Surgery enters the computer age with the introduction of laparoscopy. Computers enable magnification, enhancement, transmission of surgical procedures and images, over long distances. Not only does computer technology affect the surgical procedure, but it also affects the management of the patient’s pathology as a whole, ranging from the preoperative acquisition of the patient’s data to operative decision-making and surgical performance. These technical changes have had a profound impact on both surgical procedures and on the surgeons themselves, as they have significantly changed the way they approach many pathologies.

The Joint JSPS-IRCAD-UDS Forum aims to present technological improvements of patient care. It will include the most recent developments in image-guided surgery and minimally invasive approaches using computer science, virtual and augmented reality but also new diagnostic and therapeutic tools and strategies (i.e., confocal endomicroscopy, HIFU, biotherapies). The integration of all these technologies will trigger the emergence of new professions in which surgeons, gastroenterologists and radiologists will share their know-how in order to enhance the quality of the patient’s treatment. Diagnosis, simulation and application of new procedures will be incorporated into a virtual environment in the near future. Ultimately, the best performed procedure will be selected, validated, and transferred to a robotic database to allow for its automatic reproduction in real patients once experts have validated the integration of these new technologies.
ORGANIZING COMMITTEE

Professor Jacques Marescaux
President of IRCAD, Strasbourg, France

Professor Jean Sibilia
Dean of Faculty of Medicine, University of Strasbourg, France

Professor Yoichi Nakatani
Director, Japan Society for the Promotion of Science (JSPS) Strasbourg Office

SCIENTIFIC COORDINATION

Professor Jacques Marescaux
President of IRCAD, Department of General and Digestive Surgery, University of Strasbourg, France

Professor Didier Mutter
Vice President of IRCAD, Department of General and Digestive Surgery, University of Strasbourg, France

Professor Makoto Hashizume
Department of Advanced Medical Initiatives, Kyushu University, Japan

Professor Junji Okuda
Department of General and Gastroenterological Surgery, Osaka Medical College

SCIENTIFIC ADVISER

Professor Nobuhiko Tanigawa
Tanigawa Memorial Hospital, Osaka, Japan

ORGANIZING OFFICE

Ms Stéphanie Pery
IRCAD, Hôpitaux Universitaires
1, place de l'Hôpital
67091 Strasbourg Cedex, FRANCE
+33 (0)3 88 11 90 06
+33 (0)3 88 11 90 99
stephanie.pery@ircad.fr

Ms Satoko Tada
Directrice Adjointe
JSPS Strasbourg Office
42a, avenue de la Forêt-Noire
67000 Strasbourg, FRANCE
+33 (0)3 68 85 20 17
+33 (0)3 68 85 20 14
tada@unistra.fr
TOPICS

RoboticsVirtual Reality and Augmented Reality

Image Guided Surgery

New Minimally Invasive approaches:
   a. Mechanical : HIFU (High Intensity Focused Ultrasound)
   b. Biotherapies

NOTES (Natural Orifice Transluminal Endosurgery)

SPEAKERS FROM FRANCE

Professor Jacques Marescaux
Department of Digestive and Endocrine Surgery, IRCAD, University Hospital of Strasbourg

Professor Luc Soler
Department of Digestive and Endocrine Surgery, IRCAD, University Hospital of Strasbourg

Professor Thomas Baumert
Institute of Virology, Faculty of Medicine, University of Strasbourg

Professor Nicholas Ayache
Asclepios Project-Team, INRIA Sophia-Antipolis
SPEAKERS FROM JAPAN

Professor Makoto Hashizume
Department of Advanced Medical Initiatives, Kyushu University

Professor Haruhiro Inoue
Faculty of Medicine, Showa University Yokohama Northern Hospital

Professor Yoshihiro Muragaki
Department of Neurosurgery, Tokyo Womens' Medical College

Professor Takeshi Ohdaira
Center for Advanced Medical Innovation, Kyushu University

Professor Junji Okuda
Department of General and Gastroenterological Surgery, Osaka Medical School

