMEDICAL SERVICES

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Nowadays, image data coding is a key component of multimedia communication and storage systems, and in particular medical multimedia communication and storage systems. Many types of medical data are stored as digital images, monochrome, color or multi-component. For the sake of brevity, here, we focus our attention on continuous-tone images and video captured and digitized by use of some electronic equipment.

The goal of the paper is to give a state-of-art in compression and representation techniques that have been very improved during last decade. Currently, some revolution is taking place in digital multimedia communication, and it is influencing also medical imaging.

Here, three main aspects are:

- Lossless (reversible) still image coding. The original data can be restored from the coded representation with no loss of data.
- Lossy (irreversible) still image coding. Decoded images only approximate the original ones. There is a tradeoff between the quality and fidelity of the restored images and compression ratio measured for the compressed representation.
- Video coding. It is mostly irreversible coding of moving pictures including 3-D (stereoscopic) ones. Here, we skip the technological details but we concentrate on application aspects of the technology considered. Thus we deal with modern compression standards and their applications within medical electronics. The standards exploit work of hundreds of researchers around the world and they often define optimum or near optimum solutions trading off compression efficiency against implementation complexity and flexibility related to various applications. Standards are an asset for the industry but they also serve as reference for further research. On the other hand, it is an extremely challenging task to improve on existing standards that are optimized by hundreds of research man-months

The three major modern standards considered are:

- JPEG-LS,
- JPEG 2000,
- AVC,

for the three main topics mentined earlier.

TELEMEDICINE NETWORK IN THE EUREGIO POMERANIA

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In the euro-region Pomerania a large tele-medical network has been set up between five hospitals over the last two years. Under the responsibility of the *"Tumor Center of Vorpommern"* the University Hospital in Greifswald, the Hanse-Klinikum Stralsund, the Sana Hospital Bergen, the Asklepios Clinic in Pasewalk and the Diakoniewerk in Ueckermünde were joined together. Between these affiliated facilities digitalized clinical images can be transfered and exchanged without any loss of quality by tele-radiology. These X-ray images can further more be discussed by the medical experts using a video conference modul, which is also installed on all locations.
Following the motto: *"Let travel clinical data – not the patients"* an interdiscipline tumor conferences should be carried out supported by the new technical infrastructure. Also in remote areas - like Vorpommern - the patient can benefit from the knowledge of specialized medical centers often far a way.
For the further improvement of the tumor care a *tele-pathology-network* was also set up.
Between the following locations - having their own institutes of pathology - in Greifswald, Stralsund and Pasewalk the Carl Zeiss tele-pathology-system was installed. Doing so, digitalized images of the tissue specimen can be transferred to the remote PC-based reporting system. The integrated lighting manager of the microscope Axioplan 2™ automatically provides an optimum lighting of the specimen. X-, y-position and the enlargement are remotely controlled over a 6 to 8 channel ISDN telephone line.

A guidelines oriented medicine which is increasingly demanding a "Second opion", e.g. for the mamma diagnostics, can use telemedical technology. Small pathological institutes with only one pathologist use this telemedical technology to obtain the "Second opion" from far a way.
The hospital in Bergen has no own pathological institute at all. To provide this kind of diagnosis during operation present day the specimen of tissue is send to an other hospital by courier (e.g. taxi). Using this tele-pathology-system in collaboration with the pathological institute in Greifswald or Stralsund the same diagnosis can be made much faster and often during the same operation.

The tele-medical network introduced here was financed by the Pomerania, involving money from the EU, und the Land Mecklenburg-Vorpommern. The planing and technical support of the network is done by the institute of applied informatics e. V. at the University of Applied Sciences in Stralsund.

AUTOMATED CLASSIFICATION OF GASTRIC BIOPSY SAMPLES USING HIGH-LEVEL STRUCTURE DETECTION ON VIRTUAL SLIDE

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BACKGROUND: Digital slides and virtual microscopy was shown to be alternative techniques for routine gastric biopsy specimen analysis. Image analysis techniques should support the automated, quantitative, reproducible classification of digital slides into major histological diagnostic groups.
AIMS OF THE STUDY: Development of automated algorithms for detecting cell nucleus, glands, and surface epithelium on gastric slides.
MATERIALS AND METHODS: From routine chronic gastric well oriented mucosal biopsy, histological material 3 healthy, 17 gastritis and 7 adenocarcinoma (tubular histological pattern by WHO classifaction), H/E stained routine sections were selected. Using the Hi-Scope slide digitiser system, digitalization was performed. In C++ automatic histological evaluation modules were developed. Altogether 36 parameters described the area, cell density, cellular characteristics of the basic tissue components: the surface epithelium, the glands, the muscle and connective tissue and the inflammatory cell compartment in the biopsy. In each compartment the cell morphometric features were calculated, as well. Area ratios of the different tissue compartments (biopsy area to epithelia, gland, connective tissue area, epithelium to connective tissue, epithelium to muscle tissue, epithelium to glands, epithelium and glands to non epithelial tissue) were also calculated.
RESULTS: Significant differences were found between the ratios of the biopsy/gland area(4.68+1.65 in normal, 4.04+1.05 in gastritis, and 67.5+48.5 in Adenocarcinoma ($p<0.05$)), and in the biopsy/connective tissue area (4.4+3.9, 1.73+0.37, 2.75+1.32, $p<0.05$). Significant difference were also found in the ratio of cell numbers in the different cell compartments (5.65+2.65 in healthy,16.7+7.4 gastritis, 180.1,+114.2 adenocarcinoma $p<0.01$).
CONCLUSIONS: This preliminary study proved that the development and evaluation of quantitative tissuemetric features can be used in the automated classification of histological gastric biopsy specimen.

WORKING WITH VIRTUAL SLIDES: DICOM-3 AS A STANDARD IN PATHOLOGY IMAGES

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Aims: We have evaluated four commercial solutions and prototypes of virtual slides in order to integrate pathology images in the Picture Archiving and Communicating System (PACS) that SESCAM (Health Service in Castilla La Mancha, Spain) is implementing in every hospital of our region.

Methods: Four systems have been evaluated until now by direct observation (Bacus BLISS, Nikon Coolscope with EclipseNet Virtual Slide) and specifications and files received from the manufacturer (Aperio ScanScope, LifeSpan BioSciences)

Results: All evaluated systems were able to generate JPEG or JPEG 2000 standard files. The virtual slides in those formats can be dicomized to be stored in the hospital PACS system and are also be accessible from any medical workstation with standard DICOM viewer.

Conclusions: The most comfortable format for large volumes of virtual slides is JPEG 2000, that allow for a significant reduction of the amount of space necessary for each slide and it also permits an easy integration with PACS.
We are also integrated these standard images with the platform of the 7th Spanish-American Virtual Congress of Pathology, to be held in 2005.

THE TMAS-EXPLORER PLATFORM : AN INTEGRATED TOOL INCLUDING A VIRTUAL TMA CONCEPT

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The TMAs-Explorer platform is an integrated data basis and knowledge platform for TMA management, development, analysis, validation and interpretation. This prototype platform includes facilities for management of patient and clinical data bases and related informations on corresponding tissue blocs and histological materiel, microscopic images acquisition and analysis, virtual slides navigation and interactive annotations according to pathology ontology, focus on areas of interest and documentation by their respective proliferating indices, specific request facilities for virtual TMAs conception, multiple tumour markers TMAs image analyses and marker quantification, quality control tools integration and finally data mining processes for extraction of pertinent information and virtual TMA viewing.

The virtual TMA concept : a strategy sampling procedure, is used to demonstrate the influence of core sampling (size/location) during TMA construction. Based on the hypothesis of clonal heterogeneity of tumours and corresponding differential proliferating status, a sampling strategy involving anatomopathological annotations, tissue architecture and proliferating activity indices (coefficient and kinetics of proliferation) is proposed. Cellular sociology features will be presented with both biological meaning and quality control powers.

Tissue data basis: colon cancer cases were collected at the CRLCC (Montpellier-France) and documented by patient, clinical, biological and anatomopathological data.

Anatomo-pathological annotations: a first section was HES stained, scanned at low magnification, images were stored and annotated according to the colon cancer pathology ontology implemented in the TMA-Explorer platform. One to 5 areas of special interest were delineated for each case and specifically annotated.

Proliferating indices: a second section was Ki67-AgNORs double-stained. Areas of interest previously defined were scanned at high magnification (X40) using the AcCell™system (SAMBA technologies) : 40 to 450 fields were acquired for each area. Proliferating cells were detected by Ki67 immuno-labelling and their relative cell cycle kinetics parameters were estimated

Results: The TMAs-Explorer platform will be presented. The annotation module based on virtual slide concept and using an ontology of colon cancer pathology will be demonstrated. The virtual TMA concept will be illustrated by simulations of sampling strategies for TMA construction, results will be discussed on a practical point of view. Including data related to cellular sociology of proliferating cells will be emphasized. Finally, we will discuss on quality control protocols for evaluation of tumour heterogeneity within the depth of the TMA samples.

Granted by: "La ligue Contre le Cancer, Comité de Savoie, France" and the Bioinformactis inter-EPST program, CNRS, France

TEACHING WITH VIRTUAL SLIDES

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URL:
The virtual microscope vMic can be assessed at:
vmic.unibas.ch

Introduction:
Up to now, authors of webbased learning materials have forced the learner to non-explorative behavior by presenting predefined cutouts from large images. The cause of this unsatisfying approach lies in the amount of data (i.e. up to 130 Gigabyte for a histological slide). Such mass of data can neither be handled by most clients nor transmitted with reasonable transfer times via the WWW. We have developed a virtual slide system (VSS) vMic that handles the integration of huge images up to 260'000 by 160'000 pixel and more in WWW applications.

Materials and Methods:
The slides are scanned at a magnification of 400x to obtain maximal image quality using a Zeiss Axioskop microscope with a motorized stage and the Zeiss AxioCam HRc video camera at a resolution of 1300x1030 pixel. Images are postprocessed with Photoshop 7.0.

Applications:
The vMic has been used for various teaching purposes:
1. As a component of an online histopathology course for medical students (Basel, 2003)
2. In a "virtual pathology" laboratory for dentistry students (Basel, 2003)
3. Virtual slides in addition to conventional slides for a seminar on melanocytic tumors (Paris, 2003)
4. Virtual slides for a seminar on kidney-transplant pathology (Rostock, 2004)

Opinions of the first users:
The students and the participants of slide seminars were asked to fill in an online questionnaire about vMic. Overall most users rated the quality of virtual slides equal or even superior to real slides. Whereas some pathologists found it more difficult to make a diagnosis with virtual slides a few students indicated the contrary. This unequal impression may be explained by the highly different degree of experience of the two user groups with the two forms of microscopy.

Conclusions:
Acceptance of the new technology among the first users is good and will steadily improve with increasing experience and decreasing download times. Commercially available devices for rapid slide acquisition announced to be available soon will allow a more widespread use of virtual slides not only in education but also in tele-diagnosis and research

DEVELOPMENT AND EVALUATION OF THE DIGITAL HISTOLOGY LABORATORY IN ROUTINE WORKFLOW

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Background: Similar to the digital radiology technology, important evolution can be observed in light microscopic slide scanning. New data storage technology can supply this developmental process and application of digital histology laboratory techniques. The aim of the study is to evaluate this technology in a routine setting.

