ESF EMRC Exploratory Workshop on

Image-guided Laparoscopic Therapies

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Jesús Usón Minimally Invasive Surgery Centre

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Abstracts

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Content

Session 1: Introduction and MIS needs

Presentation 1: "New approaches of laparoscopic therapies"

Francisco M. Sánchez-Margallo – Jesús Usón Minimally Invasive Surgery Centre

Minimally invasive instruments and techniques allow surgeons to operate through really small surgical openings rather than the much larger incisions required by traditional surgery that cut through large areas of skin and muscle. The system gives surgeons a clear view of vital anatomical structures and more control over very precise movements. For many procedures, this type of surgery is just as effective as traditional surgery offering several benefits to the patient:

- Less pain
- Less risk of infection
- Less blood loss and transfusions
- Shorter hospital stay
- Less scarring
- Faster recovery

One recent innovation in minimally invasive surgery, as the Robotic Surgical Systems are, is a computer-enhanced system that can replicate the surgeon's movements with greater range of motion than previously available in standard minimally invasive surgical instrumentations. It consists of three components: physician console, robotic arms, and a monitor. This equipment assists surgeons performing cardio thoracic, urologic and gynecologic surgery.

Within the development of minimally invasive surgeries, the new concept of scarless surgery has emerged. Laparoendoscopic single-site surgery (LESS) and natural orifice transluminal endoscopic surgery (NOTES) are included in this concept, and they are the evolution of laparoscopy towards minimising the impact of surgery on the patient. Both hybrid NOTES and LESS have proven their feasibility in surgery; however, we still do not have any evidence that they can overcome laparoscopic surgery.

Multiple challenges associated with surgical training will be discussed during this presentation. Laparoscopic surgery is commonly used in many surgical procedures but requires a learning process to develop the necessary skills. Virtual reality (VR) simulators and Web-based instructional videos are valuable supplemental training resources in surgical programs, but it is unclear how to optimally integrate them into minimally invasive surgical training. Virtual reality and Augmented reality are two heavy research fields in order to develop new applications during the training program and clinical use of minimally invasive surgery. The objective assessment, intelligent proctoring, preoperative planning or intraoperative navigation are some interesting research lines for our group.

The development of advanced visualizations techniques can enhance the anatomical information available for the surgeon. This information could be useful during the surgical planning as well as for guidance and control during laparoscopic treatment. A new concept of Operating rooms designed for high-efficiency and high-technology including robotics, minimally invasive surgery, telemedicine, voice-activated systems, high-definition images, etc. is appearing. The combination and integration of imaging systems for surgery will be part of research in the coming years.

Presentation 2: "The importance of intraoperative imaging and navigation technologies in MIS"

Thomas Langø - SINTEF, Dept. Medical Technology

In minimally invasive interventions, the operator has to rely on very limited view, almost no tactile information, complex instrument manipulation, and limited interaction and control of the target inside the body. In laparoscopic surgery, the endoscopic camera is used in combination with rigid or flexible instruments, while in procedures such as bronchoscopy or endoluminal surgery, the operator is bound by the limits of the flexible camera and its working channel. These aspects limits the usefulness of these image guided diagnostics and treatment procedures.

To improve image guided interventions, we are developing a system with navigation based on both optical and electromagnetic (EM) tracking capabilities. Ultrasound and cone beam CT (CBCT) are intraoperative imaging modalities, both with 2D and 3D possibilities. The research navigation platform is based on user instrument controlled visualization methods and capable of importing preoperative images like MRI and CT (tissue, vessels, functional data). The preoperative images provides the surgeon with an overview of anatomy beyond the surface of organs seen with video-laparoscope, while ultrasound and CBCT images present real time updates of the map of the anatomy and pathology during therapy.

We have demonstrated the navigation system in clinical use in laparoscopy in the retroperitoneum (mainly adrenalectomies) based on preoperative CT images, in endovascular therapy based on intraoperative CBCT, and in neurosurgery based on intraoperative ultrasound as the main imaging modality. Furthermore, in preclinical studies, we are assessing EM based tracking of flexible instruments in laparoscopy, bronchoscopy, and other procedures. Studies on live animal trials are in publication to demonstrate potential.

We have found that EM based navigation can be performed with high accuracy but there are certain challenges that have to be adressed concerning CBCT using a robotic C-arm and also for navigated laparoscopic ultrasound during liver resections. Nevertheless, navigation principles together with advanced and flexible intraoperative visualization methods can be a valuable tool by increasing the usefulness and potential for minimal access interventions.