Professor Maki Sugimoto
Department of Gastroenterology, Kobe University Graduate School of Medicine
<table>
<thead>
<tr>
<th>Timing</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day One – Friday 21 December 2012</strong></td>
<td></td>
</tr>
<tr>
<td>09.00-9.30</td>
<td>Registration &amp; Welcome Coffee</td>
</tr>
<tr>
<td></td>
<td>Institut de Recherches contre les Cancers de l’Appareil Digestif (IRCAD)</td>
</tr>
<tr>
<td></td>
<td><strong>Auditorium Charles Lindbergh</strong></td>
</tr>
<tr>
<td>09.30-10.00</td>
<td>Opening Session</td>
</tr>
<tr>
<td></td>
<td><strong>Professor Alain Beretz</strong></td>
</tr>
<tr>
<td></td>
<td>President, University of Strasbourg</td>
</tr>
<tr>
<td></td>
<td><strong>Mr. Susumu Hasegawa</strong></td>
</tr>
<tr>
<td></td>
<td>Consul General of Japan in Strasbourg</td>
</tr>
<tr>
<td></td>
<td><strong>Professor Jean Sibilia</strong></td>
</tr>
<tr>
<td></td>
<td>Dean, Faculty of Medicine, University of Strasbourg</td>
</tr>
<tr>
<td></td>
<td><strong>Professor Toshio Kuroki</strong></td>
</tr>
<tr>
<td></td>
<td>Senior Advisor, Research Center for Science Systems, JSPS</td>
</tr>
<tr>
<td>10.00-11:45</td>
<td>1st Scientific Session</td>
</tr>
<tr>
<td></td>
<td>Chairpersons: Professor Nobuhiko Tanigawa - Professor Didier Mutter</td>
</tr>
<tr>
<td></td>
<td><strong>Professor Jacques Marescaux</strong></td>
</tr>
<tr>
<td></td>
<td>“Computer Sciences and Minimally Invasive Surgery: Inventing the Future”</td>
</tr>
<tr>
<td></td>
<td><strong>Professor Makoto Hashizume</strong></td>
</tr>
<tr>
<td></td>
<td>“Image-Guided Robotic Surgery”</td>
</tr>
<tr>
<td>11.45-12.00</td>
<td>Photo Session</td>
</tr>
<tr>
<td>12.00-14.00</td>
<td>Lunch</td>
</tr>
<tr>
<td></td>
<td>IRCAD</td>
</tr>
<tr>
<td>14.00-15.30</td>
<td>2nd Scientific Session</td>
</tr>
<tr>
<td></td>
<td>Chairpersons: Professor Junji Okuda – Professor Makoto Hashizume</td>
</tr>
<tr>
<td></td>
<td><strong>Professor Thomas Baumert</strong></td>
</tr>
<tr>
<td></td>
<td>“Functional genomics of virus-induced liver disease: from viral entry to liver cancer”</td>
</tr>
<tr>
<td></td>
<td><strong>Professor Yoshihiro Muragaki</strong></td>
</tr>
<tr>
<td></td>
<td>“Advanced Information-guided Surgery of Brain Tumors”</td>
</tr>
<tr>
<td>15.30-16.00</td>
<td>Coffee Break</td>
</tr>
<tr>
<td></td>
<td>IRCAD</td>
</tr>
<tr>
<td>Timing</td>
<td>Schedule</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>16.00-17.30</td>
<td>3rd Scientific Session</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Day Two – Saturday 22 December 2012</td>
<td></td>
</tr>
<tr>
<td>09.00-10.30</td>
<td>4th Scientific Session</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>10.30-10.50</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>10.50-12.20</td>
<td>5th Scientific Session</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>12.20-12.30</td>
<td>Closing Remarks</td>
</tr>
<tr>
<td>12.30-14.00</td>
<td>Lunch</td>
</tr>
</tbody>
</table>
SURGERY FOR LIFE INNOVATION:
ABSTRACTS, BIOGRAPHIES, SCIENTIFIC COORDINATION
Introducing an optical device into the abdomen of a patient so as to carry out the surgical procedure via a miniaturized camera represented the major change the surgical world experienced throughout the 20th century: the "minimally invasive" surgery era was born. Recent decades saw amazing progress in such minimal access procedures that replace radical surgical resections. Unfortunately, minimally invasive techniques were developed by separate and distinct specialties and are inevitably limited by the expertise of individual specialists such as surgeons, radiologists and gastroenterologists.

In parallel, medicine entered the world of computer sciences via great revolutions among which 3D medical imaging (CT, MRI and ultrasound) is surely the most obvious. Digitalisation of patient own data is nowadays present in all fields, from anatomy to the surgical intervention. This ever growing data flow remains however difficult to interpret and to exploit. This is the objective of computerized post-processing of this data. Interpretation consists in extracting from the signal (image or other) emitted by the data capturing device the information useful for diagnosis, therapeutic choice or medical treatment. In order to be understandable, this information has to be quickly, reliably and clearly translated and given to practitioners, by exploiting the principles of virtual reality. Useful information is thus mainly recreated as 3D images. Beyond diagnosis support, this data exploitation can allow to plan and simulate an intervention preoperatively. These two preoperative steps can be used intra-operatively thanks to the development of augmented reality (AR) which consists in superimposing the pre-operative 3D modeling of the patient onto the real intra-operative view of the patient. AR aims at providing surgeons a view in transparency of their patient and can also guide surgeons thanks to the virtual improvement of their real surgical tools that are tracked in real time during the procedure. This awaited technique is however currently not available for soft tissue surgery essentially due to large intraoperative deformations and topological changes of organs resulting from surgeon interactions.

A last major medical innovation which appeared early 21st century is robotic surgery. Developed to improve surgical gesture precision and efficiency, existing robots are essentially telemanipulators. Steering articulated arms reproducing all motions under control, the surgeon is able to perform operations from a distance, sitting in a comfortable seat, with no risk to make any awkward movement due to trembling or to a brusque gesture. But as for augmented reality, automatic control remains today not available due to huge difficulties to predict, analyse or control organ deformations and to adjust in real-time the robotic movements.

The evolution of surgery thus needs a revolution to overcome all these current limits. This revolution will consist in combining the best aspects of minimally invasive techniques from separate specialties, image analysis techniques, patient-specific simulation, augmented reality and robotics. The resulting approach will lead to Image-Guided Minimally Invasive Hybrid Surgery. The associated new operating room will integrate intra operative imaging technologies, especially open MRI. This integration will be a tremendous challenge, due to the difficulty to perform a surgical procedure in a high magnetic field: this environment prohibits the use of ferromagnetic surgical instruments, anesthesia machines and standard electronic energy devices. The evolution of surgery to incorporate image guidance, computer assistance, robotic augmentation and telecommunications will require a paradigm shift in the training of physicians, engineers, and other healthcare workers. The classic boundaries between medical, surgical and radiological disciplines must be reorganized to produce multidisciplinary teams who are proficient in all tools relevant to patients. It is a challenge but it will lead to the future of surgery.
Jacques Marescaux is Professor of Surgery, Chief of digestive surgery Department of University of Strasbourg Hospital and president and founder of IRCAD (1994) a uniquely structured institute advancing the field of surgery into the information era, in the area of cancer in the digestive system. He is also founder and Chief Executive Officer of the newly created IHU-Strasbourg, a center of excellence aiming at developing Image Guided Minimally Invasive Surgery and fostering technology transfer. In addition he founded the European Institute for Telesurgery (EITS) as a training facility to disseminate the groundbreaking work at IRCAD. Over the last 17 years this center has gained international acclaim by training more than 38,000 surgeons from 124 countries, and mirror IRCAD institutes have been created in Taiwan and Brazil.

