spirits

SPIRITS

Smart Printed Interactive Robots for Interventional Therapy and Surgery
2017-2020

Year 1 Executive Summary

Dépasser les frontières : projet après projet
Der Oberrhein wächst zusammen, mit jedem Projekt
Fonds européen de développement régional (FEDER)
Europäischer Fonds für regionale Entwicklung (EFRE)
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
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Foreword

We are pleased to send you this short summary of the research work achieved in the context of the SPIRITS project during its first year. This period was the time for starting collaborative work between partners, with the support of associate partners. Writing this report, we want to thank again all co-funding partners for the trust they have placed in us. We hope you will appreciate the activities that took place and the initial results obtained over the period.

C'est avec plaisir que nous vous présentons ce résumé de l'activité de recherche conduite dans le cadre du projet SPIRITS au cours de cette première année. Cette période a été le temps de la mise en place de travaux collaboratifs entre les partenaires, avec le soutien des partenaires associés. En écrivant ces lignes, nous souhaitons remercier à nouveau les partenaires co-financeurs de la confiance qu'ils nous font. Nous espérons que vous apprécierez les activités conduites, et les premiers résultats obtenus sur la période.

Wir freuen uns, Ihnen anbei eine kurze Zusammenfassung der Forschungsergebnisse des ersten Jahres im Interreg-Projekt SPIRITS geben zu können. In diesem Zeitraum wurden die erforderlichen Kooperationsbeziehungen unter Einbeziehung der assoziierten Partner etabliert. Mit diesem Bericht möchten wir auch allen Partnern für die Unterstützung und das Vertrauen danken und die bisherigen Aktivitäten und Ergebnisse vorstellen.

Project outline

The SPIRITS Interreg project aims at developing an innovative robotics by 3D printing for interventional radiology and image guided surgery.

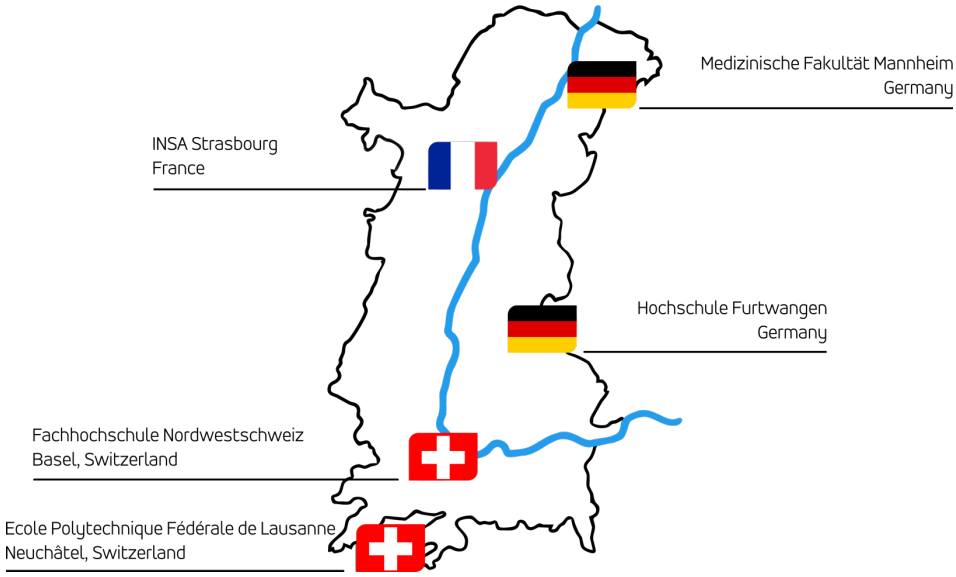
The project gathers five partners: INSA Strasbourg (leading partner), Hochschule Furtwangen, Medizinische Fakultät Mannheim der Universität Heidelberg, Fachhochschule Nordwestschweiz and Ecole polytechnique fédérale de Lausanne. Eight associate partners are part of the consortium: Universität Mainz, Alsace Biovalley, Axilum Robotics, SAES Getters S.p.a., Help Tech GmbH, Sensoptic SA, iSYS Medizintechnik GmbH, Kantonspital Baseland.

The SPIRITS project was launched as part of the Offensive Sciences program. It is supported by the Region Grand Est, Land Baden-Württemberg, Land Rheinland-Pfalz, Cantons Baselstadt, Basellandschaft, Aargau, Swiss Confederation, Baur SA and by the program INTERREG Upper Rhine from the ERDF (European Regional Development Fund). It is a 3-year project, started in April '17 with a total budget of 1.67 M€.