Presentation 3: "Image-Guided Technologies for Minimally Invasive Surgery"

Enrique J Gómez - Bioengineering and Telemedicine Centre

Image-guided interventions are computer-aided surgical techniques that provide additional intraoperative information to physicians. In order to improve surgical practice and patient safety, surgical navigators aim to allow surgeons to precisely visualize and target the surgical site. Image-guided surgical research field has been greatly expanded by the advances in medical imaging and computing techniques over the last years. Difficulties arise in soft-tissue surgeries due to organ shifting and tissue deformation, caused by breathing, heartbeat, patient movement, and surgeon's manipulation. The motivation of this research field is the efficient introduction and use in the operating room (OR) of the rich information available preoperatively from medical imaging studies and its fusion with intraoperative information for the interventional guidance.

This presentation gives an overview of methods and technologies of image guided surgery applications, mainly focused on tracking, 3D reconstruction, registration and visualization of the surgical scene. Discussion will highlight the role of medical images and surgical video in the development of these new navigation systems.

Session 2: Image-Guided Interventions Part I

Presentation 4: "Intra-operative image acquisition"

Stijn de Buck – Medical Imaging Center

Visible perception of the human interior has been a key enabling factor for many of the current minimally invasive interventions. However, visible imaging in itself is not always sufficient and in some cases it lacks essential information to perform successful and safe minimally invasive surgery. Other imaging techniques are therefore required and become more and more diverse in recent years.

An overview will be given of existing intra-operative imaging acquisition techniques. Traditional endoscopic image formation will be discussed together with its recent innovations. Visible light image acquisition techniques that are still situated in a research context also include multi-spectral, confocal micro-endoscopy and optical coherence tomography. Next to visible light, intraoperative information can also be obtained from X-ray imaging, ultrasound imaging, magnetic resonance imaging and even functional imaging. Advantages of intra-operative 3D imaging will be demonstrated by a case study on cardiac image acquisition.

Finally, problems and opportunities relating to effective clinical use of intra-operative imaging will be discussed.

Presentation 5: "Considerations on 3D Models for interactive surgery"

João Oliveira - International Centre for Technologies in Virtual Reality

Iso-surface extraction techniques such as marching cubes and other surface reconstruction techniques allow one to create polygonal models that can be converted to parametric surfaces for interactive surface deformation simulation, finite element analysis, or just visual inspection of bones or organs.

These polygonal models, however invariantly have geometric pathologies such as non-manifold surfaces, duplicate vertices, and inconsistent surface normals amongst other problems that hinder the task of geometric processing algorithms such as decimation, or visualization.

This talk, covers some of these issues which are important to address in the construction of models for interactive surgery and presents solutions.

Presentation 6: "3D image processing for image-guided therapies"

Kawal Rhode – King's College London

Many cardiac pathologies can now be treated using minimally invasive catheter-based procedures. These procedures are conventionally guided using two-dimensional x-ray fluoroscopy and can be challenging due to the requirements of accurately positioning catheters within the heart and great vessels, structures that are not visualised by the penetrating x-ray radiation without the use of contrast agents.

This presentation will outline methods that have been developed to guide catheter-based procedures using live x-ray fusion to three-dimensional (3D) cardiac anatomical models derived from imaging modalities such as magnetic resonance imaging, computerized tomography, ultrasound and 3D rotational angiography. The methods include the use of hybrid imaging systems and also conventional catheter laboratories. Methods will also be described for the correction of patient motion, such as bulk, cardiac, and respiratory motions.

The integration of motion-corrected anatomical information with live x-ray allows the derivation of the 3D spatial location of catheters within the patient anatomy and therefore the measurements made by these devices, such as electrical signals, pressure, and flow.

The presentation will conclude will an outline of the challenges that lie ahead in order to translate image-guided solutions into the clinical cardiac catheterization laboratory.

Presentation 7: "Intra-operative surface reconstruction for Augmented Reality (AR) guidance in computer-assisted laparoscopic interventions"

Lena Maier-Hein - German Cancer Research Center, Division of Medical and Biological Informatics

One of the main challenges in computer-assisted interventions is the intra-operative imaging of tissue shape, motion and morphology. This information is a prerequisite for the registration of multi-modal patient specific data that can be used for surgical planning, diagnosis and intra-operative guidance. In the context of minimally invasive surgery, an increasingly attractive approach involves 3D reconstruction of the soft-tissue surfaces using optical techniques. This talk introduces different state-of-the-art methods for intra-operative 3D surface reconstruction and discusses their advantages and limitations in the context of augmented reality guidance in laparoscopic interventions.