Methods: In the daily routine practice in a university pathology department 100 to 300 slides were prepared from 50 to 150 cases in a day. From the usual paraffin blocks 5 m sections were prepared and automatically processed. The series of bar coded slides were scanned than stored on a digital slide server. Commercial short term and long term storage systems were applied. The evaluation of the slides was performed via local and remote access. An Internet based teleconsultation service was also included. For specific tissue types (colon, gastric) automated tissue component segmentation and analysis modules were developed. For the 3D reconstruction of serial sections a dedicated program was developed.

Results: Using optimal scanning speed the daily prepared slides(100-200 pcs) could be scanned in the night. The virtual microscopy analysis provides concordant results with the optical microscopy analysis. Outside observers may perform their diagnostic evaluations through Internet access. Teleconsultation based on digital slides and virtual microscopy was applicable in selected cases. The automated algorithms could classify gastric biopsy specimen cases with high accuracy (95%). 3D reconstruction yielded a more detailed insight and diagnosis. Reports including the low resolution digital slide image, high resolution selected field of views, alphabetical report were mailed in e-mail to the referring specialists in higher safety and speed as compared to the traditional way.

Conclusions: The digital histology laboratory technology helps the specialization in pathology allowing remote access to selected tissue types of various diagnostic entity and increase remote repoting's safety and efficiency. This enables cyber corps specialists to collaborate in global extension.

POTENCY OF DIGITAL PATHOLOGY IN HUNGARY

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AIMS: Computer and telecommunication technology has been accepted by Hungarian pathologists in the last decade. Progress of human attitude relating to new digital systems depends on more factors as simplicity, accessibility, cost and equality with traditional microscopy practice (TMP). Hence, TMP is considered rigorously for gold standard in diverse regions of histopathology as telepathology consultation, panel discussions, histopathology training and remote reporting. Degree of human acceptance strongly depends on progress of technology applications which revealed ***in four decisive phase*** in Hungary . Aim of presentation is to summary the state of digital pathology and lessons we have obtained.

METHODS: In the first phase static image transfer has been realised using traditional telephone line and file transfer protocol followed by sending email graphic attachments via Internet. Second phase contained dynamic telepathology using videconference of H.320 standard and ISDN connection. Third phase included point-to-point static image consultation via ISDN line using dedicated software (Samba 7.05) and hardware (Matrox Meteor board) systems. In the fourth phase digital slide technology has been presented with special aspects to realisation of digital histopathology laboratory.

RESULTS: 1. E-mail attachment static TP via Internet proved spontaneously disseminated method among pathologists, but systematic documentation about discussion results lacks. 2. Videoconference consultation has proven useful in pilot studies but network initiatives seeked of more sophisticated tools to propagate telepathology in wider extension. 3. Dedicated static TP station have been installed in three university centre and six hospital division joining different country regions in frame of BEPRO project. Although acceptance of complex TP systems was high during the project, following this term no spontaneous usage in routine can be verified. 4. Although high contentment could be perceived during presentation and tryout of unbiased electronic slide diagnostics, no comprehensive evaluations in the routine practice are available. However, initiatives beyond histopathology practice e.g. in area of anatomy, forensic pathology and experimental pharmacology appared which may help to access and apply better technology in histopathology per se.

CONCLUSION: Factors defining wide acceptance and practical use of diverse digital tools in histopathology routine are the nex ones: efficiency, efficacy, specificity and sensibility on one side; accessibility, cost and satisfaction at large on other one. Work-flow of traditional histopathology applications provides with gold standard for these evaluations. New agenda for expert discussions, consultations, archiving, education and quality assurance will be realised by perfect way of electronic simulation of traditional histopathology routine in Hungary as well.

THE PATHOLOGIST AND THE ELECTRONIC HEALTH RECORD

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The challenging aim of the Electronic Health Record (EHR) is to gather, together at the same place, in the same time and as quickly as possible current and previous medical data, including images, coming from several experts. Nowadays, it is easy to produce images and to transmit them to a remote site. As a matter of fact, pathologists are clearly moving from laboratory image databases and point to point telepathology systems to wide image communication systems meant to be integrated into the workflow of the Healthcare Enterprise and to enrich the EHR.

The requirements for such an image communication system encompass the quality of image and the speed of transmission, the preservation of data and the confidentiality of information. In addition, new imaging stations offer solutions for interactive communication and knowledge management.

1) Image representativeness: imaging stations produce dynamic images (interactive remote microscopy) or large static images (virtual slides), and make possible for pathologists to store and send relevant fields.

2) Duration of production: robotic microscopes facilitate the tedious process of image selection.

3) Waiting period for answer: the use of image compression algorithms (wavelets), java support for microscope remote control and/or navigation in virtual slides reduces the period to an acceptable level.

4) Knowledge management: imaging stations include controlled vocabulary (ADICAP, SNOMED, etc) and classifiers relying on teleconsensus methods and/or image analysis.

5) Collaborative work: computerized collaborative tools are more and more available in viewing stations (telecursor function, multiobserver textual or audio annotations, instant messaging, chat discussion, remote control of different functions etc).

6) Interoperability: standardisation in the field imaging has been covered by the HL7 and DICOM standards.

For the practice of pathology, imaging stations should have the following features:

1) The technology must make information exchange and processing by computers easy

2) The station must include a medical imaging workflow model using well performing and semantically rich standards, such as DICOM or HL7.

Such stations will be useful in initial diagnosis to enrich the EHR with pathological reports in which critical diagnostic features shown by images can be stressed unambiguously by the pathologists. They also will facilitate referral to a specialised pathologist, as well as teaching, quality insurance, image distribution and feedback, or consensus diagnosis for pathological reviews on purpose of clinical trials.

XML TOOLS IN IPATH FOR INTERINSTITUTIONAL PATIENT RECORDS IN BREAST CANCER MANAGEMENT

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Aims: For integrated health services as disease management programmes a thorough patient data management independent of the genuine hospital and department information systems is vital. Each medical actor in such systems needs tailored and immediate access to diagnosis, treatment and outcome data of patients under his responsibility. For scientific and administrative evaluation the information has also to be proveded currently. A recent web-based telepathology system iPath is also offering tools for establishing and using such a patient record for a regional breast cancer center.

Methods: Users of iPath may write own HTML forms for recording all the structured information necessary for a breast cancer unit. The content of those forms is stored via XML in twodimensional matrices in the servers database, which can be downloaded as plain text files by the users. Together with the forms any other textural and pictorial information can be stored patient-oriented, too.

Results: The iPath functionality ensures the authorized access to and the integrity of patient data. Because only Internet connections are used, the patients have been anonymized. Each of five specialties in the breast center uses specific forms, in total 11, according the minimum requirements defined by the German Cancer Society. Until now data from 239 patients have been feeded into the database. By means of MS EXCEL or MS ACCESS the database is regularly evaluated both for individual patient reporting and for scientific and administrative evaluation.

Conclusions: The present iPath solution offers an optimal test bed for the medical content of the patient record. It is not yet the solution for wide practical use. The XML syntax needs standards, e.g. CDA (Clinical Document Architecture) for a full platform independent and interoperable application in the daily practice.

THE VIRTUAL INSTITUTE OF PATHOLOGY AS AN ORGANIZATIONAL STRUCTURE FOR DIAGNOSTIC AND CONSULTATIVE STATIC TELEPATHOLOGY

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Aim: After several years of practice in static telepathology with partners not highly experienced in pathology it has become evident that a routine use needs clear regulations for workflow and responsibility of the diagnostic and consultative process. If telepathology goes beyond private enthusiasm of partners, the requester (non-expert) has to rely on the competence and responsibility of the expert. The AFIP as well as the UICC have institutionalised that relationship for some years. A grass-root initiative as iPath users should (and can) adapt that principle, too.
Methods: A virtual institute of pathology (VIRIN) is formed by an expert group backed by specific iPath functionalities, allowing to organize a routine diagnostic service for one or more referring hospitals.
Results: In a field test with a third world hospital on Solomon Islands, comprising a total of 148 cases, the efficacy of diagnostic telepathology could be investigated for different models in technical communication levels and organization of experts. A significant acceleration in the diagnostic process has been achieved, providing the referring surgeons with a provisional diagnosis within 25 hours and a final diagnosis within 54 hours. The diagnostic security has been increased leaving only 13% of the cases with an unconclusive diagnosis.
Conclusions: The organizational principles of an institute, with regularly two experienced pathologists on duty 24 hours a day, and further pathologists ready for consultation, also in highly specific diagnostic problems, provides the referring hospital with the same level of reliabilitity of service as a institute for pathology in the real world. The experts of VIRIN are pathologists from several countries, some of them pensioners, working voluntarily in a joint effort for helping third world medical staff to help themselves.

ELECTRONIC AUTOMATED MORPHOMETRY USER SYSTEM (EAMUS) CONCEPT AND FIRST RESULTS

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Aims: To establish an automated and self-controlling internet-based morphometry system focusing on ligand and immunohistochemistry.
Theoretical Considerations: Image information in light microscopy diagnosis is based upon recognition and classification of intensity (colour and grey value) independent and dependent objects and textures. Intensity measurements of histological slides focus on immune/ligand histochemistry and in situ hybridisation techniques, and can be grouped into nuclear, cytoplasm, and membrane staining. The staining detection system requires information about the applied chromogens, the magnification of the images (calibration), the expected kind of information, and the output format. By use of self-control algorithms, which check each significant program step for potential errors, an automated measurement system has been developed, which fulfils the following conditions:
a) On-line access via platform-independent internet entry;
b) Off-line access via platform independent case/image submission (CD)
c) Transfer of submitted data to a specific measurement system
d) On-line and self controlling measurements
e) Resubmission of measurement results to the entry server
f) Transfer of results via email to the client.
The measurement systems provides analysis of DAB/AP, etc. stained and fluorescence images (FITC, DAPI, Texas Red) for stereology (low magnification), nuclear stains (MIB, etc.), membrane stains (Herceptin etc.), cytoplasm stains (galectins, etc.), and vascularization. On request, syntactic structure analysis data will be given (for higher magnification). It can be used for individual based (patient oriented) and experimental based (series of identical requests). The output format is adjusted according to the wishes of the client.
Implementation and first results: The system has been implemented on an internet server, which provides and regulates the internet communication and standardization. It transfers the images and necessary data to a measurement computer. The measurement computer screens for transmitted images and data, performs the measurements, and retransfers the results to the internet server. The internet sever retransforms the results into the final output format, and submits them to the client. First trials were successfully performed on 50 cases with various stains and measurement programs. The accuracy of object detection amounts to 95% even in inhomogeneous stained slides, the total performance time ranges from 5 – 20 minutes dependent upon the cycle time of screening.
Conclusions. EAMUS is a platform independent morphometry system which can be used for numerous applications without any specific training and performance knowledge. It works completely autonomous.

FUNCTION DATABASE: A USEFUL TOOL FOR OPTIMISING IMAGE-BASED RESEARCH DATA

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Aim: To develop research strategies to increase efficiency and objectivity of morphometric measurements in clinical trial.

Background: Quality assurance and control are of increasing significance in diagnostic and research pathology. Pathology institutes are requested to apply for certification and continuously perform internal diagnostic quality controls. Similar objectives are required for research trials. How to replace and optimise the common interactive and personnel intensive tasks?

