Project Newsletter STIFF flop

June 2012 **www.stiff-flop.eu**

Project Objectives

The STIFF-FLOP (STIFFness controllable Flexible & Learnable manipulator for surgical OPerations) project started at the beginning of the year 2012 after successful contract negotiations with the European Commission. The Commission is providing € 7.35 Mio funding over 4 years.

STIFF-FLOP focuses on Challenge 2 - Cognitive systems and robotics.

STIFF-FLOP will address a number of scientific and technological challenges. In minimally invasive surgery, tools go through narrow openings and manipulate soft organs that can move, deform, or change stiffness. There are limitations on modern laparoscopic and robot-assisted surgical systems due to restricted access through Trocar ports, lack of haptic feedback, and difficulties with rigid robot tools operating inside a confined space filled with organs. Also, many control algorithms suffer from stability problems in the presence of unexpected conditions. Yet biological "manipulators", like the octopus arm and the elephant trunk, can manipulate objects while controlling the stiffness of selected body parts and being inherently compliant when interacting with objects.

The project aims at overcoming shortcomings of existing robotic systems for minimally invasive surgery (MIS) by creating a soft robotic arm that can squeeze through a standard 12mm diameter Trocar-port, reconfigure itself and stiffen by hydrostatic actuation to perform compliant force control tasks while facing unexpected situations. STIFF-FLOP will apply a holistic approach addressing the complete robot system and studying the following research questions: design and fabrication of a soft manipulation and grasping device, distributed sensing, biologically inspired actuation and control architectures, learning and developing cognitive abilities through interaction with a human instructor and manipulation of soft objects in complex and uncertain environments.

Departing from the traditional robotic manipulation concepts that rely on fixed stiffness distributions, the STIFF-FLOP project takes inspiration from biological "manipulation and actuation" principles as they are, for example, found in the octopus who can turn its limbs from a completely soft state into a state of precise and, if needed, powerful articulation (see Figure 1) – an approach that combines advantages associated with both soft and hard systems by selectively controlling the stiffness of various parts of the body depending on the task requirements. Tightly integrating the input from established experts in biology, cognitive sciences, robotics, sensing and medical sciences, this project aims to overcome the drawbacks of current robotic manipulation concepts and to move into a new era for flexible robotics with great promise for many applications areas including minimally invasive surgery. Although we expect this field to bring new challenges when

Issues:

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exploring the behaviours of such "stiff-flop" manipulators and how they interact dynamically with their environment, there are many advantages supporting the research in the development of STIFF-FLOP manipulator.

With the aim of creating an embodiment of an artificial, flexible manipulation device modelled after the octopus limb, the STIFF-FLOP project will develop a new design approach to soft robotic manipulators whose physical morphology and control policies will adapt continuously in order to maintain an optimal symbiosis with uncertain environments and unpredictable task constraints in collaboration with a human operator in applications such as minimally invasive surgery. It is widely argued that cognition is an emerging property of physical and sensory interactions with the environment rather than something that can be programmed. Here we take the view that the uncertainty or stochasticity of the environment itself is an important architect of internal cognition that effectively organizes the body to maintain stable interactions with the real world. We believe that our approach is novel and will lay the foundation for robotic cognitive systems that can creatively face the uncertainty in the real world by allowing the uncertainty itself to drive the synthesis of cognition that can in turn control the agile body to co-exist with the uncertain world in a meaningful manner.

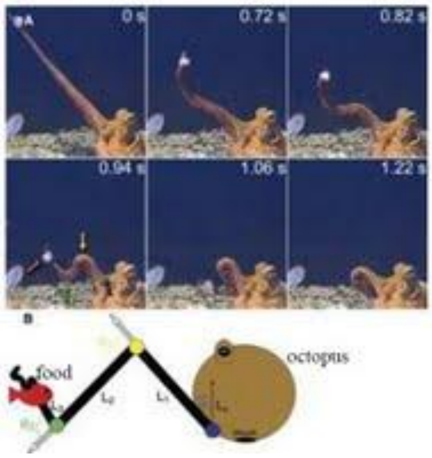

Figure 1: Octopus arm kinematics

With the support of the European Association for Endoscopic Surgery (EAES) and three internationally-leading medical institutes (Guy's Hospital London, University of Turin, St Thomas Hospital London), we will test the soft arm in a minimally invasive robotic surgery application to demonstrate its feasibility.

The Octopus Arm

A range of animal species with soft bodies, such as octopuses, or soft body parts (e.g. vertebrate tongue, elephant trunk) are capable of selectively control the stiffness of various parts of their body and thus, can exert stable forces on the

Figure 2: The OCTOPUS arm

environment. A soft robot octopus inspired by its biological counterpart (Figure 2) is being created in the framework of the EU project OCTOPUS (http://www.octopusproject.eu/), which is coordinated by the Bio Robotics Institute of Scuola Superiore Sant'Anna (SSSA).

In the framework of the STIFF-FLOP project, the SSSA team and University of Surrey (UoS) are developing a highly dexterous soft manipulator able to locally control its stiffness, taking inspiration from biological "manipulators", like the

Figure 3: Design of the STIFF-FLOP manipulator

octopus arm and the elephant trunk. Many advantages can be introduced by the STIFF-FLOP manipulator in

MIS, such as the ability to squeeze through narrow gaps and openings, inherent compliance leading to increased safety especially when in contact with humans, hyper-redundancy for improved reachability in an obstacle-cluttered environment and increased adaptability and stability in a possibly unpredictable environment.

