Programme
Fédération de médecine Translationnelle de Strasbourg
Séminaire international en Ingenierie Biomédicale
19 Septembre 2017 - Strasbourg

Programme Biomatériaux, Imagerie et Robotique Médicale de la Fédération de Médecine Translationnelle de Strasbourg

Localisation : Forum de la Faculté de Médecine
Amphithéâtre 301
4 Rue Kirschleger, 67000 Strasbourg
Tuesday September 19th, 2017
“Translating innovations to healthcare applications”

8h45 - 12h30  Technologies for health - Strasbourg presentations

8h45 - 9h00 : Welcome and introduction
Sylvain Gioux (ICube)

9h00 - 9h30 : Improving patient safety through real-time numerical simulation
Stéphane Cotin (ICube / INRIA)

9h30 - 10h00 : Image Guided Minimally Invasive Hybrid Surgery
Luc Soler (IRCAD / IHU)

10h00 - 10h30  Coffee Break

10h30 - 11h00 : A telemanipulated robotic system for assistance to intraluminal surgery
Florent Nageotte (ICube) & Bernard Dallemagne (IRCAD / IHU)

11h00 - 11h30 : Personalized neuromodulation for neuropsychiatric disorder: from bench to bedside
Jack Foucher (ICube) & Michel Berg (Axilum Robotics)

11h30 - 12h00 : Optical coherence tomography for diagnosing and image guidance
Michalina Gora (ICube)

12h00 - 12h30 : Mechanical numerical models to help surgeons solving unmet clinical needs
Nadia Bahlouli & Daniel George (ICube)

12h30 - 14h00  Lunch

14h00 - 16h30  Technologies for health - Invited presentations

14h00 - 14h30 : ICube and Strasbourg: Towards efficient clinical translation of novel technologies
Michel de Mathelin (ICube)

14h30 - 15h00 : Medical procedure assistance on machine learning for medical images
Kensaku Mori (Nagoya University)

15h00 - 15h30 : Translation of healthcare technologies at NC State and UNC
Andrew DiMeo & David Lalush (NC State and UNC)

15h30 - 16h00 : The Medical Device Center at University of Minnesota
Gregory Peterson (Medical Device Center, U Minnesota)

16h00 - 16h30  Coffee Break

16h30 - 18h00  Panel Debate: Translating innovations into healthcare applications
Fabienne Mathon (SATT Conectus)
Julie Freydiere (Alsace Biovalley)
Nicolas Pellerin (Eurométropole)
Magali Lagrange (SEMIA)
Jean-Luc Dimarcq (IHU)
**ABSTRACTS:**

**Improving patient safety through real-time numerical simulation**  
Stéphane Cotin (ICube / INRIA)

While medical imaging has become an integral part of today's medicine, new fields are emerging, such as robotics, simulation, augmented reality, or workflow analysis. In this talk I will present several applications of real-time numerical simulation in various domains, such as ophthalmology and laparoscopic surgery. I will also describe how some of this research lead to a successful technology transfer and the creation of a start-up company.

**Image Guided Minimally Invasive Hybrid Surgery**  
Luc Soler (IRCAD / IHU)

A new surgery of soft tissues is about to rise: Image-Guided Hybrid Minimally Invasive Surgery. It consists in combining technologies of conventional minimally invasive surgery using rigid endoscopes, gastroenterology using flexible endoscopes and interventional radiology using intraoperative medical imaging. The development of computer-assisted surgery is here mandatory to obtain efficient clinical results demonstrating benefits for the patient, reducing pain and post-operative complications. This computer-assisted surgery can be summarized in three major steps.

The first one consists in preoperative surgical planning and simulation from personalized 3D modelling of patients. Today, the Visible Patient service developed during the European Passport Project allows to model patients in 3D from their CT-scan or MRI. From this virtual patient clone, practitioners can preoperatively plan the surgical intervention and decide over the best treatment to apply.

The second one consists in intraoperatively superimposing preoperative data onto the real view of patients. This Augmented Reality provides surgeons a view in transparency of their patient allowing to track instruments and improve pathology targeting. Initially interactive, this Augmented Reality was user dependent and limited to rigid registration, and could thus not took organ deformation into account. The latest generation of fully automatic augmented reality overcomes such limits by using an intraoperative 3D medical image acquisition and associated non rigid temporal registration algorithm.