Theoretical analysis and results of a clinical trial: Quality assurance and control require standard operating procedures (SOPs) which reiterate in predefined periods. These basic algorithms induce a homogenisation of the involved tissue preparation and diagnostic steps, and induce a contemporary performance of several identical steps. The same ideas should be applied for image analysis, especially for morphometry and diagnosis-related predictive parameters (for example proliferation, hormone or herceptin receptors). The consecutive analysis of the basic requirements result in a "function" database in homology to a conventional (image, address, etc.) structure. The "function database contains algorithms for image and related data analysis instead of raw image or patients' data. The principals of such a function database have been tested by clinical trial on carcinogenesis of colon-rectal cancer. Centrosomes of 76 biopsies have been investigated by immunofluorescence, and the number per cell has been measured. A strict separation of image acquiring, centrosome count, and statistical analysis was performed. This new algorithm induce a pivotal increase in efficiency, data reproducibility, and data objectivity in comparison to conventional manual/visual/interactive performance.

Conclusion: A "function" database is a useful tool for quality assurance tasks, conventional and virtual diagnostic pathology.

SAMPLING: THEORY AND PRACTICE

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Aims: To theoretically describe and obtain practical experiences in sampling focussing on virtual slide technology.
Theoretical Considerations: Sampling is the selection of individual events (objects, functions, structures, etc.) from a complete set of these events with the goal to derive properties from the selected items that are valid for the complete set. These properties can be spatial associations (for example detection of gold ores) or object associated (for example estimation of mean object size). Basically, two different sampling procedures exist: random and non-random (stratified) sampling. Each of the two can be divided into a passive and an active sampling. A specific kind of sampling is the functional sampling, i.e., the focus on rare events and the analysis of their environment. Random sampling is the selection of items by random, i.e., without any sampling strategy; stratified sampling the opposite. Passive sampling is the selection of items by use of a binary detection function (yes, no) without interaction between the sampling procedure and properties of the items. In active sampling properties of the items (staining intensity, location, etc.) influence the detection, i.e., we are dealing with a probability detection function (yes <> *{probable}* <> no). Passive sampling is appropriate for information acquisition from images that can be intensity-independently divided (segmented) into a foreground-background (object - non object). Active sampling procedures are required for intensity-dependent segmentation techniques, which are, for example required in immune/ligand histochemistry.
Practical applications: Spatial oriented (non-random, stratified) passive sampling can be used for the detection of slide areas, which are prone to posses diagnosis-relevant information (for example tumor cells). In a series of 55 cases application of stratified sampling could reduce the diagnosis evaluation time of transbronchial fine needle aspirations by about a factor three. A repeated performance of this procedure at different microscope magnifications will permit an automated selection of information-relevant slide areas close to that needed for final diagnosis without human interaction. Random active sampling is appropriate to adjusting the segmentation threshold in automated immune/ligand histochemistry, especially for the detection of "positive" areas within an image. It can also be used for the correction of spatial dependent staining artefacts. This procedure is implemented in the electronic automated morphometry user system eamus.de. The automated analysis of fluorescence and DAB/AP stained immune/ligand histochemistry still images within this program was based upon random active sampling and worked without failures in more than 600 images until now.
Perspectives: A well founded sampling theory is a useful tool for application of artificial intelligence (AI) systems in automated image information acquisition systems. It can contribute to a fast and reliable handling of virtual slides, morphometry applications and automated tissue - based diagnosis.

MATCHSLIDE: OPTIMIZING VIRTUAL SLIDE DATAFLOW

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Many applications in the field of diagnostic microscopy necessitate producing, archiving and sharing XXL images, i.e. Virtual Slides. We intended studying solutions for optimizing volume and handling of data's in the hypothesis of a long time archiving and of use both by human users (see TeleSLide and TRIDEM platforms) and by image analysis systems (see VideoCell abstract). We chose two different approaches for optimization: firstly, selecting region of interest digitized at adequate magnification and secondly optimizing the technical chain microscope/camera/data pre-treatment/data compression.
Achieving the first approach led us to define different magnification groups whose use will depend upon the specific application: screening (x2.5-x16), intermediate (x10-x40), high (x25-x100).
That approach needs defining a hierarchical organization of image data's and providing adequate digitizing and viewing software.

- Achieving the second approach led us to study following points:
- the kind of array to use (Color Filter Array -CFA or RVB-tri-CCD or monochrome CCD and multispectral lighting)
- CCD array pixel size
- CCD array size
- the Numerical Aperture (NA) of the microscope lens for a given magnification
- the demosaicing process when needed
- the mosaicing process
- the way of taking into account 3d data's: image stack or 2d extended depth of field image (see VideoCell)
- the compression process: jpg/jp2000 and jp2000 parameters
- process organization

Choices depend upon individual purpose. TRIBVN being involved in a low cost solution for general purpose Virtual Slide applications made following choices:

- Bayer CFA
- 7 micrometers per pixel as an optimum compromize between image quality (SNR) and resolution
- 2/3inches CCD
- .75x nominal NA (compromise between resolution, contrast and depth of field)
- an original demosaicing process which provides compression effectiveness
- mosaicing process program suited to low cost microscope technology
- 3d data transformed in 2d extended depth of field image previously to demosaicing and mosaicing
- using jp2000 as a master archive with suited parameters; however for efficient use, it becomes necessary to install JPIP application on the server side
- organizing processes as follows: 3d>2d when needed, mosaicing calculations, demosaicing and mosaic construction followed by jp2000 compression

Agreing upon Region of Interest definition strategy for each kind of slide and taking into account the whole chain from the sample to the end user allow sufficient optimization of virtual slide use for common purpose (second opinion, teaching, quality control, epidemiological database and automated image analysis) both for histology and cytology. New low price integrated motorized systems (including camera and telecom devices) make such uses even more opened.

VIDEOCELL: A TELECONSENSUAL APPROACH FOR CELL SEMIOLOGY AIMED AT DEVELOPING AUTOMATED CLASSIFICATION TOOLS; APPLICATION TO PERIPHERAL BLOOD CELLS

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Developing image analysis and cell classification tools necessitates an established image semiology in addition to an accepted set of morphological descriptors and sample images for each parameter value.

Semiological classification are generally available. However achieving unquestionable sample images needs a consensual process. This process can be easily handled using TeleSlide platform.

Next step involves agreeing upon morphological criteria which are convenient for describing all cells categories and providing samples images for each criterium value. For that purpose an additional tool has been added to the TeleSlide platform which allows image per image description through a dedicated grid. At the end of the description process by a group of experts, it becomes necessary to synthetize a single consensual opinion for each cell morphological description. Then a query to the image database allows making up sample image folders that will be used for fitting morphological algorithms to the specified cell category.

One time the set of algorithms has been developed, it will be necessary to compare human consensus to the machine answer using new set of evaluation images until achieving adequate convergence.

Studying some cells using high power objective (x40 to x100) extended depth information: as an example, this may be very useful for differentiating red cells inclusions from platelets. In those cases, it becomes necessary to digitize stacks of images acquired at different depth in the sample. Sharing those stacks needs a dedicated function which has been settled up on the TeleSlide platform: this function allows both individual image visualization at different depth in the sample and extended depth of field reconstruction on the server side using a number of individual planes selected by the user. As an application, this method allows an user group to agree upon an image acquisition strategy suited to cells analysis using 2d images rebuilt from 3d image stacks.

Such an approach providing consensual semiology and consensual morphological description of flat and 3d cells allows developing unquestionable automatic cell classification tools. It has been applied successfully to lymphocytes and erythrocytes classification from the peripheral blood.

TELESLIDE: A MULTIPURPOSE COLLABORATIVE PLATFORM DEDICATED TO MORPHOLOGICAL STUDIES

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Since 1996, (cyto)pathologists and haematologists shared scientific communications (histopathology seminars, case reports and posters) through CD or Internet. Both authoring tools for CD and Internet platforms have been developed thanks to the common exchange format (ADICAP), initially aimed at telepathology.
Recently, new series of services were asked for, like forum, quality assurance, therapeutic protocols, consensus protocols. For that reason TRIBVN which was in charge of previous publishing applications developed "teleslide.com" an integrated platform based upon the ADICAP document format.
TeleSlide platform works like a portal based upon a single database which handles: ADICAP document, users rights and users answers. However, this single database may have restricted areas dedicated to group of users and accessed through their own web site.
In addition to the initial ADICAP document format which handles mainly single images, series of objects can now be added to suit new users requirements: pdf documents, virtual slide (see MatchSlide abstract) and images stacks associated with extended depth of field module (see VideoCell abstract).
ages, series of objects can now be added to suit new users requirements: pdf documents, virtual slide (see MatchSlide abstract) and images stacks associated with extended depth of field module (see VideoCell abstract).
The **Publication** section contains all the data that are published toward the entire community. It is freely accessed without need of login. It contains previous histoseminars sessions and speciality club case reports since 1999.
Other sections need free subscription and sign in.
Case publisher allowing upload of textual data and images in accordance with the extended ADICAP format.
Forum allows any user creating a forum or participating to an existing forum. These forums which can be illustrated with ADICAP documents he owns
Protocols needs TRIBVN previous agreement. This section allows the implementation of any protocol associated with an answering grid: generally necessitated for assurance quality applications, vote sessions, therapeutic protocols or image semiology teleconsensus.
TeleSlide platform is used by main scientific societies in France for main applications in the field of histo and cytopathology, and cytohaematology. It is opened worldwide to all scientific societies. Key numbers are as follows: >500 users, >1300 ADICAP documents, >15 000 images and associated datashets, >100 virtual slides used mainly through therapeutic protocols, >10 protocols being in use yearly. Those information's are handled inside a single database which provides powerful search possibilities.

MULTIPLE CLASSIFIERS FOR LEARNING FROM PICTORIAL INFORMATION

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In this contribution, we present selected issues of machine learning, and relate them to medical diagnostic support, especially diagnosing based on pictorial data. Formally, the task of *classification* consists in assigning a decision class label (e.g., diagnosis) to an object (case) described by a fixed set of *attributes* (features). The knowledge required to solve such a task may be automatically acquired from data (*training data*) through learning from examples. Different learning algorithms can be applied to induce various forms of classification knowledge from provided learning examples. This knowledge can be successively used to classify new cases. In this sense, learning process results in *classification system* – shortly called *classifier*. Particular classifiers perform differently when faced with different learning tasks, so researchers are still looking for new approaches to improve the classification accuracy, i.e., a percentage of correctly classified testing examples.

Recently, growing interest has been observed in integrating different classifiers into one compound classification system and combining their predictions. Both theory and experimental evaluations confirm that the use of such *multiple classifiers* improves classification accuracy in many problems. In general, one can distinguish two categories of multiple classifiers: using either *homogeneous* or *heterogeneous* classifiers, called *base classifiers* in this context. In the first category, base classifiers of the same type are trained using different samples of the training data. In a case of heterogeneous classifiers, different base classifiers are applied to the same training data.

In the proposed approach, we consider combining multiple classifiers with reasoning from pictorial information. The problem one faces in such a case is the large amount of information that is carried over by a raster image. Thus, a 'raw' raster image cannot be fed directly into learning algorithm; a separate stage of visual *feature extraction* is required. In the proposed approach, base classifiers are trained on the same training data, but using different visual features. In particular, instead of fixing the visual features prior to learning, which is the most common approach, we propose the feature definitions to be learned semi-autonomously from training data. This provides diversification of features between particular base classifiers and enables potential improvement of predictive ability.