The STIFF-FLOP arm structure, actuation strategy and stiffening mechanism have been defined (Figure 3). It will be composed of multiple modules able to provide multidirectional bending and elongation, and to be stiffened in a controllable and selective way. A number prototypes have already been fabricated and are currently tested and being characterized. In Figure 3 a prototype is shown, demonstrating its multi-bending characteristics. System level kinematic and dynamic modelling is under development at UoS. Appropriate high level and low level control strategies to control the STIFF-FLOP arm are now under investigation at UoS and IIT.

Simulation of soft tissue using SOFA

Simulation Open Framework Architecture

In the context of robotics, simulation brings the possibility of exploring, implementing and validating control laws even if the physical robotic system is not ready to be used. It is also considered as a convenient tool for development and validation, as a first stage before the real deployment of physical prototypes.

These aspects have motivated the STIFF-FLOP project to consider the modelling of the robotic arm in a simulated environment. We will use the SOFA framework (Simulation Open Framework Architecture) to realize this simulation. SOFA is an open source environment developed by INRIA, dedicated to real-time simulation of physical interaction between elements, principally for medical applications. In comparison with traditional robotic simulation frameworks, SOFA is able to handle interactions involving deformable objects, which is perfectly aligned with the characteristics of environments considered in minimally invasive robotic surgery.

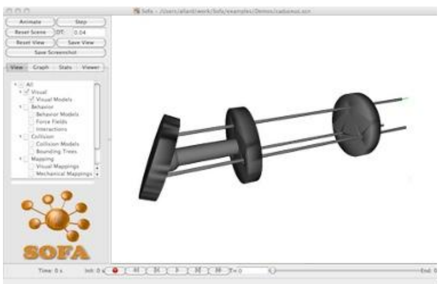

Figure 4: Simulation of the STIFF-FLOP Manipulator

The modelling of the STIFF-FLOP surgical arm within SOFA is thus currently taking place through the implementation of the main actuation mechanisms of the arm, including the cable-based tool control, the arm modules bending and stiffness through the modelling of fluidic chambers and programming central backbone pressure control. Each of these three components is currently analyzed to identify how their intended behaviour can be implanted within the SOFA framework.

Also the inter-operability of the SOFA framework and the ROS environment, that the STIFF-FLOP consortium is using for software development, has been considered. Within the context of the project, it is indeed necessary to make sure that the two frameworks are capable of fully-interacting, so that the validation of the control software developed in ROS can easily and directly be tested with the simulator. A more long term aspect is the development of a bridge in between these two components providing a convenient development framework for robotic surgery applications.