Presentation 8: "Intra-operative Navigation: Calibration and Visualization"

Stefanie Demirci - Teschnische Universität München,

In recent years, an increasing number of liver tumor indications were treated by minimally invasive laparoscopic resection. Besides the restricted view, two major intraoperative issues in laparoscopic liver resection are the optimal planning of ports as well as the enhanced visualization of (hidden) vessels, which supply the tumorous liver segment and thus need to be divided prior to the resection.

For most navigation solutions, surgeons need to update their surgical planning based on actual patient data after organ deformations. Therefore, preoperative imaging data can hardly be used. Instead, CAMP has proposed to use an optically tracked mobile C-arm providing cone-beam CT imaging capability intraoperatively and thereby providing a 3-D reconstructed volume with enhanced vessels during patient exhalation. Without any further need for patient registration, the reconstructed volume can be directly augmented on the live laparoscope video. The augmentation provides the surgeon with advanced visual aid for the localization of veins, arteries, and bile ducts to be divided or sealed.

CAMP has proposed a novel interventional nuclear imaging technique consisting of the synchronized acquisition of position, orientation and readings of gamma probes intra-operatively to reconstruct a 3D activity volume. This technology has the potential to advance standard procedures towards intra-operative 3D nuclear imaging and offers a novel approach for robust and precise localization of functional information to facilitate less invasive, image-guided surgery.

One major issue still hindering AR technology to be regularly used in laparoscopic interventions is the interaction between physician and the superimposed 3-D virtual data. CAMP has introduced the concept of a tangible/controllable Virtual Mirror for medical AR applications. This concept intuitively augments the direct view of the surgeon with all desired views on volumetric medical imaging data registered with the operation site without moving around the operating table or displacing the patient.

Presentation 9: "The Resection Map as guidance during liver interventions"

Pablo Lamata - University of Oxford

There is currently a wealth of information in medical images, and a lack of means for its intuitive and efficient use for surgical guidance. The main challenge is to solve in soft tissue surgical procedures is the image to physical registration. This presentation introduces the concept of "mental registration" to address this bottleneck, and illustrates an example of use in hepatic procedures: the Resection Map system.

Presentation 10: "Model based liver segmentation for surgery planning"

Martijn Hemeryck – Medical Imaging Center

Careful planning of interventions like liver surgery can have an impact on the outcome of the surgical procedure. In addition, such planning can be used during the surgery to improve the surgery itself. The planning step can be simplified by automating the segmentation of pre-interventional (CT) imaging.

In this talk a number of model based segmentation techniques, which were developed in our center, will be presented. Such model-based segmentation techniques can provide a generic approach to segment multiple anatomical structures. They can limit the user-dependency and can be fully automated. The presented approaches include heuristic, statistical and physiological models to segment the liver, possible tumor tissue and liver blood vessel trees.

Session 2: Image-Guided Interventions Part II

Presentation 11: "Laparoscopic video analysis as an intraoperative source of information"

Patricia Sánchez - González (Bioengineering and Telemedicine Centre, Universidad Politécnica de Madrid, Madrid, Spain)

During a minimally invasive intervention, surgeons must navigate the anatomical landscape without the usual sensory clues. In order to improve surgical practice and patient safety, surgical navigation systems allow to transfer preoperative data, images and decisions to the operating room (OR), and to give the surgeon guidance during the procedure. Traditional navigation systems require medical equipment, disturbing physicians during the procedure. Automatic analysis of minimally invasive surgical video has the potential to drive new solutions that alleviate existing needs for safer surgeries: reproducible training programs, objective and transparent assessment systems and navigation tools to assist surgeons and improve patient safety. Laparoscopic video images are an always available source of information and can be used without extra technological components in the OR. As an unobtrusive source of information in the OR, this research proposes its use for extracting useful information during surgical operations. Surgical video sequences provide information of instruments and organs, surgical maneuvers, measurements of distances or even an approximate 3D reconstruction of the surgical scene. The motivation for these solutions is the augmentation of the laparoscopic view in order to provide orientation aids, optimal surgical path visualization, or preoperative virtual models overlay.