TELEPATHOLOGY IN SOUTH EAST ASIAN COUNTRIES: PAST, PRESENT AND FUTURE

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Introduction

Telepathology(TP) is more necessarily used in the process of patient management in South East Asian(SEA) countries in practical level. The virtual institute of pathology daily responses the surgical pathology service in 24 hours turn around time with free of charge and donation principle.

History

In 1996, in Bangkok, a first meeting on Telepathology between Thai and German Pathologists was initiated. This was followed by the foundation of DIAGAID in 2000 and the collaboration with I-Path in 2001. In 2002, the workgroup settled a TP Station and a histo-laboratory in Sihanouk Hospital Center of Hope in Pnompenh (Cambodia). And in 2003, a TP station was set at the Department of Pathology in the Medical Faculty in Vientiane (Laos). In recent January 2004, the first contacts to the Ministry of Health in Yangon, Myanmar, were started, meanwhile a Thai National Project of Telepathology was also created.

Present

More than 400 requests from non-experts were sent to I-Path Basel server from Vientiane and Pnompenh and were answered at least by 2 experts within 24 hours.

Within this time the concordance of primary diagnoses of non-experts to experts' final diagnoses increased from 70 to 80%. About 10% of complex requests could not be answered sufficiently by experts, mostly due to the poor image quality, complexity of the lesions and limited panel of staining.

Ranking the factors influencing the diagnostic quality, we found the slide quality is of major importance, followed by the competence of the non-experts in field selection and the technical facilities of minor importance.

Future

Quality of Telepathology in South East Asia will be increased by improvement of

1. technical facilities of histochemistry labs in Vientiane and Cambodia. Setting up the immunohistochemistry laboratory is being discussed.
2. experience of technicians by local training
3. experience of the local pathologists by training programs abroad
4. co-operation by workshops
5. extension of diagnostic networks to other medical institutions and to other fields of telemedicine.

New members, both consulting doctors and consultants, are welcome. We try to extend the usefulness of TP at practical level to more South East Asia countries. Higher technology would be updated in cost-effective consideration. More sincerely support will fill the gap of developed and developing nations in this world.

The first step may be done by The First South East Asia Workshop on Telepathology on January 11-12, 2005, in Bangkok.

DICOM INTERCHANGE FORMAT FOR PATHOLOGY

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The ADICAP de facto standard allows french pathologists using softwares from different makers to send each other and share pathological records. Admittedly, pathological pictures and reports have to be widely and easily available for diagnosis and care purpose. Moreover pathologists imaging stations must be able to communicate with each other and also with other parties of healthcare. Integrating the Healthcare Enterprise (IHE) is an ongoing project promoting the integration of healthcare systems. IHE defines a number of integration profiles, which are real-world situations that can be efficiently managed by careful implementation of international standards as DICOM or HL7.

IDEM is an Internet platform designed to ease collaborative work between pathologists. Within the IDEM platform, a DICOM component has been developed using Java and XML technologies allowing an imaging station to convert JPG images into a DICOM file according to the IHE "scheduled workflow" integration profile.

This DICOM file:

1) copes with both static pictures and virtual slides (wide field images),
2) includes all fields of the previously defined ADICAP de facto standard and
3) includes fields for demographic data and informations for the purpose of the study, to be searched for in the laboratory information system.

Using this module, virtual slides produced at the Georges Pompidou University Hospital may be stored into the PACS (Picture Archiving and Communication System) and available within the Electronic Health Record, by the use a web browser, as well as other images from the patient (computed radiology and tomography, ultrasonography, angiography, etc).

Our intention is to implement the DICOM structured report file in order to promote the exchange of pathological reports including images showing critical diagnostic features unambiguously indicated by the pathologists.

APPLICATIONS OF VIRTUAL MICROSCOPY IN PATHOLOGY: TELEPATHOLOGY, PATHOLOGY EDUCATION, PROFICIENCY TESTING

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The use of virtual microscopy for research purposes in our Department will be briefly reviewed. Several studies in the late 1990's validated the use of Virtual Microscopy, with "virtual slides" prepared using a high-resolution digital scanner and manual "stitching" of digital tiles with Photoshop software (Adobe, San Jose CA), for telepathology applications. Excellent concordance rates with routine microscopy were obtained in studies of melanocytic lesions, lung biopsies, gastrointestinal biopsies and heart biopsies from transplant patients. The technology offered consultants the ability to provide "off-line" diagnoses over the Internet, obviating the need for the use of costly "robotic microscopes"and for scheduling busy consultants for real-time interactions.

Virtual images prepared with this technology were used in the early 2000's to teach pathology to second year medical students at the UCLA School of Medicine. "Virtual Microscopy Laboratories" have replaced light microscopes in the pulmonary pathophysiology course of the School during the past 5 years and the results of various surveys of student satisfaction will be briefly described.

More recently, virtual images can be rapidly prepared with automated devices, such as the Bliss system (Bacus Laboratories Inc, Chicago IL), and ScanScope (Aperio Technologies). Virtual slides prepared with the Bliss system have been used for the presentation of slide seminars at post-graduate meetings. The virtual image viewer can be incorporated into Powerpoint presentations (Microsoft, Redmond WA) using Active X controls, allowing the teacher to demonstrate "virtual slides" using a computer and a video projector in a manner that closely simulates more traditional slides seminars presented with multiheaded light microscopes to a smaller audience.

Virtual slides prepared manually, as described above, and automatically with the device developed by Aperio Technologies have also been used in studies of proficiency testing for gynecologic cytopathology. Adequate concordance rates, measured with kappa statistics, were obtained with light microscopy.

Potential future applications of Virtual Microscopy in Pathology Education, research and routine pathology practice will be discussed.

THE ADICAP EXCHANGE PLATFORM : COMPUTING TOOLS SERVING PATHOLOGISTS NEEDS

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ADICAP is a French national organization which promotes the use of computing and data-processing techniques for pathologists and works on the elaboration and the diffusion of a Lesions Codified Standard.
CRIHAN is a regional computing resource center that manages supercomputers, high-speed networks and provides technical and scientific help to the academic community.
These two organizations combined their efforts to build a communication platform for pathologists:

- The ADICAP methodology and reference for coding the lesions is perfectly fitted for telepathology.
- Data files structured using the ADICAP file format are virtually vendor independent and can be exchanged between pathologists.
- New tools can be added according to the users needs.
- Network of experts in any type of pathology can easily take benefit of the ADICAP exchange platform for collaborative work, telediagnostic or coexpertise needs.
- The ADICAP platform and tools can be used to build a large collection of data for epidemiologic studies and for statistic use by national health organizations.

The multiple origins of the files which have been uploaded for many years on the platform attest the interoperability capabilities. The coexpertise requests take advantage of this functionality. Some hospitals recommend using this platform instead of mail exchanges in order to improve exchanges traceability.

The ADICAP codification is widely used by anatomopathologists, hematologists and cytologists. Its thesaurus is available on http:// www.adicap.asso.fr.

New tools to produce online standard reports will be soon available on the ADICAP server. An expert specialized in each pathology is in charge of writing the correspondent "bible" (references) wich will contain the basic elements in order to write standard reports. Then, to produce an online report, the user is guided within a multiple choice questionnaire. An effective help is linked, based on text and images examples.
These bibles are available for vendors interested in implementing such tools in their own products.
The platform is also dedicated to accept developments proposed by third party vendors: some examples are exposed during this congress (Matchslide, Teleslide, Videocell are implemented on the ADICAP platform hosted by CRIHAN).

Beside its global aims, the platform allows the creation of work-on expert groups. For instance, the thirty person expert group working on the definition of a protocol concerning acute leukaemias myéloides.

A program to collect national data is under development in France: it plans to rest on the ADICAP platform. CRIHAN has prepared a formal protocol to build a collection of data issued from laboratories, available for epidemiologic studies and that potentially answers the needs of national health organizations.

COMPUTER ASSISTED STANDARDIZED REPORT

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Clinicians, and namely, cancerologists and epidemiologists need standardized reports, to be sure the same names and codes are used for the same diagnostic entities.These standardized reports should also contribute to the elaboration of national programs for care evaluation and screening for tumours.

- The technical basis of the report is an interactive questionnaire developed using state of the art software technology and following the logical steps of histological interpretation.
- The different possible answers for any question are mutually exclusive.
- For every elected answer, a prewritten sentence takes place in the progressing report as well as a specific ADICAP code, which links to the following question.
- The pathologist must answer every question and can't avoid any of them.
- During some difficult steps of the elaboration of the report, the pathologist may use an online help system (comments and pictures about the diagnostic problem encountered)
- After the last question has been answered, a complete report is issued which can be modified if necessary before it is ratified, printed and put in the archives in accordance with the regulations of the department.

The questionnaire medical data is accessible free of charge. It may evolve and be modified either to fit the suggestions of the users or to insert the improvements or unavoidable changes in the nomenclature of diseases.

Codes used int the report are standardized by ADICAP (Association for the Development of computer use in Pathology, registered by the WHO) and are freely available on the web : http://wwww.adicap.asso.fr.

An online interactive tool has also been developed to generate the reports. It can be found on the ADICAP web site. Third-party software companies and vendors may develop their own tool using the questionnaire medical data.

In daily practice, for the working out of the Computer Assisted Standardized Report, every microscope must be coupled with a computer since the data for the report are collected at the same time that the histological examination is performed.

DICOM BASED PACS AND TELEPATHOLOGY INTEGRATED WITH PATHOLOGY LABORATORY INFORMATION SYSTEM USING INTERNET TECHNOLOGIES

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Institute of pathology and forensic medicine, Military Medical Academy, Belgrade, Serbia and Montenegro Pathology is one of the most computer intensive areas of medicine and as a result diagnostic pathologists in histopathology have often been at the cutting edge of computer literacy. Our Institute use pathology laboratory information system to issue and store pathology reports since the beginning of the current year. These systems provide the diagnostician with the ability to retrieve reports and cases using coding systems such as SNOMED and ICD. System is based on advances in computer technology in recent years which are beginning to find their way into the reporting room. Rich experience in practicing telepathology for many years are offer us possibilities to start developing more advanced computer system that might assist the pathologist in the diagnosis or interpretation of a case.

Use of a web technologies enable easy incorporation of the multimedia (images, sound video, virtual reality) and are therefore ideal for an image intensive specialty such as histopathology. Fundamental to Internet-technologies is the ability to link resources together on disparate servers using hypertext. This minimizes duplication of data and resources, allows each resource to be maintained and updated by those responsible for them and reduces the need for central data storage.

At MMA, Belgrade, we have been developed and implemented a Picture Archival and Communicating System (PACS) integrated with Pathology Information System (PIS) and Hospital Information System (HIS). Two immediate issues conforming the building of medical image database systems are: lack of supporting infrastructure and inability to index images by context. To circumvent these problems, the evolutionary medical image database system being implemented at our PIS is based on a three-tiered client-server architecture: client medical workstations, database application servers, and a hospital-integrated picture archiving and communication system. PACS - viewer, acquisition console and report are a World Wide Web (WWW) clients for the Image Engine. PACS clients use advanced DHTML features such as frames, forms, tables and inline DICOM image display to provide an easy to use system for retrieving and viewing diagnostic images and reports generated by clinical procedures such as surgical pathology, radiology and gastrointestinal endoscopy. PACS client implements a number of WWW client-side features, such as DHTML forms data entry verification and makes extensive use of the ASP programming language. The PACS system uses a number of approaches for ensuring the confidentiality and security of patient data transmitted over the Internet.