Integration Platform Software System Map

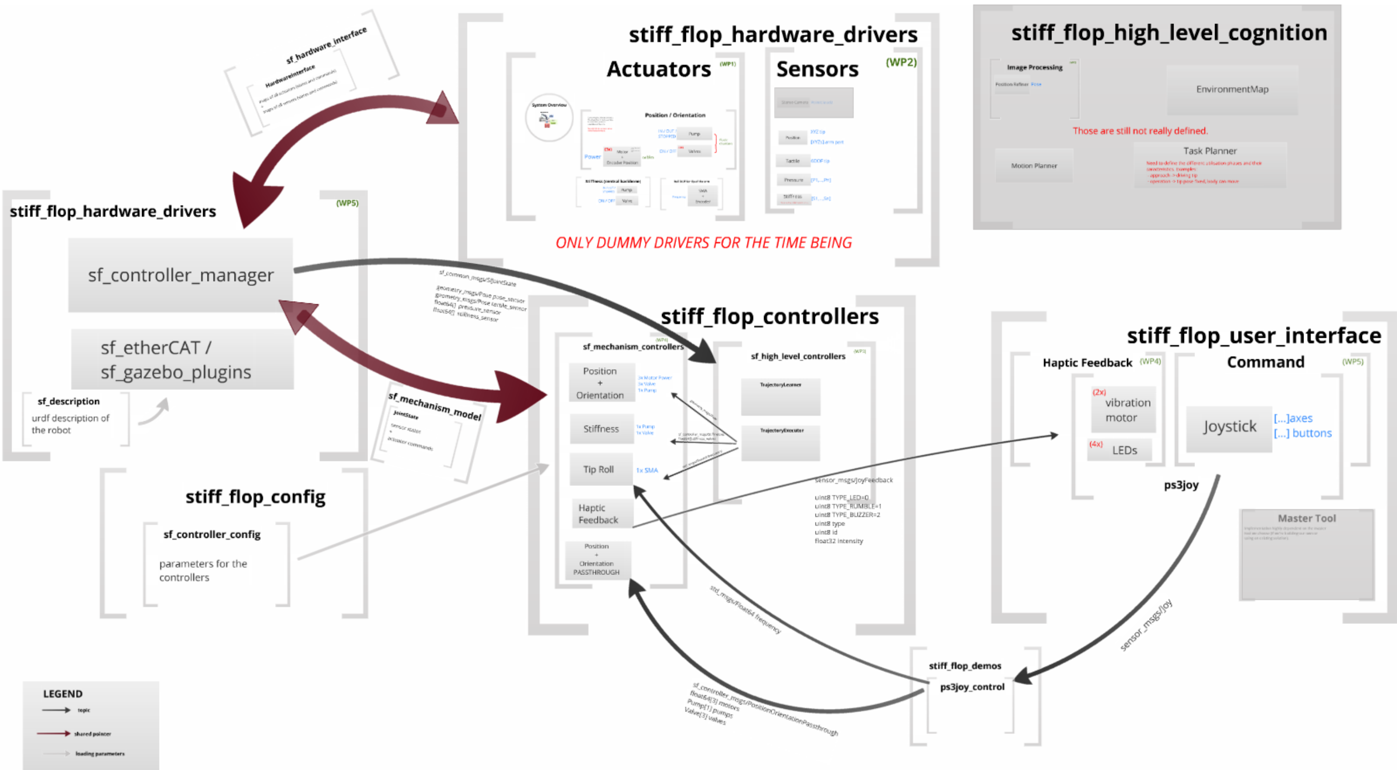

Figure 5: Software System Map

As part of the STIFF-FLOP activities, a Software System Map has been created showing the various ROS software modules and their interactions (see figure above). An up to date overview of the Software System Map is available via the following link: http://prezi.com/l4cbx4u3kp5y/stiff-flop-system-map/.

Our Software System Map represents the different ROS nodes that are going to be running on the system, as well as the connections between them. This map will be updated as the project evolves, to keep an up-to-date picture of what the whole integrated software looks like. The map is also expected to provide a very good documentation tool, especially useful when new users are introduced to the STIFF-FLOP project.

The map is organised in different stacks:

1. STIFF-FLOP_hardware_drivers: contains all the drivers for both sensors and actuators as well as the common code for running them and making the data available to other nodes.

2. STIFF-FLOP_controllers: contains both low-level and high-level controllers.

3. STIFF-FLOP_user_interface: contains the code for interfacing with different haptic devices. The haptic devices used will be defined in future steps of the project.

4. STIFF-FLOP_high_level_cognition: contains the higher level nodes, such as image analysis and planners.

Integration Platform Hardware Overview

The STIFF-FLOP hardware integration platform is a universal system for connecting input and output components to a PC running the Robot Operating System (ROS). The connection is made via EtherCAT which allows for fast, high bandwidth, real time communication between the ROS software components and the attached hardware.

The hardware consists of two basic components:

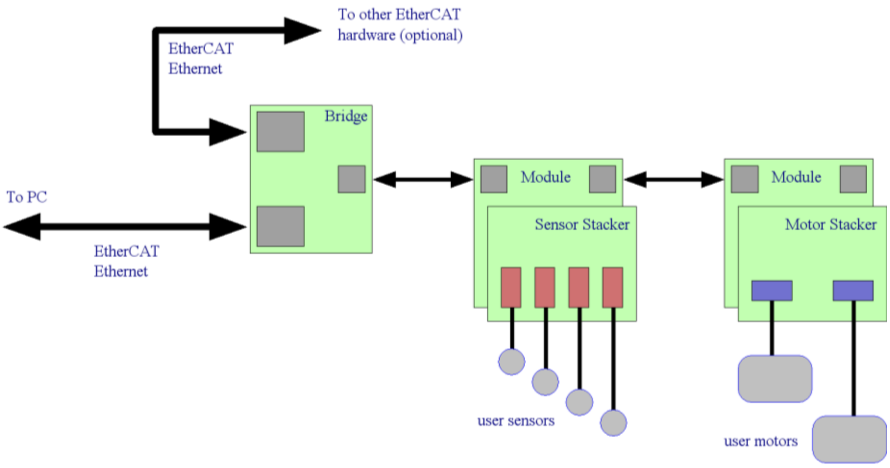

Figure 6: Integration Platform Hardware Overview

1. Modules – One or more modules are connected in a chain, and allow the connection of different sensors and actuators.

2. Bridge – This connects the chain of modules to the PC.

Modules

Since a variety of different modules will be required by the project, the design of the module has been split into two parts: one common to all modules, and one dependent on the module's function.

The common part contains the EtherCAT ASIC and the PSoC. The EtherCAT ASIC handles the physical layer and protocol of EtherCAT. The PSoC exchanges data with the EtherCAT ASIC, and handles all of the Inputs and Outputs (I/O). It is a very flexible device, that can change its pins from Digital I/O to Analog I/O simply by updating the firmware.

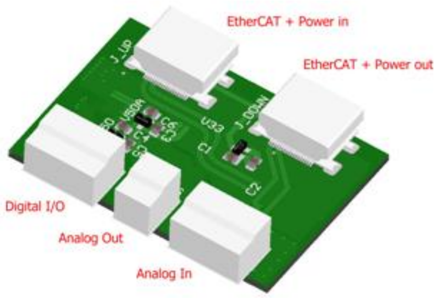

Figure 7: Stacker Board

The part dependent on function is much simpler, and is known as the Stacker board. It contains the connectors required by the application, as well as the voltage regulators. More sophisticated applications may require extra electronics on the Stacker board; for example higher resolution Analog-digital-converters, instrumentation amplifiers, high current drivers, etc.