In 2000, the IRCAD-EITS implemented a Virtual online University, WeBSurg, resulting from the need to maintain the link between the training center and the surgeons. This website features peer-reviewed contents elaborated exclusively by healthcare professionals, accredited by the most prestigious International Scientific Societies. WeBSurg encapsulates high-quality technology with high-speed multimedia communication systems to broadcast pre-recorded surgical interventions; the website is available in 5 different languages (French, English, Spanish, Japanese, and Chinese) and access is free of charge, which is of great importance, especially in developing countries.

In addition, Marescaux has initiated a Biocluster project, combining biotechnology, nanotechnology, imaging studies, robotics and computer-aided systems, within the IRCADs compounds, which will be hosting a score of 20 start-up companies in the area of medical devices.

Jacques Marescaux and his team published up to 2,930 national and international articles and communications, among them Nature, New England Journal of Medicine, JAMA, Annals of Surgery, Archives of Surgery. He has received honorary degrees from a number of Universities and honorary fellowships at the Royal College of Surgeons in London and the Japanese society of endoscopic surgery, and is member of a range of Editorial Boards. He was made Chevalier de la Légion d'honneur (1999), Officier dans l'Ordre national du Mérite (2007) and Officier de la Légion d'honneur (2012).

Jacques Marescaux was invited to deliver more than 260 speeches in many European, American, Japanese, and Chinese Universities or Schools of Medicine, amongst which the “Address to Diplomates” he gave at the Royal College of Surgeons in London, the Nobel Lecture he gave in Stockholm, and the Fogarty Lecture he gave at Stanford University.
Image-Guided Robotic Surgery

Professor Makoto Hashizume

Professor and Chairman
Department of Advanced Medical Initiatives, Faculty of Medical Sciences, Kyushu University,
Director of Center for Advanced Medical Innovation, Kyushu University, Japan

Since a new surgical robotic system, da Vinci (Intuitive Surgical, USA), has been introduced as a clinical use in 1997, it is getting increasingly popular over the world. The number of installation is now more than 2300 in the world. More than 70% of the total number of operations with the robotic system is occupied by prostatectomy and hysterectomy in 2011. It is mainly because that robotic surgery is well indicated to such complicated procedures as suturing or ligation in a confined space.

The surgical robotic system allows the surgeon to work at a distance from the operating table in an ergonomically correct position, instead of having to bend awkwardly above the patient. The surgeon’s movements are transmitted to the computer at the patient’s side. These movements are actually improved by the computer. This technology made it possible to operate on a patient under a remote control with tele-robotics. We have successfully performed remote robotic surgery on soft cadavers by using the newly developed endoscopic robotic system between Mt. Fuji and Tokyo (70 km) in 2002, between Seoul and Fukuoka (700 km) in 2005 and between Bangkok and Fukuoka (4000 km) in 2006 to 2008 where the sensible time-delay of the operator was less than 300 msec.

Virtual and augmented reality systems can be used not only for preoperative planning, but also for rehearsal before performing real operation. As surgical simulators become more perfected in the near future, surgeons may work out the best operative procedure for each patient and be able to repeat individual steps to improve the surgical technique. The simulation system and the navigation system were shown the usefulness in the clinical situation of such surgical fields as ENT surgery, neurosurgery, hepatic surgery, and GI tract surgery. The movement of the instruments and the endoscope with optical markers was monitored by a 3 dimensional position sensor. The surgeons could know the relative distance between the instruments and the target in order to perform surgery in safety. Combining augmented reality with advanced robotics could guide surgeons through technically challenging procedures and help avoid injury to vital structures. We have recently developed new prototypes of the MRI-guided surgical robotic system. It was useful to provide safer and more precise procedures in MIS.

A new surgical robotic system for single port surgery is also being developed. A highly intensive focused ultrasound (HIFU) is one of the options for the new endoscopic therapy. The newly developed HIFU was feasible to be used intra-abdominally inserted through the endoscopic sheath. Better cost-effectiveness is the most important issue from the view point of social economy. The image-guided surgery will be the intelligent therapy for next generation.
Makoto Hashizume was born in 1953. He graduated after Kyushu University School of Medicine in 1979 and finished residency at General Surgery II, Kyushu University Hospital. He obtained PhD in 1984 from Graduate School of Medical Sciences, Kyushu University, in the area of pathology for portal hypertension. He has been working in the field of minimally invasive surgery including endoscopic surgery, robotic surgery and portal hypertension. He promoted to Professor and Chairman, Department of Disaster and Emergency Medicine, Faculty of Medical Sciences, Kyushu University in 1999. He is at work on development of minimally invasive surgical robotic system collaborated with engineers and basic researchers. He received an official commendation for innovative technology from the Minister of Education, Culture, Sports, Science and Technology in 2006. He also won “the special prize of this year’s robot 2007” for MR compatible surgical robotic system. He is currently the director of Center for Advanced Medical Innovation, Kyushu University, the director of Department of Integration of Advanced Medicine and Innovative Technology, Kyushu University Hospital (CAMIT), and Professor and Chairman of Department of Advanced Medical Initiatives, Faculty of Medical Sciences, Kyushu University.

