



# SPIRITS

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

## Year 2 Executive Summary

# Foreword



*The SPIRITS project is completing its second year, and we are pleased to provide you this summary of the activity conducted during the period. Intensive work was carried out on the key technologies of the project, and actions to disseminate the results were also performed at the regional, national and international levels. In writing these lines, we would like to thank the co-financing partners once again for the trust they have placed in us. We hope that you will appreciate the activities carried out and the results obtained over the period.*



*Le projet SPIRITS achève sa deuxième année, et c'est avec plaisir que nous vous transmettons ce résumé de l'activité conduite au cours de la période. Un travail intensif a été conduit sur les technologies clés du projet, et par ailleurs des actions de diffusion des résultats ont été conduites à l'échelle régionale, nationale et internationale. 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 résultats obtenus sur la période.*



*Das zweite Jahr des Projekts SPIRITS ist abgeschlossen, und wir freuen uns, Ihnen diese Zusammenfassung der in diesem Zeitraum durchgeführten Aktivitäten zur Verfügung stellen zu können. An den Schlüsseltechnologien des Projekts wurde intensiv gearbeitet, und es wurden auch Maßnahmen zur Verbreitung der Ergebnisse auf regionaler, nationaler und internationaler Ebene durchgeführt. Mit dem Schreiben dieser Zeilen möchten wir den Kofinanzierungspartnern nochmals für das Vertrauen danken, das sie uns entgegengebracht haben. Wir hoffen, dass Sie die durchgeführten Aktivitäten und die im Laufe des Zeitraums erzielten Ergebnisse schätzen werden.*

## Project outline

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

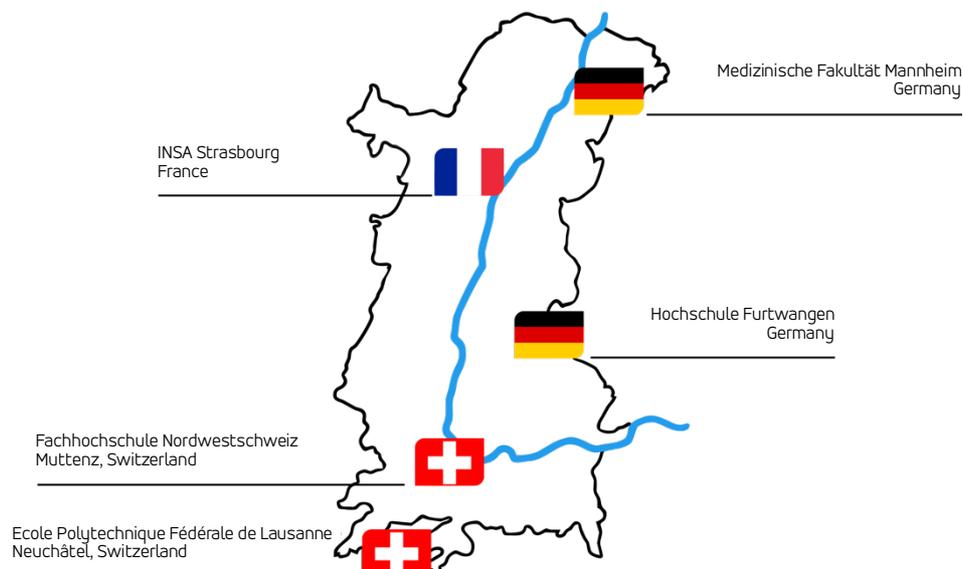
The project gathers five partners: INSA Strasbourg (leading partner), Hochschule Furtwangen, Medizinische Fakultät Mannheim der Universität Heidelberg, Fachhochschule Nordwestschweiz and Ecole polytechnique fédérale de Lausanne. Eight associate partners are part of the consortium: Universität Mainz,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

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 European Regional Development Fund (ERDF) - to the tune of 436 201 €. It is a 3-year project, started in April '17 with a total budget of 1.67 M€.

## Project objectives

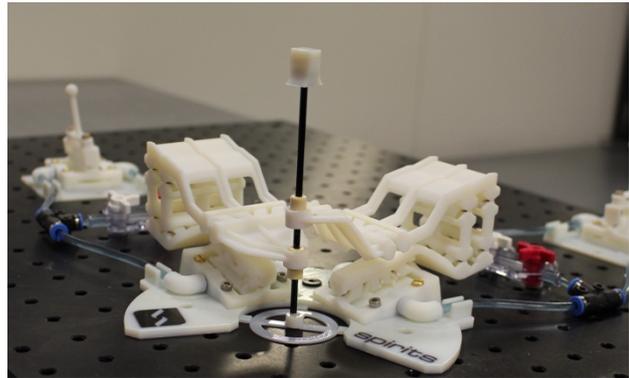
Medical image is being used more and more for guidance of medical tasks in radiology and surgery. Image-guided surgery is seeing strong development for a better management of pathologies. Targeted accuracy is very high, even though the access to the patient is very difficult, and exposition to X-Rays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