One type of stacker board has been designed and made so far, which contains a mix of functionality: 4 Digital I/Os, 2 Analog outputs, and 4 Analog Inputs.

Bridge

Each chain of modules requires one bridge board to connect it to the PC. Like the modules, the bridge has also been split into two parts: the Bridge "Base" board, and the "Phy" board. This is to save on cost.

Most users will want only one chain of modules, in which case they can use one Base board and one Phy board. If they wish to have more than one chain of modules separated by a long Ethernet cable, then they can add another Phy board to connect the Ethernet cable. The Bridge base board also contains the power supplies needed to convert the 9v-12v input down to 5v and 3.3v for the electronics. The Phy board provides the physical Ethernet interface.

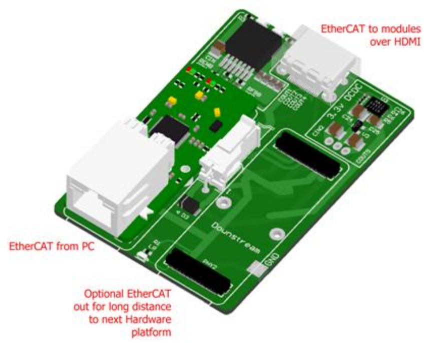

Figure 8: Bridge Board

Mechanical design and software development

The boards will all be housed in Aluminium casings. These are available in a range of sizes to suit the needs of the modules, and also in different colours to help identifying them. The modules are connected together with standard HDMI cable. These are low cost, easily obtainable, and available in a range of lengths.

Figure 9: Mechanical housing

The software and firmware that is needed to run the system is currently in its final development stage. A demonstration of the system is planned for July.

Recent - Visits

Kick-Off Meeting

The STIFF-FLOP kick-off meeting took place at King's College London, on 19th and 20th of January 2012. The meeting was very well attended, with on average 2 to 3 consortium members representing their individual institutions (for a complete list of partner institutions and contacts, see http://www.stiff-flop.eu/index.php/partners).

At the meeting, Prof. Althoefer provided an overview of the aims, objectives and work tasks of the project. Incorporating inspiration on how octopuses actuate and control their limps, the project endeavours to create flexible and highly-redundant manipulators that can change their state from completely soft to entirely articulated. The long-term target is to develop a fully-integrated manipulation device that can conduct medical operations in a minimally invasive fashion. Integrating multiple sensor modalities and haptics with intelligent control and learning paradigms, the project will achieve a tool that can learn from clinicians and the environment it is operating in to conduct autonomous tasks in the setting of an operating theatre.

Relevant management and administrative elements were presented, including the setting up of the Scientific Interest Group, the Peer Review Board, the STIFF-FLOP website. Project management, project structure, the timing of tasks and activities, financial and administrative methods were introduced and explained.

Recognising the importance of input from previous and on-going work as part of related projects as well as the need to obtain a good understanding of the medical requirements, colleagues from the OCTOPUS project (Hochner on biological inspiration and Cianchetti, Laschi and Menciassi on technical and scientific advancements of the OCTOPUS project) and associated medical colleagues (Prof. Dasgupta and Arezzo) presented relevant background information and an in-depth requirements analysis, respectively.

During the remainder of the meeting work package leaders presented overviews and action plans of the scientific work packages:

- WP 1 Hyper-redundant Mechanisms (Lead: SSSA),
- WP 2 Multi-modal Sensing (Lead: KCL),
- WP 3 Cognitive Development in Bio-inspired Manipulators (Lead: IIT),
- WP 4 Underactuated Control and Human Robot (Lead: UoS),
- WP 5 Interaction System Requirements Integration, Validation & Implementation / Benchmarking (Lead: Shadow).

Workshop - “da Vinci based Surgery and da Vinci Try-out”

Figure 10: The Da Vincy Surgical System at Guy’s Hospital London

Prof. Dasgupta organised and held a workshop on da Vinci based surgery and da Vinci Try-out session at Guy’s Hospital London, taking place on 12th and 14th of March, respectively. Prof. Dasgupta kindly arranged the workshop for the STIFF-FLOP consortium so that researchers were able to watch a live surgery based on the da Vinci robot and have some hands-on da Vinci experience two days after the visit at his theatre. During the surgery, Prof. Dasgupta explained the procedure of the prostate surgery. He indicated weaknesses of the da Vinci system and elaborated on the challenges for the STIFF-FLOP project, in particular, emphasising the need to improve surgical robots for MIS.

Seminar “Haptics for Education and Training in Dentistry”

A seminar in the field of “Haptics” was held at King’s College London on May 29th, 2012. The purpose was to exchange thoughts and know-how between the Centre of Flexible Learning in Dentistry who is involved in the project hapTEL™ and Prof. Kaspar Althoefer’s research team which is within the Centre for Robotics Research.

Dr. Jonathan P. San Diego, project manager of hapTEL™, presented the overall aim of their research activities which is to design, develop and evaluate a virtual learning system for aspiring dentists, including haptic and synthetic devices. The hapTEL virtual system is to be used initially in dentistry mainly focussing on enhancing the students’ skills as well as perception and manipulation capabilities when operating in 3D environments . One of the important aims is to teach the students how to prepare and fill tooth cavities in the 3D virtual environment. The devices will be integrated into the curriculum to evaluate the extent to which Technology Enhanced Learning (TEL) can enhance the quality of learning and the kinds of pedagogical practices that will emerge around innovations through TEL.