Makoto Hashizume is the authors more than 1,000 publications or book chapters, and more than 200 invited international conferences.
Functional genomics of virus-induced liver disease: from viral entry to liver cancer

Professor Thomas Baumert

Head, Inserm Unit 748 Virus-Host Interactions and Liver Disease, Institute of Virology and Center for Hepatology and Digestive Diseases, University of Strasbourg, France

Viral hepatitis is a major cause of hepatocellular carcinoma (HCC) worldwide. A thorough comprehension of the virus-host interactions and pathogenesis is needed to develop an hepatitis C virus (HCV) vaccine, more efficient and safe antivirals overcoming viral resistance and strategies for prevention and treatment of virus-induced HCC. Addressing these needs, our laboratory applies a translational and multidisciplinary approach including cutting-edge molecular virology, cell biology, functional genomics, bioinformatics and clinical modelling to understand and to model fundamental and clinical processes of virus-induced liver disease. Using functional genomics and a molecular investigative approach we have uncovered key pathways in virus-host interactions. Translating the knowledge acquired in the program, we aim to elucidate the functional impact of the identified factors and mechanisms for the pathogenesis of liver disease and HCC. Using novel technologies based on biogradable nanovectors we develop novel strategies for prevention and treatment of virus-induced HCC. Within the IHU Strasbourg and in collaboration with our academic, clinical and industrial partners including the Laboratories of Excellence HEPSYS and VRT, the EU networks HEPAMAB, HEPATO-REGIO-NET and ERC HEPCENT we translate our results into clinical preventive and therapeutic applications for virus-induced liver disease and cancer.
Professor Thomas Baumert

Head, Inserm Unit 748 Virus-Host Interactions and Liver Disease, Institute of Virology and Center for Hepatology and Digestive Diseases, University of Strasbourg, France

Address: INSERM U748, 3 Rue Koeberlé, 67000 Strasbourg, FRANCE

+33 3 68 85 37 03
+33 3 68 85 37 24
Thomas.Baumert@unistra.fr

Professor Thomas F. Baumert, Professor of Medicine, is head of Inserm Unit U748, Director of the Institute of Virology, University of Strasbourg, and Attending Physician and Gastroenterologist at the Center of Digestive Diseases at the Strasbourg University Hospitals.

He received his MD from the University of Heidelberg, Germany. Following his doctoral thesis in Biochemistry (Prof. D. Keppler) at the German Cancer Research Center (DKFZ) in Heidelberg (Prof. H. zur Hausen) and his internship in Internal Medicine at the Ludwig Maximilians University in Munich, he was a postdoctoral fellow in Dr. T. J. Liang’s laboratory at Massachusetts General Hospital, Harvard Medical School, Boston and the Liver Diseases Branch at the National Institutes of Health, Bethesda, USA.

He subsequently joined the Department of Medicine at the University Hospital in Freiburg, Germany to become a board-certified gastroenterologist, associate professor and to establish his laboratory focussing on the molecular pathogenesis of hepatitis B and C virus infection. In 2006, he relocated to the University of Strasbourg in France as full professor of medicine to create and head a new Inserm research unit on virus-host interactions and liver disease.

Current research interests include the molecular investigations of virus-host interactions and pathogenesis of liver disease. The understanding of basic mechanisms of disease biology has allowed his laboratory to uncover novel strategies for prevention and treatment of chronic viral infection and virus-associated cancer. Recent examples include the elucidation of the molecular pathogenesis of hepatitis C virus (HCV) liver graft infection (Fafi-Kremer et al. J. Exp. Med. 2010), the discovery of cell entry factors and antiviral targets for HCV infection (Lupberger, Zeisel et al. Nature Medicine 2011) and dissection of the molecular mechanisms of HCV evasion from B cell responses (Fofana et al. Gastroenterology 2012). Since 2012 he is a principal investigator within the IHU Strasbourg to coordinate a program on applying novel technologies for prevention and treatment of hepatocellular carcinoma. He has received several awards including the Hans Popper Young Investigator Award, the Chair of Excellence Award and the Laboratory of Excellence Award of the French National Research Agency. He has published more than 100 scientific articles and is an inventor on 9 patents and patent applications.

Research in his laboratory is supported by the European Commission through the ERC, FP7 and INTERREG IV programs, Inserm, the Agence Nationale de Recherches sur le Sida, hépatites virales B et C (ANRS) and the Agence Nationale de Recherche (ANR). He is an Associate Editor for the Journal of Hepatology and serves as a member of the editorial board of several journals.
Advanced Information-guided Surgery of Brain Tumors

**Professor Yoshihiro Muragaki**

Faculty of Advanced techno-surgery (FATS), Institute of advanced Biomedical Engineering & Science (ABMES), Graduate school of Medicine, Tokyo Women's Medical University (TWMU) and Department of Neurosurgery, TWMU, Japan

Objectivity and reproducibility required for surgical procedures in the 21st century can be provided by the medical engineering technology. We are developing cutting-edge medical systems and devices for highly precise information-guided brain surgery, which can be characterized as advanced surgeon’s eye, brain, and hand. Intelligent Operating Theater was established in Tokyo Women’s Medical University in 2000, and by this time we had experienced more than 1000 surgical cases with application of the intraoperative MRI, updated neuronavigation, advanced neurophysiological and histopathological monitoring. As a consequence the outcome of glioma management has been dramatically improved. Additionally we developed a dedicated computer-based system for accumulation, storing, integration, and analyzing of the various surgical data, which resulted in optimization of the surgical quality and safety. Application of such a system may enable adequate risk management and prediction of the surgical results. New therapeutic robot equipped with microcamera and dedicated forceps was developed to assist surgeon’s hand manipulations, whereas other devices applying such energy source as ultrasound and laser are currently under investigation. Our final goal is to integrate all these systems and devices into comprehensive surgical framework and to attain governmental authorization for its clinical use. The objective of the present report is overview of our experience with the advanced information-guided surgical management of brain tumors. This study is partly supported by The Japan Society for the Promotion of Science (JSPS) through the "Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program)" initiated by the Council for Science and Technology Policy (CSTP).