Finally, this integrated system is telepathology (telemedicine) ready and easy for use. Respecting a principles of DICOM structured reporting this system is enabled for automatic generation of telepathology (telemedicine) requests with all clinically significant datas and images using a PACS clients. These clients also can be used by teleconsultant experts for viewing images and datas and generating reports in a form of DICOM teleconsultation amendments.

IRANIAN AND GERMAN EXPERIENCE IN TELEPATHOLOGY: COMPARISON OF UICC-TPCC AND IPATH BY APPLICATION OF INNOVATIVE SCORING SYSTEMS

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Background: Teleconsultation in diagnostic pathology performed by digital imaging is not yet fully accepted as a routine way of quality assurance of problematic cases in Iran. We established a systematic approach for teleconsultation of difficult cases in order to analyze the performance of available systems and to demonstrate the usefulness for routine diagnostic pathology. In addition, specific telepathology conditions in Iran and in Germany have been investigated.

Material and Methods: A total of 80 cases encompassing a wide variety of diseases were selected from Pathology Department, Kerman University, Kerman, Iran (40 cases) and Institute of Pathology, Charite, Berlin (40 cases) between May 5th 2003 and 3rd October 2003. Identical image sets of the included cases were contemporarily sent to the telepathology consultation center of the Union contre le Cancre (UICC-TPCC, Berlin) uicc-tpcc.org and iPath platform installed at the Institute of Pathology, University of Basel, Switzerland telepath.patho.unibas.ch. Time needs for image acquisition, image transfer, and reply of comments were measured following the central European time (CET). An innovative scoring system scaling the distance between primary and the expert's diagnoses was applied. In addition, the level of difficulty and uncertainty of the primary diagnosis was recorded. The performance between the two systems was scaled from Berlin and Kerman.

Results: The image acquisition time was comparable for the Berlin and Kerman cases in contrast to the image submission time, which was substantially lower for the Berlin cases due to the high speed internet connection accessibility. No significant differences between primary and the expert's diagnoses were noted in both systems. However, the time interval measured from image submission until receiving the expert's statement was considerably shorter for iPath server compared to the UICC-TPCC. In addition, quite a high number of unanswered cases (cutoff level two weeks) remained on the UICC-TPCC. The diagnostic scores and the performance of the two systems were nearly identical.

Conclusion: The short answer time of the iPath server is helpful for urgent diagnostic assistance, especially if no time consuming additional investigations (immunohistochemistry, gene analysis, or molecular biology) are needed for final diagnosis. On the other hand, the available broad panel of appointed internationally well-known experts attract requests to the UICC-TPCC.

THREE-DIMENSIONAL RECONSTRUCTION AND ANALYSIS OF GASTRIC BIOPSY SPECI-MEN BY ELECTRONIC SLIDES OF CONSECUTIVE SECTIONS AND VIRTUAL MICROSCOPY

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OBJECTIVE: The application of an electronic slide and a software simulated virtual microscope can contribute to a more efficient, convenient histological analysis. These techniques would also support the automation of histological analysis and three dimensional reconstruction of histological objects. **STUDY DESIGN:** From routine gastrointestinal biopsy specimen (5) 5 m thick, H/E stained, 50 to 300 serial sections were prepared and barcode labelled. A fully computer controlled scanning microscope was used for the scanning. A program called 3D-SCOPE was developed for the virtual microscopy orientation, analysis of the sections. Using the mathematical moduls for automated surface epithelia, gland, non-epithelial tissue determinations, tissue component specific 3D insights were prepared. **RESULTS:** During the serial 2D evaluation of the gastrointestinal specimen minor changes in the diagnosis and slightly different diagnostic classes could be detected as compared to routine glass slide based analysis. 3D recontruction of the serial sections were informative only demonstrating structures of epithelial origins switching off the lamina propria. This way glandular alterations were better identified. **CONCLUSIONS:** 3D reconstruction of serial sections using digital slides can support the more detailed analysis of histological specimen.

ANALYSIS OF PUBLICATION OUTPUT IN TELEMEDICINE

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Introduction: Publication output reflects to a certain degree development in a discipline. The present study therefore aimed at analyzing publication output in telemedicine.
Material and Methods: The MEDLINE® database was searched for the total number of medical publications and the number of publications on telemedicine during 1964 and July 2003 as well as their distribution by country (n = 42).
Results: Telemedicine publications made up 0.05% of all medical publications cited in MEDLINE®. American and European countries along with others classified as industrialized produced 96.6% of all telemedicine publications, whereby in terms of publications per million inhabitants it was above all the northern European countries (e.g Norway, Finland) who took the lead.
Conclusion: In terms of publications per million inhabitants european countries (e.g Norway, Finland) are ahead in telemedicine publication output.

WIDE FIELD IMAGE CAPTURE - QUICKLY AND EASILY IN BOTH FLUORESCENCE AND TRANSMITTED LIGHT USING THE TISSUEscope

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Specimens that overfill a microscope 10x objective field of view typically must be imaged using a tiling method. In tiling, sequential fields of view are acquired as separate image files that are stitched together by software and displayed as one image. This process can be very time consuming especially when algorithms are employed to align edges of individual fields. Depending on the quality of the stage movement and algorithms used, artifacts are introduced from misaligned fields.

Biomedical Photometrics', TISSUEscope (confocal.com) is a laser confocal scanning microscope that can acquire up to a 20 mm x 70 mm field of view as one continuous image. The TISSUEscope is equipped with a blue, green and red laser. It can simultaneous acquire two images, each from a different laser in fluorescence, reflected or transmitted mode. Since the images are acquired concurrent, and are aligned, they can be superimposed, increasing the information available from one scan. Software allows for the same selected field of view to be rescanned with different excitation parameters. Therefore, multiple fluorescent images of this same field of view are acquired perfectly aligned. This allows not only for quantification of several markers but also co-localization studies of these markers, yielding information about the molecular processes in cells of a heterogeneous tumour population. When all three lasers are activated, collectively they create white light, and an image comparable to that of a transmitted light microscope is obtained. This allows a fluorescent stained slide to be imaged then restained as an H&E and reimaged. The benefit being that selected areas of interest on the H&E can be directly linked to the same areas on the fluorescent images. Using a xenograft model, multiple fluorescent labeling of blood vessels and hypoxic markers will be linked to the histology of the H&E section, demonstrating the TISSUEscope as a functional tool for telepathology.

TELEPATHOLOGY IN TRANSPLANTATION PATHOLOGY: A RETROSPECTIVE STUDY

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Introduction

Transplantation pathology is characterized by emergency to avoid delayed graft function and by the need of high diagnostic accuracy both to assess organ integrity and to diagnose possible organ rejection. Resuscitation and transplantation centers should relay in/on tempestive expert diagnostic service. Telepathology in transplantation pathology [1] may play a relevant role in ensuring ubiquitous specialized diagnostic accuracy. A feasibility study has been recently conducted [2] on a retrospective case set of about 20 patients (11 liver and 9 kidney biopsies) to assess timing and diagnostic accuracy using an active telepathology system. To address specific needs, we modified the system STeMiSy [3], developed to delivery remote frozen section service in 1999 in the province of Trento. Preliminary results suggest that telemicroscopy can offer appropriate technological support in delivering pathologists' expertise to resuscitation, allowing the creation of a national transplantation diagnostic network.

Material and methods

The study was conducted on 20 retrospective cases, 15 biopsies from transplanted patients (9 kidneys and 6 livers) and 5 liver biopsies at time t0. Diagnoses were rendered by an expert pathologist (JLR) through the system and compared to panel diagnoses. Different stainings were available for each case; stained glass slides were set on the robotic microscope stage on pathologist's demand. Diagnoses were scored as a. completely concordant, b. discordant-not clinically relevant and c. discordant-clinically relevant. Choen's Kappa statistical test was applied to measure diagnostic concordance. A P value less than 0.05 was considered statistically significant.

Results

The mean diagnostic time was 18,8 8,0 min. In 2 out of 20 cases the pathologist asked for additional staining (liver biopsies at time t0). The diagnostic accuracy was 70% of type a. and 95% of type b. Overall concordance was statistically significant. On average, 22,6 10,8 digital images were acquired for each case in addition to the overview image. A total of 620 images were acquired.

Discussion

The preliminary results suggest that telemicroscopy may become a reliable remote diagnostic tool in transplantation pathology. The design and implementation of a national transplantation diagnostic network based on telepathology could address the need to delivery highly specialised skills in transplantation pathology. It might also be used as learning tool to remotely train junior pathologists.

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PITFALLS AND SPECIAL PROBLEMS WITH FROZEN SECTION EXAMINATION VIA TELEPATHOLOGY

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In our study about frozen section examination via Telepathology (TP) in cooperation with the Department of Thoracic Surgery LFK in Hemer we integrated an continuous intern control of quality (retrospective „Error analysis") of every case within a few working days.
The aim was to detect systemical or methodical errors immediately to avoid recurrent errors. This method also allowed a continuous development of the procedure with possible changes of the whole procedure within a few days if necessary (Learning-Curve and Reaction).
On this way we established a method using the know how of every single case.
In 215 of 232 cases (92, 67%) right diagnoses already have been made via TP.
In 6 cases delayed diagnoses and in 11 of 232 cases (4, 74%) wrong diagnoses have been made (9 false negative and 2 false positive).
The analysis of these errors showed a large variety of reasons but at first of all we notice the same well known problems in frozen section examination independent of the method (TP vs. conventional) . In addition to that we found different source of trouble caused be TP-specialities. We found difficulties to detect technical problems (e.g.colouring) of the slide. A more or less worse overview of the slide via TP makes it more difficult to catch the area of interest immediately (or at all) specifical in lymph node examination. The increased number of delayed diagnosis was caused by wrong or less strong indications for the frozen section examination (experimental study). An increased number of wrong diagnoses caused by the macroscopical examination and preparation of the specimen by the surgeons and not by the pathologist did not occur.
The histological examination of specimen on a screen differs from the usual microscopy work and leads partially to a different procedure of examination.
As long you take notice of the special circumstances of TP a high level of correct diagnoses without significant difference between frozen section examination via telepathology or conventional examination is possible.

REMOTE PATHOLOGY ASSISTANCE FOR CERVIC CANCER SCREENING IN CAMBODIA. A REAL SIZE, PROOF OF THE TELEMEDECINE CONCEPT.

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LEDA is a virtual non governmental organisation (NGO) intended to freely ensure Links in Education, Diagnosis and clinical Assistance to the professionals of health, locals or expatriates, in emerging countries, with the means of internet connection allowing to exchange files and images through a central web site in this interactive part. An educational section of the site provides basic medical education to health workers from developing countries.

The Web site, **LEDAMED**, is the product of a Scientific Grouping of Interest,grouping together various organisations supported by the French Ministry for Research : National Centre for Space Studies (CNES), Pathology Center of Dijon (Centre de Pathologie de Dijon), Further Education Development and Health (Développement et Santé), Institute of Medicine and Space Physiology (MEDES), Institut Pasteur, Doctors of the World (Médecins du Monde), Pain without Borders (Douleur sans frontieres) and Pathology Cytology Development (Pathologie, Cytologie et Développement).

Principle of LEDA program rests on the implementation :
- of a chain of cyto and/or histo diagnosis remotely assisted by specialised doctors ensuring the progressive formation of the local personnel rather than sustaining an enduring substitutive situation. In Phnom Penh, Cambodia, local technicians were fully autonomous after one year of local assistance provided by an expatriate cytotechnician and have been working for more than two years, with an enduring quality and not any major logistic trouble.
- a Centre of medical teletransmission opened to all, deliberately using low stream wire phone Internet access, to maintain low transmission costs.