Min Li and Jelizaveta Zirjakova, two PhD student in the Centre for Robotics Research (CoRe), gave talks on “Virtual Palpation System with Haptic Feedback” and “Simulation of Soft Tissue Viscoelastic Responses, Study of Tool/Tissue Interaction and Determinants of Probing Behaviour”, respectively. Their research will be of interest within the STIFF-FLOP project, especially where haptics and tactile feedback to the surgeon is concerned when using the STIFF-FLOP manipulator.

ROS Workshop

After the decision was made that ROS (Robot Operating System) was to be used in STIFF-FLOP, the SHADOW robot company organized a ROS workshop for all partners to get everyone up to speed with regards to the main ROS concepts. The workshop lasted three days, from the 21st to the 23rd of May, and took place at King's College in London.

The first part of the workshop was dedicated to the general concepts and principles of ROS, with lots of hand-on practice on how to write ROS code, interact with a ROS system and debug a running ROS system. The second part was specific to the STIFF-FLOP project. Furthermore, the Software System Map was introduced and discussed in detail, to make sure it matches as closely as possible the expectation of the system.

This was a very fruitful event where all participants collaborated toward a better understanding of the system as a whole.

The SHADOW Robot Company is available to arrange ROS training workshops elsewhere.

Technical Meeting at King's College London

In conjunction with the 3-days ROS Workshop, the STIFF-FLOP consortium had technical meetings. Each WP leader presented an approach of how to integrate their work into ROS. The presentations were leading to fruitful and helpful discussions. Prof. Kaspar Althoefer introduced an Action Plan for each partner for the first review period (until the end of Year 1).

Lab Visit at King's College London

During the ROS Workshop, held at King's College London from May 21st to 23rd, 2012, the STIFF-FLOP consortium was invited to visit the laboratories in the Centre for Robotics Research. The majority of the presented research projects are related to medical engineering and cover the following topics:

- HYDRA: A Novel Approach to MRI-guided Interventional Cardiology, *Alberto Caenazzo and Prof. Kaspar Althoefer*
- MR-Compatible Autonomous Catheterization Robot with Unfolded Navigational Maps, *Ali Ataollahi, Prof. Lakmal D. Seneviratne and Prof. Kaspar Althoefer*
- Soft Robotics: Granular Jamming for a Flexible Manipulator, *Allen Jiang, Prof. Kaspar Althoefer and Dr. Thrishantha Nanayakkara*
- Air-Cushion Tactile Sensor for Medical Applications, *Dinusha Zbyszewski and Prof. Kaspar Althoefer*
- Stiffness Sensing Probe for Tissue Abnormality Identification during Minimally Invasive Surgery, *Dr. Hongbin Liu, Jichun Li, Dr. Xiaojing Song, Prof. Lakmal D. Seneviratne and Prof. Kaspar Althoefer*
- Stiffness Sensing Probe for Tissue Abnormality Identification during Minimally Invasive Surgery, *Dr. Hongbin Liu, Jichun Li, Dr. Xiaojing Song, Prof. Lakmal D. Seneviratne and Prof. Kaspar Althoefer*
- Pixel-based Optical Fibre Tactile Force Sensor for Robot Manipulation, *Hui Xie and Prof. Kaspar Althoefer*
- ROS Implementation for Grasping and Manipulation, *João Bimbo, Dr. Hongbin Liu, Dr. Xiaojing Song and Prof. Kaspar Althoefer*
- Simulation of Soft Tissue Viscoelastic Responses, Study of Tool/Tissue Interaction and Determinants of Probing Behaviour, *Jelizaveta Zirjakova, Prof. Kaspar Althoefer, Prof. Prokar Dasgupta and Dr. Thrishantha Nanayakkara*

- Virtual Palpation System with Haptic Feedback, *Min Li and Prof. Kaspar Althoefer*
- A Multi-axial Optical Fibre and Linear Polarizer Based Force and Torque Sensor for Dexterous Robotic Fingertips, *Ramon Sargeant, Prof. Lakmal D. Seneviratne and Prof. Kaspar Althoefer*

The presented research is of particular interest for WP2. King's College London will develop tactile sensors, a 6-axis force, a shape and a stiffness sensor which will be integrated into the STIFF-FLOP manipulator as well as novel haptics concepts.

Guest Lecturer at King's College

On 24th February 2012, Dr. David Noonan from Imperial College London was invited to give a lecture at King's College London on "**A flexible mechatronic device for minimally invasive surgery - Design for access, imaging and diagnostic sensing**".