**Information-guided Surgery**

- higher resection rate + lower complication rate
- Anatomical Information (iMRI, update navigation)
- Metabolic Information (PET (methionine))
- Functional Information (mapping (awake), monitoring (MEP, SEP))
- Histological Information (Frozen section)

**Intelligent Operating Theater**

**References**

1. Iseki H et al, Stereotact Funct Neurosurg 76:159-67, 2001
Professor Yoshihiro Muragaki

Faculty of Advanced techno-surgery (FATS) Institute of advanced Biomedical Engineering & Science (ABMES), Graduate school of Medicine, Tokyo Women’s Medical University (TWMU) and Department of Neurosurgery, TWMU

Address: 8-1 Kawada-cho Shinjuku-ku Tokyo 162-8666 Japan

+81 35 367 99 45
+81 35 312 18 44
ymuragaki@abmes.twmu.ac.jp

Brief Biographical History:

1986-88 resident of department of neurosurgery Tokyo Women's Medical College
1988- attending staff of department of neurosurgery Tokyo Women’s Medical College
1992- board neurosurgeon of Japanese Neurosurgical Society
1992- 1995 visiting scientist of Department of pathology and laboratory Medicine of Pennsylvania University (USA; Prof. Trojanowski and Prof. Lee)
2006- assistant professor of Faculty of Advanced techno-surgery (FATS) and Department of Neurosurgery Tokyo Women's Medical University
2009- associate professor of FATS/Neurosurgery
2011- professor of FATS/Neurosurgery

Main Works:


Membership in Learned Societies:

The Japanese Society of Neurological Surgery
The Japanese Society of Neuropathology
The Japanese Computer Assisted Radiology and Surgery (JSCAS)
From Medical Images to Virtual Physiological Patients

Professor Nicholas Ayache

Research Director, Asclepios Project-Team, INRIA, Sophia Antipolis, France

In this talk I will show how Computational Sciences can exploit the information provided by structural and functional medical images acquired at various scales to build anatomical and physiological models of the patient useful for computer aided diagnosis, prognosis, and therapy. Applications in neurology, neuro-oncology, cardiology and probe-based confocal laser endomicroscopy will illustrate the talk.
Nicholas Ayache is a Research Director at Inria (French Research Institute for Computer Science and Applied Mathematics), Sophia-Antipolis, France where he leads the ASCLEPIOS research group on biomedical image analysis and simulation. Since January 2012, N. Ayache has also been Chief Scientific Officer of the newly created Institut Hospitalo Universitaire (IHU) of Strasbourg. N. Ayache has also been a scientific consultant for several industrial companies or international research institutes, and has been a co-founder of four start-up companies in image processing, computer vision, and biomedical imaging.

After his engineering degree (Ecole des Mines, 1980) and his Master of Science (UCLA, 1981), N. Ayache received his Ph.D in 1983, and his "Thèse d'Etat" in 1988, both in computer science, from the University of Paris XI, on the development of vision capabilities for autonomous robots.

Since 1988, N. Ayache’s research interests have been focused towards the creation of computational tools for the analysis of medical images, for image-guided therapy and surgery simulation. A central point of his research is the introduction of advanced geometrical, statistical, biophysical and functional models of the human body for the analysis and simulation of medical images.

N. Ayache is the author or editor of 10 books (including Artificial Vision for Mobile Robots (MIT-Press) and Computational Models for the Human Body (Wiley)), the author of 30 book chapters, 12 patents, and more than 400 peer-reviewed scientific publications which have received over 20,000 citations (h-index 79), according to Google Scholar (December 2012).

N. Ayache is the co-founder and co-Editor in Chief of the scientific journal Medical Image Analysis (Elsevier), an Associate Editor of Transactions on Medical Imaging (IEEE), a member of the editorial board of Computer Assisted Surgery (Wiley), and Medical Imaging Technology (Japanese Society of Medical Imaging), a member of the editorial board of Mathematical Modelling and Numerical Analysis (M2AN).

In 1995, N. Ayache chaired the first International Conference on Computer Vision, Virtual Reality, and Robotics in Medicine (CVRMed) held in Nice, and in 2003 he co-chaired the First Symposium on Surgery Simulation and Soft Tissue Modeling. In 2007 he was Program Chair of the MICCAI (Medical Image Computing and Computer Assisted Intervention) conference in Brisbane, and was elected General Chair of the MICCAI 2012 Conference held in Nice in Oct 2012.

Nicholas Ayache received in December 2006, the "EADS Grand Prize of Information Sciences and Applications" from a jury of French Academy of Sciences, in October 2007, the "Researcher of the Year award" from the "Nouvel Economiste" Journal and in October 2008 the "Microsoft Award for Science in Europe" awarded jointly by he Royal Society and the French Academy of Sciences.

In October 2011, Nicholas Ayache was awarded a prestigious ERC (European Research Council) advanced grant for the analysis of dynamic medical images (MedYMA 2012-2017).
Revolutionary procedures for minimally invasive endoscopic surgery

Professor Takeshi Ohdaira

Division of minimally invasive advanced medical science, Center for Advanced Medical Innovation, Kyushu University, Japan

Introduction: Aiming for complete cure of digestive lesions, we have made progress in evidence of surgical procedures. In recent years, various minimally invasive surgical treatments which minimizes invasion on sick persons have been focused on. And Single Port Surgery (SPS), Needleoscopic Surgery (NS), and Natural Orifice Transluminal Endoscopic Surgery (NOTES) have been examined. These treatment methods have merits and demerits respectively, so we have discussed which approach is less invasive as medical treatment for patients. However, without sticking to use only one surgical method, combination use of SPS • NS • NOTES also have been started to look for in view of safety and surgical efficiency. We reviewed the possibility of efficient integration of SPS • NS • NOTES in animal study and practical clinic by developing of innovative devices.