The whole is integrated in a logic of care within the existing structures of health in order to ensure the adapted therapeutic downstream.

A first application of the LEDA principe was telecytopathogy in Cambodia to ensure the tracking of the precancerous and cancerous lesions of the cervix. Samples have been provided by most of the local structures in charge of Woman Health, at the scale of 3-500 screenings / year.

LEDA action in Cambodia demonstrates the feasibility of efficient, robust and low cost telemedicine in an area still lacking medical specialists.

THE INSTRUMENT FOR AUTOMATED SCREENING OF PERIPHERAL BLOOD CELLS (ASPBC): TELEMEDICINE APPLICATIONS

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The report considers remote control programs designed for cytological analyzer ASPBC. The analyzer ASPBC automatically prepares the data of general blood analysis from a dry smear. The instrument includes a computer-driven motorized microscope and specialized software that implements the automatic analysis. The instrument includes additionally remote control programs used for controlling the instrument, receiving the obtained information, and deciding via transmission the data and commands trough a network.

Programmatically, this software makes the analyzer ASPBC a WEB-server offering different functions of remote control, such as
- viewing the microscope fields of view;
- controlling the automated microscope, including motions of the stage, automatic focusing, etc.;
- viewing and saving the results of analyses.

The client workstation working with the analyzer ASPBC can be a PC under any operating system whose software includes a WEB-browser with virtual Java-machine. The instrument ASPBC and client workstations must be connected to a network that supports the protocol stack TCP/IP, which means that they must be connected either to the corresponding local network (Intranet), or to Internet. In order to ensure the stable transfer of images, the network transmission rate must be about 100 KBit/s, which agrees with performances of modern Ethernet networks.

THE CREATION OF A LUNG PATHOLOGY ONTOLOGY BASED ON UMLS FOR IMAGE RETRIEVAL

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Introduction: Images are an important component of both clinical care and medical education. The use of the Digital Virtual Microscope (DVM) with stores and processes digitalised histological glass slides offers new advantage in image retrieval. Therefore it is necessary to add more information about the image content. The pathology report contains the description of the images and under this point of view the report could be considered as metadata of the digital slides in the Virtual Microscope. The Unified Medical Language System (UMLS) is a collection of thesauri, nomenclatures and vocabularies in the biomedical domain and therefrom builds a large basis to link the image information ontologically. The goal of the project is to analyse how UMLS could be integrated in an OWL based ontology to improve the image retrieval functionality of the DVM considering lung cases as example.

Methods: The DVM stores and processes digitalised images in a relational database (SQL-Server, Microsoft). The pathology reports are stored in the Pathology Information System. To create the lung ontology we used the ontology and knowledge-base editor Protégé 2.1 and we created ontology files in the OWL standard format. All cases of lung pathology were selected and transferred to a HL7 compatible XML format. After a linguistic analysis of 100 selected reports we extracted a list of terms and compared with UMLS concept term lists. Both the relevant terms of the pathology reports and the subset of UMLS where transferred to the ontology to prepare the semantic network for the image retrieval system.

Results: We created an ontology based on a subset of UMLS and additional terms highly specific for the histopathology of lung. For the relevant subject „lung pathology“ concepts of the following sources are predominantly used: SNOMED, Digital Anatomist and MeSH.
There exist only a few german concepts in UMLS, so adding a german translation is essential.

Conclusion: UMLS open up a large basis for the the compilation of a semantic network but at present could not be used unrestricted with open source tools. For the development of a domain specific ontology for lung pathology image description it is essential to add specific terms based on the analyse of present pathology reports.

USEFUL TOOLS FOR THE DIGITAL VIRTUAL MICROSCOPE - IMPLEMENTATION OF THE DIAGNOSTIC PATH

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Background: The routine use of a virtual microscope will be a paradigm shift comparable with the introduction of the digital radiology. For the first time all histological glass slices will be scanned and digitalised and can be view by a specialised browser without any delay. In a medium-sized instituted every day more then 100 cases with approximately 1500 images will be processed and stored. The main advantage of a virtual microscope is the reuse of the images to compare, for decision support and education.
The intention of this project is the extension of the functional range of the Digital Virtual Microscope (DVM) by the development of the so called diagnostic path, witch is the connection from observation path (path of the examiner through the histological slide) and the dictation path (sequence of the pathology report).

Methods: The DVM stores and processes the images and the observation path in a relational database (SQL-Server, Microsoft). Basis of the project is the structural analysis of present pathology reports. The reports were transferred into an XML structure including an extension to be able to register to each text fragment the time and the slide fragment the pathologist is currently analysing. Based on this structure, an editor was implemented in Mircrosoft Active Server Pages (ASP). A additional tool is able to compile the “diagnostic path”, witch is the connection from the “observation path” and the “dictation path” (sequence of the pathological report) and to code the content of the dictation to the Concept code of the Unified Medical Language System (UMLS). The coding and search software is programmed in java (version1.4).

Results: A editor window was integrated into the Digital Virtual Microscope. The description of the slide, in the prototype version entered by the pathologist, is stored in the database. A specialised tool generates a Health Level Seven (HL7) compatible XML document including the dictation path. For coding and search the histological description four software modules were developed. Module 1 for the processing of the pathology report files, the compilation of the diagnostic path and the UMLS encoding of report text. Thereby the report files could be automatically encoded on the average to 13%. Module 2 for editing the encoded terms and Module 3 and 4 for search and administration.

Conclusions: The integration of the diagnostic path functionality represents a valuable extension of the Digital Virtual Microscope and offers the possibility, to find again histological structures in the image as described in the pathology report. The small count of automatically coded words is very valuable concerning the further usage of the UMLS concept codes. But the study shows that UMLS is not so specific for terms of histopathology. For a more specific search it is necessary to add the missing concepts and create new type of relation. Beside the search for a specific region in the virtual slide the dictation and observation path can be used for a quality assurance system.

ULTRASTRUCTURAL TELEPATHOLOGY-AN APPLICATION OF REMOTE ELECTRON MICROSCOPY VIA INTERNET

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Aims: The main task of ultrastructural telepathology is to deliver adequate electron microscopy (EM) findings in the shortest amount of time to establish or support pathological diagnoses from a remote location. As in light-histopathology, the consultation of experts is essential for complex EM cases (tumors, renal, skin, muscle, nervous system, ciliar and storage diseases; rapid viral diagnosis - including bioterror scenario), and original specimens need to be examined directly instead of interpreting pre-selected images.

Methods: We used a remote EM diagnostics system based on the LEO 912AB TEM equipped with a 1024x1024-pixel CCD camera located in Regensburg, controlled by the "analySIS" software from a server and linked via Internet to locations throughout Europe. The standard software (EsiVision, ver. 3.2, Soft Imaging System/Muenster) was expanded with a dedicated “TelePresence-Server-Module” that handles the communication between the EM and the remote expert. At the "client site" (experts located in Berlin, Koblenz, Zurich, and Innsbruck) standard desktop-PCs or a notebook running the same "analySIS" software expanded with a Client-Module were applied.

Results: Ultrathin sections of selected diseases and negative-stained specimens containing virus particles were examined remotely live via Internet. The remote EM control included: stage navigation and search for area of interest at low magnification and resolution, selection of adequate magnification (18 - 400.000x), focus adjustment, beam brightness and exposure time control, and local image documentation at full resolution. Conclusions: Remote EM examination of pathological samples has been established by combining the full digital and highly automated EMs with digital image acquisition, commercial telepresence microscopy techniques, and rapid advances in Internet technology.

VIRTUAL SLIDES - MOTIVATION, APPLICATION AND TECHNOLOGY

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Ideal virtual slides are intended to represent the full information content of their real counterparts; in principle they are a special type of a data bank. The availability of complete virtual slides offers opportunities to apply search operations for relevant objects within a slide, their diagnosis and finally population analysis on a slide, what is not possible with the ´image collections´ of the past.

Motivations to push the development of virtual slides result from several attractive opportunities compared with their real counterparts:

- Many identical copies can be provided from 1 case;
- Virtual slides do neither break nor bleach;
- A multitude of investigators may have access to identical slides in parallel.

These features promote new applications in several fields of pathology and cytology:

Education: Training of different groups with identical slides, creation of affordable slide based study material, ideal examination scenarios with identical slides for all participants at the same time becomes feasible; telelearning gets a new attractive tool, and finally text books may be accompanied by complete slides.

Documentation: Non-bleaching and unbreakable slides can be archived. This becomes more and more relevant regarding legal challenges in quality control in pathology.

Science: Researchers get opportunities to archive durable slides also of rare diseases from all over the world. A further aspect is the opportunity to get from the same sections differently stained samples as the previously stained specimens are still available for comparison as virtual slides. Different evaluation methods may be applied to the same preparations, also after several years, as slides do not change form nor color. Similar arguments hold for developers of slide evaluating equipment: they can rely on identical databases also after years, what is a great advantage regarding the tremendous costs of collecting new slide material, diagnosed according to FDA-accepted criteria.

The technology to create and to display virtual slides has matured in the last years. Several scanning strategies are applied to store and to retrieve complete slides, and first commercial products have appeared on the market. Acquisition strategies applied are line- and area-scanning as well as imaging with 2D-cameras with different pixel resolutions per image.

Assuming an active slide area of 25x50 mm2, and a requested maximum resolution of 0.25mm, slides may be stored with acceptable data compression on 1 CD. Techniques to retrieve the data material in a manner compatible to conventional microscopy may be adapted from computer graphics.
Most realizations of virtual slides provide not all features of conventional slides. Restrictions are made for spatial and color resolution, loss of 3D information, and very often for selected areas and magnifications. Upcoming commercial solutions of different quality and costs provide the opportunity to optimize performance and costs.

FROZEN SECTION TELEPATHOLOGY, EXPERIENCES AND RECOMMENDATIONS FOR NEXT GENERATION EQUIPMENT

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The contribution will report on experiences gained by 3 user groups during frozen section telepathology diagnosis in the last years. These users belong to very different categories:

- Routine application since 1999 in up to 20 cases per day, summing up to several thousand cases per year. Highest priority has the frozen section service for a remote hospital. Three pathologists are familiar with the system. Permanent availability has highest priority.
- Routine application since 2001 with several hundred cases per year. This institution integrates its telepathology activity also in evaluation scenarios and scientific projects.
- Experimental application with less than 100 cases per year. The primary aim of these institutions is to evaluate telepathology with respect to a future introduction in routine application.

All 3 institutions take part in the continuing field test of the German Society of Pathology accompanying the introduction of rules for telepathology in frozen section scenarios.

The results reported by all groups with respect to errors in frozen section diagnosis, demonstrate the same quality as the conventional procedure. The quality of diagnoses depends on the familiarity of the pathologist with telemicroscopy. Therefore all groups started with training programs and decreased by and by the rate of cases, for which no diagnosis could be made by telepathology.