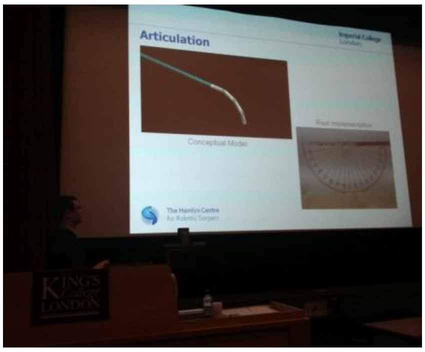

Figure 11: Lectures at King's College

This talk introduced a new seven degree-of-freedom mechatronic instrument which is capable of providing controlled flexibility along curved pathways inside the body and hence reduce the number of incisions required when performing complex in-vivo explorations and interventions. The principal component of the device is its novel modular mechatronic joint design which utilises an embedded micromotor-tendon actuation scheme to provide independently addressable degrees of freedom and three internal working channels. The design is optimized to have a minimum footprint within the operating theatre yet provide enhanced functionalities over existing MIS compatible flexible instrumentation. The talk described how the redundancy of the instrument's seven degrees of freedom can be exploited to explore the entire peritoneal cavity from a single incision point, and how it can provide a stable base for the deployment of interventional instruments and optical imaging probes during in-vivo porcine experiments.

Announcements and upcoming events

Technical STIFF-FLOP meeting in Pisa

All project partners are invited to the next STIFF-FLOP project meeting at the Scuola Superiore Sant'Anna in Pisa. It is scheduled for October 1st - 2nd. Details for the project meeting including the agenda will be available before the meeting.

RobMed2012

Medical Robots 2012 International Conference (Zabrze, Poland 7th Dec 2012)

The project members are invited to the 10th Conference on Medical Robots held in Zabrze. The Conference is organized by the International Society for Medical Robotics. In response to a broad interest among representatives of science, medicine and the media, the scope of this annual meeting of research workers, designers, constructors and users of robots, will cover all robotized equipment used in medicine.

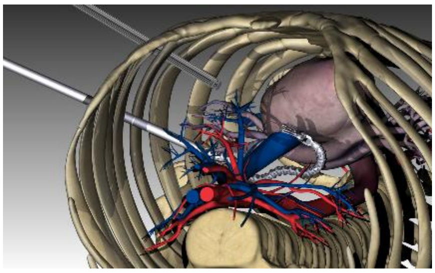

Figure 12: minimal invasive surgery

Originally the conference organized by the Foundation for the Development of Cardio Surgery was inspired by a group of scientists and constructors of a Polish surgical robot called Robin Heart. The project launched in 2000 included open conferences assessing the progress of works and designating the directions for numerous practical applications. The Robin Heart Project greatly contributed to the revival of medical robotics in Poland. During the International "Medical Robots 2012" conference the progress of the surgery robot of the Robin Heart Project and others Polish robots (for instance rehabilitation robots) will be demonstrated.

A competition for young participants of the "Medical Robots 2012" conference is international and addressed to students, young research workers but also to hobbyists and lovers of robotics not necessarily associated with universities or research institutes. We are happy to welcome young fans of robotics who are still learning at school and planning to enter the university. During the conference a special, competitive session for Young Scientists, students and hobbyists interested in robotics aspiring to win the "Robin" and "Arrow" statuette, will take place. The winner will be awarded prize– the prize pool is about 1,600 EUR.

Figure 13: Robin Heart robot

Venue: conference room at the Foundation for the Development of Cardio surgery in Zabrze, Conference languages: Polish and English

Conference fees: free of charge

Detailed information for the conditions of participation at the Conference are available at: www.medicalrobots.eu

For more information please contact Dr. Zbigniew Nawrat (President of the International Society for Medical Robotics) at
phone number: +48 32/3735664,
e-mail: nawrat@frk.pl

STIFF-FLOP Workshop on the Development of Robot-based Cardiosurgery

All project partners are invited to the Workshop organised by the Foundation for the Development of Cardio surgery (FRK). The Workshop will take place in the beginning of December 2012 in Zabrze (for exact dates, please refer to the project's website (www.stiff-flop.eu). The main focus of this Workshop will be on surgical tools for minimally invasive surgery, including training on several surgical techniques and tools as well as training with the Robin Heart robot.