Presentation 12: "MITK platform for developing new navigation systems"

Matthias Baumhauer - German Cancer Research Center, Division of Medical and Biological Informatics

Doing research in the field of surgical navigation is a challenging task – systems and prototypes have to face highest demands in terms of accuracy, robustness, and ease of use. As of 2008, about 80 % of all publications w.r.t. surgical navigation systems for endoscopic soft tissue surgery have been evaluated either by in-silico, or by in-vitro experiments. This indicates, that in particular the translation of medical computer science related research work into clinical research and patient studies is a bottleneck to research progress. One major reason for this can be found in the huge challenges for research groups to develop feasible prototypes with reasonable effort.

This talk will address the challenges of surgical navigation with respect to research platforms for rapid application prototyping. It will introduce the MITK (Medical Imaging Interaction Toolkit, http://www.mitk.org), an open-source software package maintained by the German Cancer Research Center, and gives insight about how MITK leverages the workload in developing navigation systems. Furthermore, the international software platform initiative CTK, the Common Toolkit (http://www.common-tk.org) will be introduced in context to existing software platforms

Presentation 13: "Real-time detection and tracking for Augmented Reality environments"

Judith Mühl - Institute for graphics and computer vision

Augmenting reality is an emerging technique to support difficult tasks in real life with a new user interface and new interaction techniques. "Augmented Reality combines real and virtual, is interactive in real time and is registered in 3D." [Azuma] So to be able to use augmented reality tracking is one of the most demanding, but absolutely necessary tasks. Without tracking there is no registration in 3D and no relationship between real and virtual parts of the scene.

Tracking concerns identification of real elements in a scene and determination (measurement) of position and orientation in real space. There are several techniques how to solve this problem. Most used is either electromagnetic or else optical tracking. All methods have their specific advantages and drawbacks and sometimes need to be combined to deliver satisfactory results. Furthermore, software or system development in a medical environment has highest demands in safety and most demanding standards which need to be met. Therefore, only specifically developed technology can be put into use. My talk will show possibilities and difficulties using existing tracking technology. I will discuss which technologies to best use in which situations, where rapid prototyping can be achieved as an intermediary step, and how to overcome some of the difficulties aligned with the subject.

[Azuma] R. Azuma, A Survey of Augmented Reality Presence: Teleoperators and Virtual Environments, pp. 355–385, August 1997.

Presentation 14: "Biomechanical models of soft tissues: real-time applications"

Estefanía Peña - University of Zaragoza

Accurate determination of the biomechanical implications of minimally invasive surgeries on patients requires developing patient-specific models of the organ or vessel under consideration. In this regard, combining the development of advanced constitutive laws that mimic the behavior of the soft biological tissue with advanced computer analysis and medical imaging techniques provides a powerful tool for modeling vascular tissues on a patient-specific basis. A material models for developing patient-specific simulations of soft tissue geometries obtained from medical imaging techniques is presented.

The general framework is demonstrated in a several examples showing the capabilities of the framework in modeling minimally invasive surgeries such us angioplasty, stent insertion or extraction of retrieval filters.

Presentation 15: "Intraoperative tracking for laparoscopic surgery"

Sandrine Voros - Laboratoire TIMC-IMAG

This presentation focuses on research performed at the TIMC-IMAG laboratory, in Grenoble, France, around « intraoperative tracking for laparoscopic surgery ». We will present a new 3D tool tracking method based on statistical and geometric modelling from 2D laparoscopic images along with our preliminary results on a testbench. We will also briefly mention another project involving the development of a robot for US guided needle insertions for brachytherapy. This second project includes a 3D US elastic registration of the prostate.

Presentation 16: "3D reconstruction of the surgical scene using structured light"

Marcos A. Rodrigues (Sheffiled Hallam University, Sheffield, UK)

In this presentation we will briefly discuss the principles of structured light and some of its advantages and limitations in relation to other 3D imaging methods. We will then discuss the sequence of processing that is required for 3D reconstruction. This will include 2D image filters, stripe detection and indexing, 3D reconstruction into a point cloud, and 3D post-processing operations such as mesh triangulation, noise removal and smoothing. We will also discuss calibration requirements and procedures, and the system's performance and its real-time capabilities for integration to augmented reality scene reconstruction.

Presentation 17: "The role of industry in the progress of image-guided procedures"

John Hyde - Perception Sensors & Instrumentation Ltd

Recent advances in imaging technology has led to the employment of image-guided procedures to a much wider market sector. This advancement, coupled with faster more efficient processing, provides opportunities to develop evermore complex algorithms for image processing in real-time. A consequence of this being a distinct blurring of boundaries between application types.