Methods: We developed new devices in the each area of SPS + NS + NOTES, and reviewed three possible combinations; SPS + NOTES, SPS + NS, and NS + NOTES. Animal testing: We conducted living-pig experiments and applied to human in clinical use. We performed SPS + NOTES, SPS + NS, and NS + NOTES with pig weighing 40Kg. As for NS + NOTES, taking its potential into consideration, we established a new operative procedure called Multi piercing surgery (MPS). We evaluated the weak points of SPS, that is clashing and securement of triangular formation, by using locus display of magnetic navigation system. The problem of vision which is weakness of NS was solved by using large caliber flexible endoscope with NOTES method, and defogging in body also cleared as well. It was revealed that NOTES method could carry specimen out of body even if its greatest dimension was over 6cm. Moreover, we made sure that it was possible to avoid damaging organs during operation in all cases. It was affirmed that the combination of minimally invasive surgical technique in clinical tests in human could provide more efficient and safe surgery.

Conclusion: One possibility is suggested that, as premises for combination use of SPS • NS • NOTES, development and use of innovative devices allow to perform minimally invasive treatment while keeping safety and efficiency.
Professor Takeshi Ohdaira

Division of minimally invasive advanced medical science, Center for Advanced Medical Innovation, Kyushu University, Japan

Address: Maedashi 3-1-1, Higashi-ku, Fukuoka-shi, Fukuoka-ken, JAPAN

☎️ +81 92 642 50 20 / 47 53
✉️ +81 92 642 47 54
✉️ takeshiws.ohdaira@nifty.com

EDUCATION/POST GRADUATE TRAINING:
Graduation:
1990 Saitama Medical School, Saitama, JAPAN
1990-1992 (Residency), Department of General and Digestive Surgery, Jichi Medical University, tochigi, JAPAN
1993-1995 (Fellowship) Department of General and Digestive Surgery, Jichi Medical University, tochigi, JAPAN
1998 Ph.D in Medicine

PREVIOUS PROFESSIONAL POSITIONS AND APPOINTMENTS:
1996-2001 Assistant Professor, Department of General and Digestive Surgery, Jichi Medical University, tochigi, JAPAN
2001-2003 Professor, Center of Post-graduate of Pre-hospital Emergency Medicine
2003-2008 Assistant Professor, Department of General and Digestive Surgery, Jichi Medical University, tochigi, JAPAN
2009-2010 Assistant Professor, Center for Integration of Advanced Medicine, Life Science and Innovative Technology, Kyushu University Hospital, JAPAN
2010-2011 Associate Professor, Center for Integration of Advanced Medicine, Life Science and Innovative Technology, Kyushu University Hospital, JAPAN

PRESENT POSITION OR ACADEMIC RANK:
* Professor, Division of minimally invasive advanced medical science, Center for Advanced Medical Innovation, Kyushu University
* Visiting Professor, Division of Gastroenterology, Department of Internal Medicine, Kobe University
* Visiting Professor, Department of economics, Fukuoka University

HONORS AND AWARDS:
2003, 2006, 2010, 2011 (Four times) Best Technology Award, European Association for Endoscopic Surgery (EAES)

PROFESSIONAL AND SOCIETY MEMBERSHIPS:
2002- Present A board certified surgeon of Japan Surgical Society
2005- Present A technical certified surgeon of the Japan Society for Endoscopic Surgery (JSES)
2006- Present A management councilor of Japan Society of Computer Aided Surgery
2009- Present A member of Society of American Gastrointestinal and Endoscopic Surgeons (SAGES)
Per-oral endoscopic myotomy (POEM) for esophageal achalasia

Professor Haruhiro Inoue

Digestive Disease Center, Showa University Northern Yokohama Hospital, Japan

Haruhiro Inoue, MD., Shin-ei Kudo, MD.

INTRODUCTION: To establish less invasive permanent treatment for esophageal achalasia based upon NOTES concept [1], per-oral endoscopic myotomy (POEM) was developed for esophageal achalasia. Submucosal tunneling [2] in submucosa was first created and then myotomy was carried out inside the tunnel. Animal experiment was reported by Pasricha J et al [3] and then we refined its techniques for clinical application [4].

Patients: POEM was performed in 275 consecutive cases of achalasia from September 2008 to September 2012 in our hospital. Among them 34 cases sigmoidal achalasia were involved.

IRB and IC: POEM got IRB approval from our hospital. Written informed consent was given to all patients.

PROCEDURE: Submucosal tunnel was around 15 cm on average. Endoscopic myotomy of was performed at approximately 13 cm in total length (10 cm in esophagus and 3 cm cardia). Smooth passing of endoscope through EG junction in the true esophageal lumen was confirmed at completion of myotomy.

RESULTS: In all cases dysphagia symptom significantly reduced. Chest pain was also dramatically improved. Resting pressure was 39.7 mmHg before POEM, and reduced to 12.5 mmHg after procedure. No major complications related to POEM were experienced. During follow-up period (longest 4 years), no additional treatment was necessary. Even in sigmoid type effects of POEM were remarkable. 10 cases of surgical failure (9 Lap-Heller Dor and 1 thoracoscopic myotomy) were also successfully treated by POEM.

CONCLUSION: Middle-term data of POEM was excellent with no serious complications.

2. Sumiyama et al. Gastrointest Endosc. 2007;65:679-83
Dr. Haruhiro Inoue was born in Fukuoka Prefecture of Japan in 1958. He received M.D. Degree from Yamaguchi University, School of Medicine in 1983. He started surgical training in 1983 at 1st Department of Surgery, Tokyo Medical and Dental University. Japanese National Board of General Surgery was issued in April 1987. Japanese National Board of Digestive Surgery was also issued in June 1990. Japanese National Board of Digestive Medicine was issued in December 1991. He got Ph. D. degree from Tokyo Medical & Dental University in December 1991.