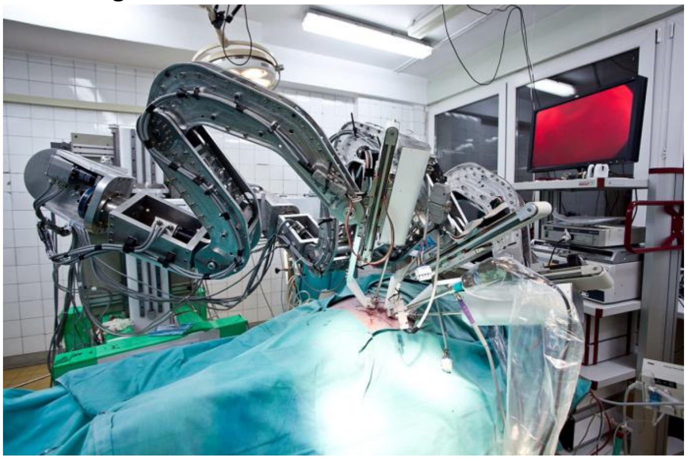

Figure 14: Robin Heart robot

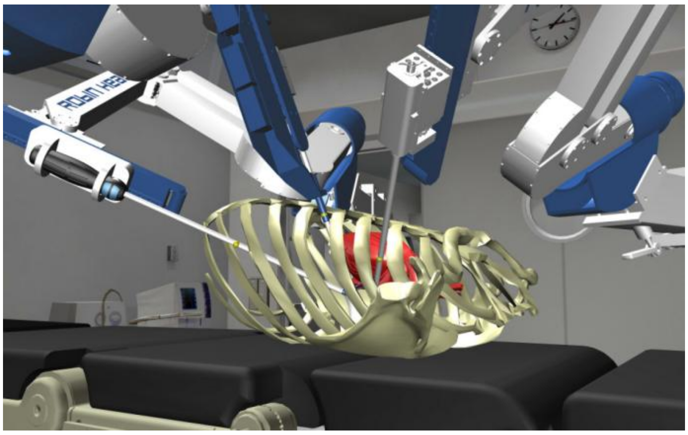

Figure 15: Operation planning with the Robin Heart robot

The Robin Heart Team from FRK will support the project in developing the first flexible robotic instrument by designing, construction and testing work related to a gripper, operator console and feedback device, verification and application robot study and dissemination of project results. A detailed overview of the activities and surgical systems at FRK will also be presented as part of the Workshop.

REMAR 2012 - The Second ASME/IEEE International Conference on Reconfigurable Mechanisms and Robots

Prof. Althoefer will give a keynote speech at REMAR 2012 on miniature force sensing concepts for robot-based minimally invasive surgery (http://www.kcl.ac.uk/nms/depts/informatics/research/robotics/conferences/ReMAR2012/index.aspx).

Publications and Press

The STIFF-FLOP project funded by EU research commission was advertised in the King's College London newsletter "Comment" in March 2012, Issue 199. The objective of the project on developing octopus-inspired robotic technique for improving the performance of current minimally invasive surgeries has been introduced through "Comment" to the staff, students and friends of King's College London.

Octopus-inspired robotic surgery research attracts €7.35m EU funding

Issue 199 | March 2012

Researchers are taking inspiration from the octopus to develop robotic technology that will enable doctors to carry out a far greater range of minimally invasive surgical procedures than previously possible, including heart, brain and cancer operations.

The Centre for Robotics Research in the Department of Informatics, together with clinicians from Guy's and St Thomas', will lead a consortium of European scientists and medical doctors to create flexible robotic tools to improve 'keyhole' or minimally invasive surgery. The four-year research project has received €7.35 million funding from the European Union.

The research team will create novel manipulation arms that, when entering the body through a tiny incision point, will bend around organs and operate on parts of the body that could not previously be reached. The robot arm will stiffen once its tip has reached the point of intervention, allowing the surgeon to carry out surgical procedures comfortably and accurately.

Kaspar Althoefer, Professor of Robotics & Intelligent Systems, said: 'There are many operations that cannot be carried out with existing technology. We will be using the octopus as a role model to create novel medical tools. This approach will provide solutions with real benefits for patients and surgical staff.'

Octopus-inspired medical robotic manipulator

News

KING'S College LONDON

Comment

For staff, students & friends

Conference contribution:

B. Hochner. Invited Speaker. **The neurophysiological basis of motor function and learning and memory in the octopus - an animal with a complex 'embodiment' the 2012 Second Molluscan Neuroscience meeting**, on "Molluscan Neuroscience in the Genomic Era: from Gastropods to Cephalopods," May 16 -19, 2012 Scripps Research Institute, Jupiter, FL.

B. Hochner. Invited speaker. **Neurophysiological organization of the learning and memory network of modern cephalopods – octopus and cuttlefish** at Cold Spring Harbor-Asia Conference on Invertebrate Neurobiology, June 18-21, 2012, Suzhou, China.

W. Kier, B. Hochner, D. Tsakiris, C. Laschi, organisier T. Flash. **Controlling Movement in the octopus - from biological to robotic arms**, Symposium at the 22nd ANNUAL CONFERENCE of the Society of the Neural Control of Movement, April 23-29, 2012, Venice, Italy.

G. Levy, T. Flash and B. Hochner. **How octopuses coordinate their eight flexible arms in crawling?,** The 22nd ANNUAL CONFERENCE of the Society of the Neural Control of Movement, April 23-29, 2012, Venice, Italy.

D. Tsakiri, A. Kazakidi1, M. Kuba, A. Botvinnik, M. Sfakiotakis, T. Gutnick, S. Hanassy, G. Levy, J.A. Ekaterinaris, T. Flash and B. Hochner. **Swimming patterns of the Octopus vulgaris**, The 22nd ANNUAL CONFERENCE of the Society of the Neural Control of Movement, April 23-29, 2012, Venice, Italy.

N. Nesher, N. Feinstein, L. Englaster, E. Finkel and B. Hochner. **Functional characterization of the cholinergic motor innervation in the special neuromuscular system of the octopus arm**, The 22nd ANNUAL CONFERENCE of the Society of the Neural Control of Movement, April 23-29, 2012, Venice, Italy.

A. Menciassi. **New Generation Robots for Endoluminal and Single Port Surgery**, Symposium of surgical robotics at BioRob, June 24, Rome, Italy.