Recommendations expressed by the pathologists for next generation equipment were with respect to:

- A common request of all was to increase the transmission speed beyond the present 512 kb/s. This request reflects not only the saving of time, but also the mental process, how a pathologist compiles the impression of an organ from several fields of view. A progress in this problem will be achieved with the application of the coming UMTS technology.
- ´Give me back the full field of view and resolution of my modern microscope´ is the next recommendation. This request is tightly connected to the previous one, as far as data transmission is concerned. The other aspect is the resolution of displays. Special screens with resolutions of up to 27 Mpixels are available today to acceptable prices.
- Some pathologists also asked for a virtual 0.6x magnification image, which would be between the overview and the 1.25x magnification of the present system.
- Black box microscopes without knobs and scanning tables visible would promise more robustness and less error possibilities in handling.

The most important improvement in interactive telepathology however, would be considered, if agreements in the chambers of pathologists could be settled, under which circumstances interactive telepathology may be practiced.

FROM IMAGE DATABANK TO WEB-BASED DATABANK

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Several years ago the idea of placing the databank in the center of telemedical endeavor seemed quite unorthodox. Databases or image databanks were designed to enable the storage of patient images in the beginning from one type and later from different sources. With time the idea evolved that modern concepts should not only be limited to image storage and retrieval but enable the storage of all relevant digital or non-digital information needed for patient diagnosis, treatment, follow-up or consultation as well as for later statistical or epidemiological evaluation. The introduction of CIMS (Clinical Image Management Systems) a tool is created, which combines patient demographic data, clinical data, examination data as well as images collected in examinations. In this way electronic patient records are created. In telemedicine application electronic patient records can be moved from point to point in medical service workflow. Following this idea databases are created containing integrative patient records instead of respective examination data. These databases also should allow easy data transfer via Internet or some other means. All the data must be stored safely, and allow stable retrieval. Compliance of such databases to standards (such as DICOM) is mandatory. The evolution of this idea can be followed trough the evolution of the database ISSA (VAMS, Zagreb) and telemedicine system Pharos. They developed from two separate entities with the possibility of exchanging data and images to an integrated system where each element can be run individually or the telemedicine part can be used as a transfer tool serving the database. We can say that the database moved to the coast of the communication sea. A logical step further was to immerse it into the sea. It was done by introducing a web server (ISSA Web server) allowing for creation of patient databases which can then be assessed from any computer linked to the Internet. So now we have a vast number of options how to proceed with our patient integrative record. We can transfer our patient record, containing all data, point to point (using ISSA-Pharos system) or put it on the ISSA Web server (for consultation) or mail it as e-mail attachment (to the family doctor) or put it on a CD (which the patient can car with him). This system is fully operational in several different settings: Teleneuroradiology network (Croatia), Island telemedicine (Croatia), UTMB Department of Pathology (USA), Institute of Pathology Zagreb etc. The Croatian telemedicine server moved from the TELECOM to the Medical Faculty University of Zagreb and its new address is: telemed.mef.hr.

TELEPATHOLOGY IN CONSULATIONS OF DISPERSED/DIFFUSE LUNG LESIONS - VARIOUS METHODS APPLICATION

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The assessment of lung biopsies of the patients with "dispersed/diffuse lung lesions" [DDLL] requires a multidisciplinary approach with evaluation of clinical, radiologic and pathologic parameters. The interpretation of the samples morphology is often difficult for surgical pathologist, in most cases the diagnosis is not purely pathologic; in complex cases consultations with other expert-pathologist helps in pattern recognition and conformation of the predominant pathologic features. Application of telepathology [TP] offers some benefit for the diagnostic accuracy or limits a differential diagnosis for the histologic patterns.AIM The study was performed to assess a usefulness of teleconsultations for the pathologic diagnosis of lung biopsy in DDLL patients - in relation to the used TP method and histologic pattern of lung injury.

MATERIAL and METHOD

40 samples of open lung biopsy of DDLL patients (material of NTB&LDRI and K-PCP) entered the study. The paraffin sections (H&E and special staining) were examined by light microscope before and after TP consultation. The histologic lesions were classified according to the ATS/ERS and WHO criteria for lung diseases. The cases were consulted by expert pathologists using static telepathology (SAMBA Technologies, TPS 7.0, France) or by using static or dynamic telemicroscopy (Coolscope, NIKON, Poland). The coolscope offers possibilities for: a/ reviewing of scanned microscopic images stored in a database; b/ dynamic telemicroscopy by remote control of a robotic microscope ("real time" teleconsultations) by web browser (no special software); c/ review "off line" of the scanned whole microscopic slides in a way like with the robotic microscope (Virtual Slides technique, Eclipsnet software).

RESULTS

The majority of cases (26/40) was consulted by static TP (SAMBA); the number of transmitted selected images ranged from 4-36 per case. All images with the clinical data were transmitted successfully. The scanned images of 10 cases were stored in database for static telemicroscopy (up to 280 MB/image), 7 cases were prepared by virtual slides technique (up to 850 MB) or for "real time" teleconsulation. The difficulties appeared during teleconsultations by using telemicroscopy via Internet.87% of consulted cases represented pure or mixed histologic patterns of interstitial pneumonias [IP], granulomatous IP and organizing pneumonias. The complex cases represented collagen vascular diseases and pulmonary vascular diseases. The results of TP consultations were in agreement with the extend of the histologic patterns but did not determine a definitive diagnosis (the limited spectra of differential diagnoses were proposed and a need of clinico-radiologic correlation was stressed).

CONCLUSIONS

Static telepathology via Internet is sufficient method for expert pathologists in teleconsultations of DDLL, but needs large number of transmitted selected images. Telemicroscopy by coolscope is superior to static TP by offering a possibility of whole section scanned images as well as 2 modifications of "real time" teleconsultations, however needs high band network and advanced computers.

TELEMIC - THE FIRST OPEN SYSTEM FOR TELEPATHOLOGY

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Telepathology is the practice of remote pathological examinations with the use of telecommunication links. Two basic systems exist for performing remote pathological examination: static and dynamic. Both have different needs in computing and telecommunication aspects as well as specialised hardware or software. TELEMIC has introduced a new concept for telemicroscopy using the Internet and conventional Web page with Java support for microscope remote control as well as image transfer and discussion. This open telepathology system has typical client-sever architecture. Telemicroscopy server is a computer connected with the robotised microscope and digital camera, with Internet access. Java based telemicroscopy software transforms the computer into an Internet server that distributes new microscope images automatically to all connected clients. This software is free available. Telemicroscopy clients can remotely operate the microscope via standard Internet browsers. Any Internet user can access the web page of the server to become a telemicroscopy client. Chat function allows for the online exchange of written text. Discuss function enables the display of on arrow to all connected clients for highlighting distinct structures of the images on the mouse button press. This system is optimized for simplicity while presenting all features of thelepathology system necessary to discuss difficult cases or to present these to any expert in the field through the Internet. This is an important step forward to diffuse the use of telepathology among pathologists. Any pathologists with Internet access can became a participant of telepathology session or even consultant without the specialised acquisition hardware or software because this system can be also used for conventional light microscope. This offers new perspectives for telepathology and we predict that on this way, with the use of new products e.g. COOLSCOPE, many pathologists and scientists will use this possibility to form networks for teleconsultation. This development will promote the communication between pathologists as well as quality insurance of diagnosis. Information and example is available at website http://ampat.amu.edu.pl/telepathology/.

DEVELOPMENT AND FIELD TEST OF A NEW AGE STANDERDIZED TELEPATHOLOGY SYSTEM USING A BROAD BAND INTERNET AND SECURITY FUNCTION BY AN IC CARD

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In the last ten years in Japan, public line-based, real time telepathology systems were most prevailing and now more than 130 hospitals are running the systems with or without a robotic microscope. They are used mostly for quick frozen section intraoperative remote diagnosis in the absence of a pathologist of the hospital. However a demand for an Inernet-based, and at the same time, secure, standardized network telepathology system was increasing and eventually we made up a project to develop a new system for the purposes of consultation of difficult cases, education, quality assurance, etc. We describe here the new system and results of the first field trial. The system is consisting of a central data server and several client image input and receiver systems connected each other by 100 Mbps broad band internet lines. Each client is equipped with any image input equipment irrespective of its modality and manufacturers. There is virtually no limitation of image number and size used for the telecommunications. Standardized formats for descriptions of patient data, specimen properties and any other necessary information for pathology consultation were set on a computer. An authentication is given for a correct user or users of each cliant by issuing IC card. The field test of the system connecting Kyoto, Mie and Okinawa areas with a data centre in Kawasaki was conducted in February 2004 and was successful in accumulation of interesting cases and in mutual consultations and discussions with no restriction of time and no significant stress on routine pathology works. The step of issuing IC cards made it possible to charge cost for users. Fields of application of the system will be broad and at the hands of pathologists who will use it.
(The authors are grateful to the Japan Ministry of Economy, Trade and Industry for its financial support and encouragement for the project.)

EXPERIENCES IN THE PRODUCTION OF DIGITAL SLIDES BY AN AUTOMATED HIGH-RESOLUTION SCANNER SYSTEM AFTER AUTOMATED SLIDE PREPARATION

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BACKGROUND: Automated slide preparation systems are available for histological routine use. We recently developed and installed the Hi-Scope slide scanner system in a routine environment. Aim of the present work was the evaluation of Hi-Scope for everyday applications.
METHODS: Hi-Scope and a digital storage environment were installed in the biopsy specimen laboratory. 5 m sections from gastrointestinal and surgical pathology material were prepared as usual. The slides were deparaffined, stained and coverslipped using automated systems. The barcode labeled slides were placed into the Slide-Scope cassette and scanned by the Hi-Scope system automatically. A day 100 to 200 slides were scanned. Hi-Scope is an autoloader, autoscanner, and auto focusing slide scanner. Slides were stored on dedicated slide server computers equipped with fast short term and slow long-term storage components.
RESULTS: In the experiment 4000 slides were scanned altogether and 6 cassettes were reused continuously. From the 80 cassette loading cycle the cassette stuck once. From the three type of slides used the machine could not load 3% of the cheap, low-quality no name slides, 0.5% of the Superfrost slide with square edges and corners and 0.1% percent of the Starfrost slide with grounded edges end corners. A slide load, unload cycle is 10 seconds. Slides were identified using 6 decimal digit barcodes. The resolution was 0.16m / pixel. The scanning speed of the system was 2.5 images / second including auto focusing. With this resolution 1 mm2 was scanned in 20 seconds and resulted 20Mbyte digital data using 1:5 JPEG compression.
CONCLUSIONS: Hi-Scope can be used in the routine for slide digitization and archiving.

DYNAMIC TELEMACROPATHOLOGY WITH INTERNET CAMERAS

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There is a growing demand for static macropathology either as a method for documentation (quality assurance) or macropathological teleconsultation.
Even in telepathological consultation static pictures can be of great help, but daily practice shows the limitation of this method.
In the past, dynamic telepathology was a complicated and expensive task. But today internet cameras could solve this problem.
The aim of the present pilot study was to test the performance of macropathological teleconsultation via the internet.

Material and methods:
In 30 cases under the condition of frozen section service the gross cutting and preparation of the fresh tissue has been done by a pathologist in training under the supervision of the senior pathologist next room with the help of an intranet camera.

Results and conclusion:
In all 30 cases the dynamic three dimensional macroscopicappearance of the specimen was easily shown via the intranet and could be done in the same way as standing next to the grossing place. Gross and macroscopic teleconsulting could solve some of the legal problems of frozen section Telepathology in Germany.