One example of an industrial application with strong parallels to the medical sector is on-line verification of laser engraving for product identification, whereby lasers cut into a material to a predetermined depth with a precisely controlled cutting pattern. Normally the cutting pattern is text but this is arbitrarily set by the control system. As this technique evolves it is becoming possible to engrave on uneven surfaces and complex shapes that are presented to the engraving system in random orientations.

Engraving systems can be preprogrammed such that provided the work piece is presented to the engraving system in precisely the same position, a consistent result is obtained. By making the system aware of the world in 3D and with provision of online feedback about the cutting depth and position, the system is able to locate the target area and make corrections to the cutting process depending on the actual cutting performance. The key to this is online 3D modelling of the work piece, providing accurate dimensional measurements in real-time combined with object recognition.

The parallels with the requirements for image-guided medical procedures is striking. A close relationship between industrial and medical developers in these fields would significantly advance both sectors. Possibly the largest problem in bringing these two worlds together is the highly restrictive confines in many of the medical applications and the inability to change the design of the product/patient to optimise it for image-guided procedures.

Presentation 18: "Surgical Process Modeling"

Pierre JANNIN - INRIA, INSERM, CNRS, Université de Rennes 1

The objective of this presentation is to demonstrate the needs for models in computer assisted surgery. We suggest the improvement of information, involved in the surgical process, by translating implicit knowledge into explicit one. Making information explicit goes through the construction of models. In the last 20 years, a lot has been done for building numerical patient specific model from multimodal pre operative images. Image segmentation and registration methods allow defining surgical target(s), some reference areas, areas to be avoided, and trajectories from these images. This model can be displayed in the operating room along with the real patient, thanks to augmented reality and updated by using intra operative images (e.g., 3D US, video images).

Image guided surgery made information about the patient more explicit, but lot of information still remains implicit, especially regarding the surgical practice. The high inter patient and inter surgeon variability in surgery has to be studied and modelled for its explicit understanding. I will demonstrate that surgical models are an appropriate solution. I will explain the global methodology for surgical process modeling including the definition of a surgical ontology, the development of software for surgical experience description based on this ontology, the development of methods for automatic recognition of surgeon's activities, and the analysis of these descriptions for knowledge generation about the surgical practice. This approach will be illustrated by different studies. I will also show how surgical process models can be useful for surgical education, assessment, simulation, planning, during surgery and postoperatively.

Session 3: Assessment

Presentation 19: "Assessment and training for image-guided therapies"

Werner Korb - Innovative Surgical Training Technologies

According to actual regulations, all medical devices need to be properly assessed. Those directives focus on the protection of patients as well as on the protection of the user (resp. clinical personell). Keeping this in mind is even more important for innovative devices, such as navigation or mechatronic devices for minimally invasive surgical therapy.

Therefore, we developed in an interdisciplinary working group, with participants from universities in Leipzig and Rennes, a procedure as well as a checklist for researchers, who want to assess their developments. This checklist is based on the healthcare technology assessment (HCTA), which is already an established assessment methodology.

Particular care needs to be taken with respect to surgical systems that automate the tasks of a human operator and allocate these tasks to machines or computers. This automation not only includes mechatronic or robotic instruments, but also (semi-)automatic image processing (such as segmentation), image analysis, augmented reality, etc. In such cases dedicated psychological criteria, such as trust in automation, complacency, situation awareness, and loss of skills as well as mental workload need to be investigated.

Based on the recent assessment studies, which include the investigation of psychological criteria and the evaluation of the man-machine interface of surgical devices, it turned out that innovative surgical training methodologies are needed. This last point is the subject of current research in our working group.

Assessment of human factors and the training of surgeons and OR personnel are both performed in simulated environments (simulation). Our working group develops real-size artificial patient phantoms including electronic and mechatronic parts.

In future research, it is important to integrate the systematic assessment of image guided therapies from the beginning in every development project. This will improve the transfer from research institute to clinical routine as well as the medical technology and device market.