A. Menciassi. **Micro robots; future trends**, 20th international congress of EAES, June 20-23, Brussels, Belgium.

A. Menciassi. **Robots for single port**, 20th international congress of EAES, June 20-23, Brussels, Belgium.

On 23rd May 2012, Professor Althoefer presented results and advancements relating to STIFF-FLOP at the 20th International Congress of the EAES (European Association for Endoscopic Surgery) in Brussels (http://congress.eaes.eu/Congress2012.aspx) in his talk on **Tools and Devices for Present and Future Surgery**.

M. Morino and A. Arezzo organized the **Postgraduate Course on Transanal Endoscopic Microsurgery**, including afternoon Hands-on course, 20th international congress of EAES, June 20-23, Brussels, Belgium.

A. Melzer and Y. MIntz organized the **Technology Symposium I on Robots and Manipulators revised**, 20th international congress of EAES, June 20-23, Brussels, Belgium.

C. Gutt , **Robotic surgery failed to deliver significant advantages over standard laparoscopy**, 20th international congress of EAES, June 20-23, Brussels, Belgium.

A. Melzer, **Image guided robotic surgery – current status and future applications**, 20th international congress of EAES, June 20-23, Brussels, Belgium.

M. Morino, **The 2013 Consensus conference for clinical robotic surgery- are we ready to make decisions?** 20th international congress of EAES, June 20-23, Brussels, Belgium.

M. Morino chaired the session **Difficult situations in suturing and stapling (black videos),** 20th international congress of EAES, June 20-23, Brussels, Belgium.

A. Melzer, **Image guided robotics**, 20th international congress of EAES, June 20-23, Brussels, Belgium.

C. Gutt , participated to the FACE to FACE on **Robotics: a real advantage for patients ?,** 20th international congress of EAES, June 20-23, Brussels, Belgium.

A. Arezzo, gave the Sir Alfred Cuschieri Lecture of the Technology Committee, **INNOVATIVE FLEXIBLE ENDOSCOPY: A TOOL FOR SURGEONS AGAIN**, 20th international congress of EAES, June 20-23, Brussels, Belgium.

A. Arezzo, G. Scozzari and M. Morino won the **Free paper presentation Olympus - EAES award session, with the paper** IS SINGLE PORT LAPAROSCOPIC CHOLECYSTECTOMY SAFE? RESULTS OF A SYSTEMATIC REVIEW AND META-ANALYSIS, 20th international congress of EAES, June 20-23, Brussels, Belgium.

A. Arezzo, **Role of flexible endoscopy in surgery**, 20th international congress of EAES, June 20-23, Brussels, Belgium

M. Morino, **Total mesorectal excision (TME): open, laparoscopic, or robotic?,** 20th international congress of EAES, June 20-23, Brussels, Belgium

Y. Mintz, **BRINGING NOTES TO PATIENTS SAFELY- Update on devices,** 20th international congress of EAES, June 20-23, Brussels, Belgium

A. Melzer, **Novel robotic systems integrated with novel imaging platforms** - the smart operation of the future?, EAES Technology Committee 2012 Winter meeting. January 13th, Brussels, Belgium

A. Arezzo, **Classification and appropriateness of treatment of early lesions of the colon and rectum**, Συνεδριακό Κέντρο ΜΗΤΕΡΑ «Ν. Λούρος», ΠΡΟΣΚΛΗΣΗ, Athens, Greece

A. Arezzo, **Instruments for One Port Surgery,** INTERNATIONAL CONGRESS “Mini-invasive Surgery: what’s new?” WALKING IN NEW TECNOLOGY, March 22nd, Naples, Italy

Journal Paper:

M. Piccigallo, U. Scarfogliero, C. Quaglia, G. Petroni, P. Valdastri, A. Menciassi and P. Dario. "**Design of a Novel Bimanual Robotic System for Single-Port Laparoscopy**", *Mechatronics, IEEE/ASME Transactions on* , vol.15, no.6, pp.871-878, Dec. 2010

Advisory Groups

A number of advisory groups were set up and colleagues from different scientific backgrounds agreed to be members of these groups and provide advice to the project where required.

Special Interest Group

- Prof. Andreas Melzer, University of Dundee, UK
- Dr. Irion, Dr. Solleder, Dr. Nowatschin, Karl Storz, Germany
- Dr. Shamim Khan, Guy's Hospital London, UK

Peer Review Board

- Prof. Peter Brett, Institute Director of Brunel Institute for Bioengineering, UK
- Prof. Elena De Momi, Politecnico di Milano, Italy and Co-Investigator of EuRoSurge

EAES Task Force

- Prof. Alberto Arezzo and Prof. Mario Morino, Digestive, Colorectal, Oncologic and Minimal Invasive Surgery, Department of Surgery, University of Torino, Italy
- Prof. Andreas Melzer, IMSAT Institute, University of Dundee, UK
- Prof. Yoav Mintz, Director of Center for Innovative Surgery, Hadassah-Hebrew University Medical Center, Jerusalem, Israel
- Prof. Carsten N. Gutt, Department of Surgery, Klinikum Memmingen, Germany
- Prof. Georg Kaehler, Klinikum Mannheim Chirurgische Klinik, Germany
- Prof. Andrea Pietrabissa, Department of Surgery, University of Pavia, Italy

The TASK FORCE for continuous clinical feedback and consultancy was established and the STIFF-FLOP project was presented officially to all members during the 2012 EAES annual meeting (in Brussels, 20-23 June 2012).