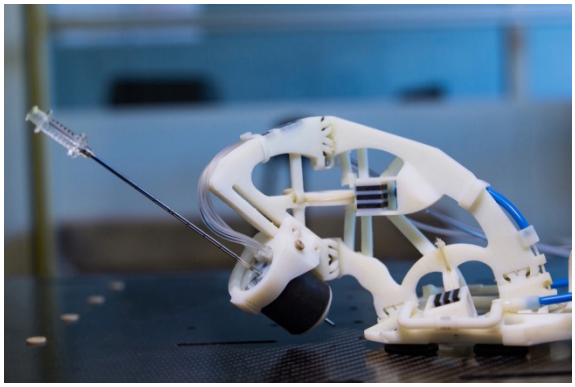
Project objectives

Medical image is being used more and more for guidance of medical tasks in radiology and surgery. Image-guided surgery is seeing strong development for a better management of pathologies. Targeted accuracy is very high, even though the access to the patient is very difficult, and exposition to X-Rays often used by imaging devices represents a risk for physicians.

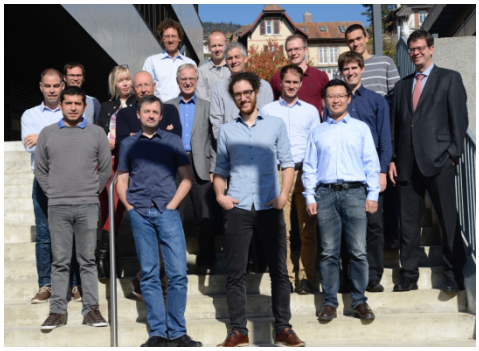
As an answer to the current limitations in image-guided tasks, SPIRITS partners are developing an innovative robotic device for percutaneous procedures, combining a robotic manipulator compatible with multiple imaging modalities, a smart manipulation of surgical tools, and interactive manipulation with efficient user feedback.



Year 1 in a nutshell



During Year 1, partners have conducted intensive investigations on medical and technological aspects of the project. First, analysis by observation and through interviews with medical partners has allowed the team to build the robotized procedure workflow. Second, technological developments have been launched with encouraging results on 3D printing of soft actuators and titanium-based parts, design of tactile transducer, robotic manipulator and instrumented surgical needles. SPIRITS has also gained visibility during this first year, with more than 4.000 connections to the project website, 3 published or submitted scientific papers and participation in several events targeting companies or a large audience.



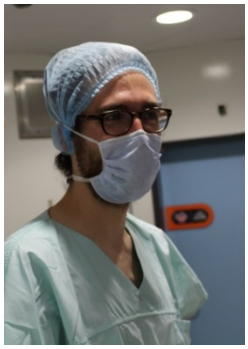
Team Work

During this year, partners gathered for joint meetings in Strasbourg (F), Neuchâtel (CH) and Furtwangen (DE). These were opportunities to foster collaboration within the research consortium, with exchanges during on-site mutual visits of technological platforms. A meeting with associate partners was also organized after the first semester of the project to create cross-links between partners and associate partners.

Visibility & Dissemination

SPIRITS is about health and improvement of surgical techniques. Presenting the work to a wide audience is important for the partners. The project was present at the Fête de la Science in Strasbourg in October 2017, with more than 1.200 people joining the event at the Palais Universitaire. Over 4.000 connections to the SPIRITS website (spirits.icube.unistra.fr) have been recorded during the first year of the project. The latter is available in French, German and English

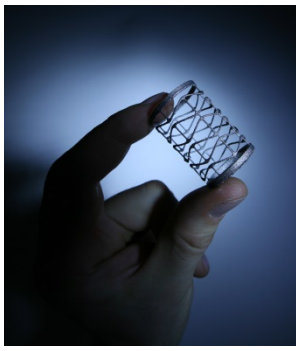
SPIRITS is also about transfer of medical technologies. The project was also present at Meet&Match meetings late 2017 in Strasbourg (F), and in March 2018 in Olten (CH) at the « Meet the expert: Implants conference ».



From requirement to robot design

More than 35 h of observation of medical procedures in Strasbourg and Mannheim have been used to build a precise workflow of current manual technique and to propose a simple way to use a robotic device as an assistance. The « robotic way » to proceed during biopsies -the tasks of interest- has been validated by radiologists. Several experiments conducted on phantoms have also been carried out.

3D Printing of robotic components



Additive manufacturing of titanium and nickel-titanium parts still represents a big challenge given the complex geometries of parts intended for robotic use. Intensive work has been performed on the analysis of geometry and mechanical properties of parts directly derived from the current prototype of the developed system. Manufacturing limits have been identified, and the bottlenecks are under investigation. Proofs of concept have been obtained and characterized with promising performances.

Drive technology for surgical needles

Multi-material additive manufacturing is being used to build surgical tool driver i.e. a motor to move the needle during insertion and retraction. In-depth analysis of its behavior is being performed experimentally. In addition, the compatibility of the component with sterilization process was observed with a new design to also take into account biocompatibility issues.

In parallel, the use of soft materials using additive manufacturing is being assessed with the now increasing number of adapted manufacturing techniques.

Feedback technology

Providing information to the radiologist beyond the visible with force-related events is crucial. Research work is focusing on two aspects. First, customization of an instrumented surgical tool was achieved to investigate the capacity to detect events during procedures such as punctures. Second, a tactile transducer was developed with several proofs of concept to compare them through user-in-the-loop tests.

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