Presentation 20: "Optical tracking for surgical skills assessment"

Magdalena K. Chmarra – Technical University Delft

Minimally invasive surgery (MIS, e.g., laparoscopy) requires special surgical skills, which, ideally, should be objectively assessed. Several studies have shown that motion analysis is a valuable assessment tool of basic MIS skills. To use motion analysis as the assessment tool, however, it is necessary to track and record motions of MIS instruments. At Delft University of Technology, a four degrees of freedom device for tracking real MIS instruments in training setups has been developed. The device, named "TrEndo", consists of a gimbal mechanism with three optical computer mouse sensors. The gimbal guides the MIS instrument, while optical sensors measure the movements of the instrument. To demonstrate the use of the TrEndo, we investigated whether novices, intermediates and expert surgeons can be distinguished on the basis of their psychomotor MIS skills. 10 experts (experience > 100 laparoscopic procedures), 10 intermediates (10-100 procedures), and 11 novices (no experience) performed four tasks in a box trainer. Movements of laparoscopic instruments were recorded with the TrEndo and analyzed using six motion analysis parameters (MAPs). The MAPs of all participants were submitted to Principal Component Analysis (PCA), a data reduction technique. The scores of the first principal components were used to perform Linear Discriminant Analysis (LDA), a classification method. Performance of the LDA was examined using a leave-one-out cross-validation. 23 (74%) participants were correctly classified with the proposed method: seven experts, seven intermediates, and nine novices. This result demonstrates the potential of the TrEndo to aid in the objective assessment of psychomotor surgical skills.

Presentation 21: "Human factors and ergonomic process management to increase surgical quality"

Adinda Freudenthal - Technical University Delft

To develop next generation laparoscopic navigation needs of the surgerical team should be uncovered and technology potential should be identified. These needs should be met by a combination of technologies, developed by a range of researchers.

Multi technology development is generally - in industry - managed as a concurrent engineering process in which requirements/ specifications are set and different components should play their part in functioning as defined. For next generation medical imaging many of the user requirements cannot be identified up front, because there is limited knowledge from comparable product tests or documents. Also it is not clear where the boundaries between different components should be.

Ergonomics is a method to identify requirements and to assess proposed solutions; this is well known and practiced by many imaging developers. However, incentives to solve user problems aim at restricted functionalities and related human factors, not at optimizing the daily workflow and the larger safety system. No studies have been conducted to evaluate all human factors levels in a systemic way. This has to be done before prioritization can be conducted and before ergonomic detail studies. Detail studies should include sensory, cognitive and physical ergonomics as well as organizational ergonomics. There is a challenge in already developing while not all requirements are known yet. Nevertheless the two should run in parallel and in relation, while bridging the communication gap between technologists and medical users and experts.

Unfortunately, the majority of young researchers have received almost no multidisciplinary training, while even experienced researchers have rarely worked with all required disciplines at once. This has been a concern for European Union for several years now, and is one of the reasons for the workshop initiative. Methods are needed for hands-on training to collaboratively co-design.

Presentation 22: "Augmented Reality Haptic for assessment laparoscopic therapies"

José Blas Pagador - Jesús Usón Minimally Invasive Surgery Centre

Nowadays, Augmented Reality (AR) is only focused on visual or graphics enhance of the real scenes. Do you think is it possible to augment the tactile feedback in surgical training and minimally invasive procedures? Some efforts have been focused on visual-haptic and haptic rendering, but maybe the tactile haptic concept to obtain sensorized or smart surgical instruments must be redefined.

The Augmented Reality Haptic (ARH) system was developed to solve this gap between physical and virtual tools. Therefore, the ARH system is based on electromagnetic tracking devices to use in training and real procedures as an objective assessment method. Although the Hand-Motion Analysis (HMA) has been used before in minimally invasive surgery studies, we introduce the Tool-Motion Analysis (TMA) as an alternative method. Hence, the TMA analyses the tooltip movements instead of the hand movements in order to improve the results of the objective assessment for laparoscopic procedures.

Presentation 23: "Approaches for validation and assessment of surgical simulation devices"

Luisa F. Sánchez-Peralta - Jesús Usón Minimally Invasive Surgery Centre

Surgical simulation devices are widely proved to be a useful tool for surgical skills training because they provided a secure, reliable and reproducible environment. There are different types of surgical simulators: physical or box trainer, virtual and hybrid ones. Once a simulation device is designed, it must be evaluated thorough and objectively in order to determine its reliability and validity. Different approaches are usually made to tackle this evaluation. Firstly, reliability measures the reproducibility and precision of the device. On the other hand, validity measures the extent to which the device is actually teaching or measuring what is intended to teach or measure. Within this validation, usually a division between subjective and objective tests is made. The former include face validity (that asses the realism of the device); and content validity (appropriateness of the device as teaching tool). The latter comprise construct validity (ability to distinguish between different groups of expertise); concurrent validity (how the device under test correlates with a gold standard); and predictive validity (transferability of skills from the simulation device to the operating room). This talk is focused on describing these tests to validate surgical simulation devices that can be used for assessment.