He also got Japanese National Board of Gastroenterol Endoscopy in April 1993. In 1995 he visited Department of Surgery, University of Southern California. He received several award from oversea societies; Crystal award (honorary member) of ASGE (American society of gastrointestinal endoscopy) in 2006, Honorary member of Russian Society of Digestive Endoscopy (No.007) in 2010. He also received Pioneer in Endoscopy award from SAGES (Society of American Gastrointestinal Endoscopic Surgeons) in 2011. He published more than 80 articles in English.
From virtual patient to augmented reality intra-operative assistance

Professor Luc Soler

Head of R&D Department, IRCAD, Department of General and Digestive Surgery, University of Strasbourg, France

Medical image processing led to a major improvement of patient care by guiding the surgical gesture. From these initial data, new technologies of virtual reality and augmented reality can increase the potential of such images. The 3D modeling of patients from their CT-scan or MRI thus allows an improved surgical planning. Simulation offers the opportunity to train the surgical gesture before carrying it out. These two preoperative steps can be used intra-operatively thanks to the development of augmented reality (AR) which consists in superimposing the pre-operative 3D modeling of the patient onto the real intra-operative view of the patient. AR provides surgeons with a view in transparency of their patient and can also guide surgeons thanks to the virtual improvement of their real surgical tools that are tracked in real time during the procedure. During the intervention, augmented reality therefore offers surgeons a view in transparency of their patient, what tomorrow will lead to the automation of the most complex manoeuvres. In the near future, thanks to the exploitation of these systems, surgeons will program and check on the virtual clone of the patient an optimal procedure without errors, which will be replayed on the real patient by the robot under surgeon control. This medical dream used to be virtual, but today it is about to become reality.
Luc Soler was born on 6th October 1969. In 1999, he was valedictorian for the magister at the Higher Education Computer Science School of the Paris University. He obtained his PhD in Computer Sciences in 1998. Since 1999, he is a research project manager in computer sciences and robotics at the Research Institute against Digestive Cancer (IRCAD, Strasbourg). In October 2000, he joined the surgical team of Professor Marescaux as invited professor at the Medical Faculty of Strasbourg. His main areas of interest are medical image processing, 3D modelling, virtual and augmented reality, surgical robotics and abdominal anatomy. In 1999, his research work has been awarded with a Computer World Smithsonian Award, in 2003 with the first World Summit Award in the eHealth category, in 2004 with the «Best Vision Paper » of IEEE Robotics & automation society, in 2005 with the 2nd international award of the « Sensable Developer Challenge », in 2006 with the « Le monde de l'informatique » trophy in Health category and in 2008 and 2009 with the first prize of the Kitware Best biomedical Vizualisation award of MICCAI.
Minimally invasive surgery for colorectal cancer based on virtual surgical anatomy

Professor Junji Okuda

Department of General & Gastroenterological Surgery, Osaka Medical College, Takatsuki-City, Osaka, Japan

The conventional oncologic principles can be maintained in laparoscopic surgery. For advanced right colon cancer, we perform lymph node dissection exposing so called the surgical trunk. For the resection of advanced distal sigmoid/rectal cancer, we routinely perform lymph node dissection around root of IMA with preserving the left colic artery. For either of these procedures performing safely, it is important to know the precise individual vascular anatomy bearing their variations. However, there are major issues in laparoscopic surgery, such as no tactile sensation, limitation on visual fields. To overcome these issues and to accurately identify the vascular anatomy of each patient, we have applied Integrated 3D-CT imaging as preoperative simulation and intraoperative navigation since July, 2000. Integrated 3D-CT imaging appears to be quite useful especially for cancer located around the left flexure of transverse colon, where there are major variations on vascular anatomy. Using no-touch technique appropriately under the precise recognition of laparoscopic surgical anatomy, additionally simulated and navigated by Integrated 3D-CT imaging for each patient, systematic lymphadenectomy with tailor-made vascular dissection by laparoscopy appears to be feasible and more meticulous compared to one by conventional open surgery. Until this October, we did more than 3000 colorectal cancer surgeries by laparoscopy. In this presentation, we will demonstrate our advanced laparoscopic colorectal surgery based on 3D-CT imaging including surrounding organs as virtual surgical anatomy.
Professor Junji Okuda

Department of General & Gastroenterological Surgery, Osaka Medical College, Japan

Address: 2-7 Daigakumachi, Takatsuki-City, Osaka 569-8686, Japan

☎ +81 72 683 12 21 (Ext. 2361/2541)
✉ +81 72 685 20 57
✉ sur017@poh.osaka-med.ac.jp

Education/Degrees:

1996 Ph.D. (Dr. of Medical Science), Osaka Medical College
(Thesis: Mutant p53 protein in relation to growth and progression of superficial type colorectal tumors)

1984 M.D. magna cum laude, Osaka Medical College

APPOINTMENTS

Present Position:

Supervisor, Section of Minimally Invasive Surgery
Supervisor, Section of Colorectal Surgery
Associated Professor & Chief Staff

Department of General & Gastroenterological Surgery
Osaka Medical College

1996 Research Fellow, Department of Colorectal Surgery, The Cleveland Foundation, OH, USA

- One of the pioneers & experts of laparoscopic colorectal surgery in Japan
- More than 3500 laparoscopic colorectal surgeries
- Mainly laparoscopic colorectal cancer surgery (more than 3000 cases)
Innovative minimally invasive surgical simulation and navigation system using Bio-Texture Modeling technology

Professor Maki Sugimoto
Associate Professor of Gastroenterology, Kobe University Graduate School of Medicine, National University Corporation, Japan

Our new technique of Bio-Texture Modeling by multimaterial 3D printing system enabled manufacturing patient-specific 3D organ models by simultaneous jetting of different types of model materials. We evaluate an anatomical 3D rapid prototyping modeling to facilitate planning and execution of the surgical procedures and educational aspects.

Based on CT and MRI images, regions of interest were segmented using OsiriX software. After generating an STL-file out of the patient's data set, the inkjet 3D printer created a 3D multimaterial organ model. This system enabled the simultaneous use of two different rigid materials, two flexible materials, one of each type, any combination with transparent material, or two jets of the same material to form 3D organ textures and structures. The patient individual 3D printed models were used to plan and guide the successful laparoscopic and robotic surgery.