THE ESLIDE SYSTEM FOR DIGITAL SLIDE ACQUISITION AND VISUALISATION: IMAGE PROCESSING ASPECTS

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Introduction

In the process of acquiring digital slides, a major requirement is the possibility of letting the apparatus (either robotized microscope or slide scanner) devoted to acquisition run in an unsupervised way for all the time needed for the acquisition of thousands of images. Among the critical issues, one is the autofocus, from which the image quality is strictly dependent. Research microscopes provide for an embedded autofocus system; however, they are designed for supporting the human user work, and may fail during a digital slide acquisition. In order to overcome this, and to exploit low-cost robotized microscopes, we developed an autofocus algorithm specifically aimed at unsupervised runs on whole glass slides.

As the motorised stage precision is usually lower than the optical resolution, digital slides obtained from a motorised microscope often show small gaps or superimpositions between adjacent images. We also tried to overcome this, by developing a mosaic algorithm for image montage.

Methods

Two aspects should be covered by an autofocusing algorithm: a focus measure and a search strategy. The former should be a measure of detail present in the images, while the latter is the method used in locating the position with higher focus measure. In our approach, we used a dichotomous search algorithm based on the standard deviation of pixel brightness calculated on the green image channel (chosen among four tested measures). After testing four of the focus measures reported in the literature (1-3), we chose standard deviation for its robustness to noise. The mosaic algorithm for digital slides is more complex than usual methods used for producing panorama images, because of the two-dimensional matrix which composes the slide, that makes it difficult to preccisely align the single images. Our algorithm starts from slightly superimposed images, and then finds the minimum error match between the two images. The procedure is applied in a recursive way to rows and columns of the image matrix.

Results

The autofocus appears to be sufficiently precise in long runs, with defocussing that may occur when large blank areas are traversed during acquisition. However, even in such case, the algorithm is able to automatically go back to focus in very few fields.

The mosaic algorithm provides for generally better digital slides, although it is impossible to avoid every gap, due to sub-pixel errors that may cumulate.

Discussion

The experiments made on histologic and cytologic samples allowed us to confirm the suitability of the proposed algorithm for the acquisition of digital slides.

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REMOTE MICROSCOPY OF FROZEN SECTIONS - PRELIMINARY RESULTS OF A STUDY ON RELIABILITY, REPRODUCIBILITY AND INTEROBSERVER VARIABILITY

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Due to the development of modern telecommunication by means of high speed data transfer either by normal telephone lines or by internet we are faced with new abilities and chances in pathology.
Telediagnostic of frozen sections is the most sophisticated application of telepathology. This means application of remote microscopy on freshly prepared cryosections obtained during surgery in a hospital without an own pathologist.
However, it is still unclear how reliable the diagnoses on slides are, which are sampled and produced completely without the presence of a surgical pathologist.
To evaluate this problem, a field study was designed. It comprised a number of 10 pathologists active in telepathology in Germany so far. Participants were asked to put their complete case documentation on a consultation server. The final diagnosis based on standard pathological procedures was transmitted to the study centre.
About 300 cases of various organ systems had been collected, concerning questions of malignancy or tumor free resection margins.
In about 10 % of these cases a conclusive diagnosis could not be delivered due to various reasons.
According to the design of our study an evaluation of reproducibility, accuracy and reliability is intended. The data provide a sufficient basis for a statistical evaluation concerning evaluation time, sample origin and clinical question as well as the reliability compared to the final diagnosis. Concerning the interobserver variability the response of the study participants is still incomplete.

REINVENTION OF LIGHT MICROSCOPY: A NOVEL ARRAY MICROSCOPE FOR ULTRARAPID VIRTUAL SLIDE PROCESSING AND TELEPATHOLOGY

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Virtual slides can be used for telepathology although a current limitation is their slow processing times (e.g. over 3 minutes). Our approach to increasing efficiency leverages miniaturization, ultra-precise manufacturing, parallel computer processing, and a new sensor design in order to produce a next-generation multi-optical pathway imaging instrument. The DMetrix ultrarapid virtual slide processor incorporates a novel "array microscope" that increases the field-of-view of a light microscope over 50-fold. We miniaturized the components of multiple light microscopes and then aggregated the objective lens components into lenslet arrays consisting of 80 lenses arranged in 8 staggered rows of 10 lenses each. The instrument has an NA=0.65. Stacked lenslet arrays and an overlying sensor (i.e., digital camera) on top of the uppermost lenslet array form an ensemble that functions as a miniaturized video microscope as it scans in the long axis of a glass slide. The overall dimensions of the imaging system, including the sensor but excluding the light source, are 2.4 cm (diameter) x 0.9 cm. (high). Each of the tiny microscopes digitizes one 225-um wide stripe. Information is obtained simultaneously from the 80 miniaturized microscopes. It is immediately assembled into a composite image file (virtual slide) and stored in an on-board server linked to the Internet. The virtual slide processing cycle is reduced to less than one minute and the images are of excellent quality. Human performance studies on human breast surgical pathology specimens show that DMetrix virtual slides are of diagnostic quality and that a high level of diagnostic accuracy is achievable using the DMetrix ultrarapid virtual slide scanner as an input device for telepathology.

TELEPATHOLOGY: BARRIERS TO A BRIGHT FUTURE

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It is no secret that the growth of telepathology over the years has been far slower than expected. Synchronous advances in telecommunications and digital imaging technology, decreasing prices of increasingly powerful computing equipment and true competition within the commercial market has resulted in tremendous progress and innovation. Nonetheless, the oft-predicted telepathology explosion has yet to come to pass.

A number of key technical, organization, fiscal, and societal factors impact the widespread use of telepathology - as a global practice with over 200 contributors, the AFIP has identified these factors over and over again, both within our practice and those of our colleagues.

Many technical bottlenecks continue to impact this rapidly advancing specialty. Bandwidth continues to be a rate-limiting factor for many users around the globe. File interoperability continues to be an issue. Unlike teleradiology systems, advanced telepathology systems are rarely interoperable and their output follows no single standard - setting the stage for significant user dissatisfaction and backlash.

Organizational barriers to the acceptance of telepathology generally fall into three categories: cultural, regulatory, and technical. The employment of telepathology represents a fundamental paradigm shift for most organizations, and often is predicated on corporate cultural change. Regulatory issues remain extremely fluid and poorly defined - within the U.S., licensure and credentialing issues vary from state to state and appear to be becoming more restrictive over time. New patient privacy legislation in the U.S. has established new standards for security of patient information, with substantive penalties for inadvertent disclosure. Reimbursement issues for telepathology in the US are also a thorny issue.

Fiscal issues regarding telepathology may have eased in recent years for pathologists desiring to experiment with the technology, but fully-fledged programs are still quite expensive. Coupled with a distinct lack of quantitative data concerning the telepathology's cost-effectiveness, many practices in today's age of managed care may considere it extravagant, and the diagnosis missed because of lack of access to expert consultation an "acceptable risk".

In terms of societal barriers, a number of factors have influenced pathologists' acceptance of telepathology. While not totally anchored in the past, many pathologists have a deep respect for tradition and migration away from the traditional microscope has been slow. Issues of computer literacy, user-friendliness of systems, and increased workload for most pathologists also impact on the acceptance of telepathology.

Many of these barriers will ultimately fall; however, it is important that pathologists who are interested in exploring this subspecialty be cognizant of potential pitfalls so that they may either avoid them or minimize their effects.

AFIP TELEPATHOLOGY - WHERE ARE WE GOING?

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The Department of Telemedicine at the AFIP, established in 1993, is one of the most well-known telepathology consultation services in the world. Over a decade later, the Department's mission continues to grow, encompassing not only teleconsultation, but also spearheading the Institute's growing distance learning and online publication efforts.

The Department's growth and direction is not random, but has been shaped by economic and political pressures common to many academic centers. Over the last several years, we have strived to find (and promote) a military-relevant mission which would show cost-effectiveness to the Department of Defense, while also allowing us to continue to conduct telemedicine research and pursue international consultation and collaboration. The Army Telepathology Program (ATP), instituted in 2002, is a collaboration between the AFIP, the Walter Reed Army Medical Center, and the Army's Telemedicine and Advance Technology Research Center which is responsible for the deployment of 16 robotic microscopes in military laboratories in the continental US, Hawaii, Korea, and Germany. In its first full year, we installed 12 systems, processed a caseload of 270 second opinion teleconsults in 2003, and set the stage for increasing workload in 2004 and beyond.

In October 2003, the Department assumed responsibility for distance learning at the AFIP, with a mandate of rapidly bringing AFIP to the leading edge of online pathology CME. With an extensive use of virtual slides from the AFIP archive as well as a plan to reproduce the entire series of AFIP Tumor and Non-tumor Fascicles in an online form, the Department has not only filled the military's desperate need for online pathology CME, but created new and innovative educational products for its customers around the globe.

During this session, we will discuss factors shaping the direction of the AFIP's telemedicine activities, the effects of continued technological advances in Internet and digital imaging technology, and the AFIP's vision for the future of telepathology, as we chart where the Department heads into 2005 and beyond.

CONSULTATION TELEPATHOLOGY IN DEVELOPING COUNTRIES, DIAGNOSTIC ACCURACY IN THE PHNOM PENH-PROJECT

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Telepathology consultation between experienced pathologists with qualified histological laboratories show a high diagnostic concordance between Telepathology Diagnosis (TPD) and the diagnosis rendered on following material (Truth Diagnosis TD), (B. C. Williams at all 2003).

High quality of slides, standardised and reproducible stains, large panels of immunohistochemistry and optimal soft and hardware for image capturing as well as diagnostic competence of sending pathologist provides a high quality of electronic images and correct telepathology diagnosis even in diagnostic complex requests.

However in developing countries the standards in histological laboratories are low. The educationed level of technicans is mostly below the level in industrialised countries and the diagnostic experience of pathologists is limited.

To prove the diagnostic benefit of telepathology under these conditions we evaluated the diagnostic concordance of TPD and TD by reviewing the slides of the last 100 cases, sent from Sihanouk Hospital Center of Hope (SHCH) of Phnom Penh, Cambodia.

TD were made by 2 pathologists using slides and also blockmaterial in non conclusive cases and TD were compared with TPD given by at least 2 experts before. It seems that TPD even under limited conditions in developing countries may be a powerful tool for supporting pathologists in these countries in their routine work and training.

SPECIFICATIONS AND IMPLEMENTATION OF A NEW EXCHANGE FORMAT TO SUPPORT COMPUTERIZED CONSENSUS IN PATHOLOGY

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In the field of pathology discussion sessions around multiheaded microscopes enhance reproducibility of the diagnosis and may succeed in reducing inter and intra observer variability. Computerised tools and Web technology may make easier the organisation of consensus sessions and help pathologist to find an agreement about features which are diagnostic.
Current limitations of the available tools devoted to telepathology are the lack of representativeness of most pictures and tools for collaborative work. Moreover, there is no universally accepted standard for exchange of virtual slides in order to gather the opinions of several experts.
To obviate these difficulties we have developped an internet plateform within the IDEM project in order to provide pathologists with the data they need to use during the collaborative session
The data include :
1 pictures i.e. the representative and relevant virtual slide
2 written data for image description i.e. the list of diagnostic morphological features
3 operating schedule in order to reach a consensus with step to step indications
In order to assume the new tasks, we propose the use of an extension of ADICAP de facto standard for the storage and the transmission of annotated virtual slides.
We describe this new format, its incorporation into the IDEM consensus platform and the way to operate in order to transform consensual descriptions for transmission to pathologists using non IDEM systems.

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