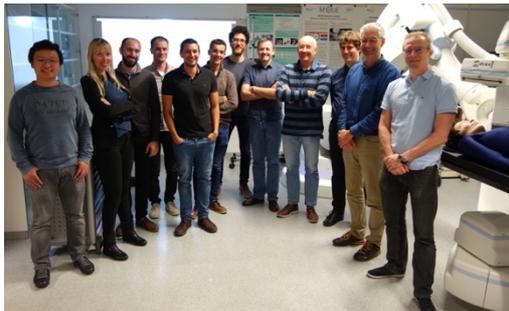


## Year 2 in a nutshell

During Year 2, partners have altogether conducted top-notch research to develop new technological solutions for image-guided medical procedures. In particular, novel hydraulic solutions have been developed with use of multi-material additive manufacturing. Performances of titanium 3D printing was significantly improved. Proofs of concept of instrumented surgical tools have been elaborated. Impact of robotics was also assessed in medical conditions, and use of tactile feedback was tested in the scenario envisioned in SPIRITS context.



SPIRITS has also increased its visibility. After two years, over 14,000 connections to the project's website have been recorded. The project team organized its first workshop with 45 participants from 4 countries, and participated in large-impact events such as Medica, the world's largest medical trade fair.



## Team Work

During this year, partners gathered for general meetings in Furtwangen (DE), Mannheim (DE) and MuttENZ (CH). These were opportunities to foster collaboration within the research consortium, with exchanges during on-site mutual visits of technological platforms. Several meetings with associate partners were organized in addition for specific technical exchanges.

## Visibility & Dissemination

SPIRITS is about development and transfer of medical technologies. Strong efforts were made to present the work achieved in the consortium at national events like for instance the SSB+RM annual meeting in Fribourg (CH), the [MEET THE EXPERT] event "Materials and Surface Technology for Implants" in Olten (CH), the well-known conference for the implant industry with more than 80 participating companies and international events such as IEEE EMBC conference. With help of Fraunhofer PAMB in Mannheim, SPIRITS was even present at Medica trade fair, attracting over 120,000 visitors in November 2018.



SPIRITS is about health and improvement of surgical techniques. Presenting the work to a wide audience is important for the partners to make people aware of ongoing efforts in the Upper Rhine for healthcare. The project was for instance part of the Fête de la Science in France in October 2018. Over 14,000 connections to the SPIRITS website ([spirits.icube.unistra.fr](http://spirits.icube.unistra.fr)) have been recorded after two years. The latter is available in French, German and English.



## Hydraulic actuation for robotics

Thanks to a close work between partners in Strasbourg (F) and Mannheim (DE), new solutions for hydraulic actuation in medical context were developed. They will be presented at next IEEE International Conference on Robotics and Automation, the largest research conference in robotics, in May 2019. The developed designs combine advantages of multi-material additive manufacturing and hydraulic principles to get small-size active joints for robots that are compatible with medical imaging devices. They rely on 3D-printed miniature piston rods with integrated sealings.

## Tactile feedback and embedded sensing

Providing information to the radiologist beyond the visible with force-related events is crucial. Research work is focusing on two aspects. First, a tactile feedback system, developed during the first year of the project in Furtwangen (DE), was used to perform user tests in order to identify adequate feedback scenarios in the context of biopsy procedures. In parallel, an innovative DEAP-based solution is developed to help miniaturization. Second, an instrumented surgical needle was achieved and tested in lab conditions in Neuchâtel (CH). It gives a direct access to interaction forces between the tool and surrounding tissues.



## 3D Printing of robotic components

Robot design in medical context is challenging because of the lack of space in the operating room, and also the required compatibility with different imaging devices. Work between Strasbourg (F) and Muttenz (CH) is ongoing to investigate new designs obtained using 3D printing of titanium structures. Thanks to advanced manufacturing strategies, significant progress was made by our partner in Switzerland in terms of minimum thickness and size of robotic components.

## Evaluation of robot impact

The SPIRITS approach of image-guided procedures is to rely on assistance tools provided in the imaging devices. The impact of such robot use was investigated in terms of procedure duration and X-ray exposition in collaboration with University Hospital of Strasbourg. Very encouraging results were obtained in terms of safety improvement, validating the interest of using a device like the current SPIRITS proof of concept.





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