The third one consists in robotizing the procedure by replacing human gesture by a robotic gesture that can be automated. Such automation needs the use of automated augmented reality that gives in real-time the special position and shape of organs and internal vascular and pathological structures. We have thus first plugged the existing surgical robot to our virtual and augmented reality systems. In parallel, we have developed new flexible surgical robots allowing us to control their movement. It gives us today for instance the possibility to automatically filter in real-time breathing movements during surgery in transluminal or single port surgery.

We will present these concepts and current applications of this Image-Guided Hybrid Minimally Invasive Surgery, and future perspectives in this domain.

**A telemanipulated robotic system for assistance to intraluminal surgery**  
Florent Nageotte (ICube) & Bernard Dallemagne (IRCAD / IHU)

Intraluminal surgery is an attracting technique for surgical procedures in the digestive tract since it avoids any visible scar for the patient. However, it is a very demanding technique for surgeons when realized with manual instruments. Indeed, on the one hand conventional instruments used with standard endoscopes lack distal mobilities. On the other hand, surgical platforms such as the Anubiscope® from Karl Storz, are difficult to control from the proximal side and require at least two skilled physicians who must collaborate in a very limited workspace.

As a consequence only very skilled surgeons and endoscopists are currently able to perform advanced treatments, such as Endoscopic Submucosal Dissection (ESD) with the available manual instruments. This unfortunately limits the availability of interesting treatments for many patients.

In this talk we will present the development of a robotic device called STRAS, which allows to solve most of the mentioned issues through the motorization of flexible endoscopic systems. We will explain how this system was designed starting from the medical constraints and we will show the results of preclinical trials performed on swines at the IRCAD in Strasbourg for ESD procedures.
**Personalized neuromodulation for neuropsychiatric disorder: from bench to bedside**  
Jack Foucher (ICube) & Michel Berg (Axilum Robotics)

The CEMNIS, non-invasive neuromodulation center of Strasbourg, emerged from the ambition to develop patient-adapted therapies to circumvent the poor pathophysiological foundation of neuropsychiatric disorders. Therefore, we first developed reliable imaging and analysis procedures to determine the functional basis of the single patient’s symptoms. Secondly, to correct these functional anomalies with transcranial magnetic stimulation (TMS), we developed a robotic positioning device to target precisely the abnormal regions, allowing the creation of a spin off, Axilum Robotics. The CEMNIS is now involved in the clinical validation of these personalized therapies.

**Optical coherence tomography for diagnosing and image guidance**  
Michalina Gora (ICube)

Optical coherence tomography (OCT) is an imaging method that uses near-infrared light to provide images of internal tissue structures. Cross-sectional OCT images can cover up to 3 mm inside of the tissue and are similar to those from the ultrasound but have much higher resolution. The unique information on microscopic architectural morphology delivered by OCT in real-time, in a non-invasive way, and without a need of application of contrasts can be used similarly to histology to render diagnosis. In only 25 years from its introduction, this optical imaging technology has become a standard of care in ophthalmology. According to the Research and Markets company, the OCT market will reach 1.32 billion of US$ by 2020. That also includes growing research and commercialization efforts in application of OCT for imaging of internal organs in cardiovascular and digestive systems. Examples and challenges of the translational research in OCT will be presented with the main focus on evolution from imaging to guidance of interventional procedures in the digestive system.

**Mechanical numerical models to help surgeons solving unmet clinical needs**  
Nadia Bahlouli & Daniel George (ICube)

The works developed within our team focus mainly on the understanding, modeling and numerical simulations of the mechanical behavior of media with evolutionary microstructure. For this, we develop and use biophysical micro-macro approaches and multi-scale mechanics that integrate scale-up techniques specifically designed for biological tissues and based on imaging tools for the mechanical characterization of biological tissues. The themes coherence is here linked to the study of the constitutive laws associated with the materials whose microstructure play an important role. Those materials may be biological (skull, brain, bone, tendon, etc.), but also (bio)compatible polymers or composites that can be used in biological applications such as bone substitutes or hip prostheses. The existing links between the projects are defined through experimental approaches or numerical modeling and simulations accounting for the biology, physics and chemistry of the materials to better understand and optimize their physical and mechanical properties.