The 3D objects using combination of transparent and soft materials allowed creation of translucent medical models that show visceral organs and other details that can be handled, overcome the limitation of the conventional image-guided navigation. This enabled each composite material to provide specific values of bio-texture for tensile strength and elongation to break for training of pre-surgical dissection and suturing procedures.

These technologies provided better anatomical reference tool as a tailor-made surgical simulation and navigation, and contribute to medical safety/accuracy, less-invasiveness and improvement of the medical education for students and trainees.

The bio-texture modeling by multimaterial 3D printing system combines the advantages of conventional 3D modeling, precise virtual 3D planning in minimally invasive laparoscopic and robotic surgery.
Professor Maki Sugimoto

Associate Professor of Gastroenterology,
Kobe University Graduate School of Medicine,
National University Corporation, Japan

Address: 7-5-1 Kusunoki-cho Chuo-ku Kobe Hyogo, 650-0017 JAPAN

☎️ +81 78 382 63 05
☎️ +81 78 382 63 09
✉️ sgmt@med.kobe-u.ac.jp

Education and Professional Experience

1996-; Resident Department of Surgery, Teikyo University school of medicine
1998-; Resident Department of Surgery, National Tokyo Medical Center
2000-; Post graduated fellow Department of Surgery, Teikyo University school of medicine TOKYO
2004 ; Ph.D. (Medical Science) Teikyo University graduate school of medicine TOKYO
2004-; Fellow Department of Surgery, Teikyo University school of medicine TOKYO
2004-; Assistant professor Department of Surgery, Teikyo University school of medicine Ichihara hospital CHIBA
2008-; Visiting fellow Department of GI endoscopy, Veterans Affairs Palo Alto Health Care System, Palo Alto, CA, USA
2009-; Associate Professor Department of gastroenterology, Kobe University Graduate School of Medicine KOBE

Professional Society

International Society of Surgery (Active member, 2005-)
FICS: Fellow of International College of Surgeons (2006-)
SAGES (International member, 2009-)
RSNA (Active member, 2006-)
SMIT (Active member, 2007-)
The Japan Surgical Society (Board Certified surgeon, 2004-)
Japan Gastroenterological Endoscopy Society (Board Certified endoscopist, 2009-)
The Japan Society of Endoscopic Surgery (JSES) (Holder of Endoscopic Surgical Skill Qualification, 2007-)
Professor Didier Mutter

Vice President, IRCAD
Department of General and Digestive Surgery,
University of Strasbourg, France

Address: 1 place de l'Hôpital, 67091 Strasbourg Cedex, FRANCE

+33 3 88 11 90 41
+33 3 88 11 90 99
didier.mutter@ircad.fr

Professor Didier Mutter is recognized worldwide as an outstanding Surgeon in digestive and endocrine surgery at the University Hospital of Strasbourg, a Professor at the University of Medicine of Strasbourg and a Researcher in the field of minimally invasive surgery at the IRCAD Institute of Strasbourg.

Born in 1959, he studied at the University of Strasbourg, the largest university in France, ranking among the best in Europe. His excellent educational background includes a residency in General and Digestive Surgery, a graduation in Medical Studies with Honours, a PhD in sciences as well as a University Professor degree.

Highly interested in new technologies, information age and robotics, he helped to create in 1994 under the leadership of Professor Jacques Marescaux the IRCAD (Research Institute Against Digestive Cancer) and the EITS (European Institute for TeleSurgery). As a Vice-President of the Institute since the beginning, he has been implied in the launching and in the sustainable development of different medical programs and courses at the three IRCAD sites (Strasbourg, Taiwan, Brazil), let alone his dedication, as Associate Editor, to WebSurg, the World Electronic Book of Surgery.

Professor Mutter is convinced that the image-guided surgery will be of major importance in the years to come and lead to innovative win-win operating techniques and practises. His daily involvement as a Surgeon at the University Hospital of Strasbourg and as a Professor at the University of Medicine of Strasbourg clearly contributes to pave the way both in the theoretical and practical fields of activity.

Professor Mutter has authored over two hundred peer-reviewed scientific publications and over one hundred videos. As a guest speaker, he took part in more than four hundred national and international conferences.
Professor Nobuhiko Tanigawa

President & Director, Tanigawa Memorial Hospital
Emeritus Professor, Osaka Medical College
Trustee, Foundation of Kobe International Medical Exchange Foundation
Governor at large from Japan, American College of Surgeons

Address: 1-16-59 Kasuga, Ibaraki City, Osaka, 567-0031, JAPAN
☎ +81 72 622 3833
☎ +81 72 625 2785
✉ tanigawa@tanigawa-hp.or.jp

EDUCATION & CREDENTIALS

October, 2009: Member for Merit, The Japanese Association for Clinical Oncology
February, 2009: Honorary Member, The Japanese Association for Gastric Cancer
October, 2007: Governor at large from Japan, American College of Surgeons

May, 1979: Doctor of Medical Science (Ph.D.) (Kyoto University)
April, 1974 — October 1977: Postgraduate School, Faculty of Medicine, Kyoto University, Kyoto, Japan
June, 1970: Medical License, Japan (Certificate No. 206695)
April 1963 — March 1970: Kyoto University Faculty of Medicine, Kyoto, Japan

AWARDS

December, 1987: Japanese Foundation for Multidisciplinary Treatment of Cancer
The general research grant
January, 2006: Chevalier de l’Ordre National du Merite

SPECIALITY AND RESEARCH FIELD OF INTEREST

Gastrointestinal Surgery, Endoscopic Surgery, Gastric Cancer,
Surgical Oncology, Cancer Chemotherapy, Chemosensitivity testing