Title

**AR2OR – Taking Augmented Reality to the Operating Room**

Institution

**ALCoV (Advanced Laparoscopy and Computer Vision group), ISIT, UMR6284 CNRS / Univ. d'Auvergne**

Training place

**Faculty of Medicine and Gynecologic Surgery Department of Nouvel Hopital Estaing, Clermont-Ferrand**

Supervisor name

Adrien Bartoli, with Toby Collins and Daniel Pizarro for the technical part, and Michel Canis and Nicolas Bourdel for the medical part

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Brief Description of the project

The ALCoV group develops new solutions to aid surgery with Augmented Reality (AR). One of our leading projects concerns the surgery of the uterus, and in particular, the surgery of uterine fibroids (aka myomas). In many cases, these benign tumors must be removed surgically by laparoscopy, but are hidden within the uterus' body, causing the surgeon difficulties to find them. Laparoscopy’s principle is to introduce an optic fiber connected to a camera, and surgery tools, by small abdominal incisions. Laparoscopy and the hidden tumors form a clear case where AR can bring a tremendous help, especially because the tumors are clearly visible on a preoperative MRI scan undergone by all patients, and are marked and segmented weeks before surgery by a radiologist. AR here thus means transferring the tumors’ location and shape from the MRI to the laparoscopic view during surgery. Implementing AR requires one to solve two key problems. P1 is the registration problem, which is to estimate the transformation between the MRI and the laparoscope in some reference position. P2 is the tracking problem, which is to update the transformation in realtime while the surgeon moves the laparoscope. We have proposed effective solutions to P1 and P2, in references [1] and [2] respectively. So far, these were tested using a pelvis phantom and retrospectively on patient data using recorded laparoscopic videos. The next step: taking the system to the Operating Room (OR).

The goal of this internship is to take the existing modules developed in ALCoV to the OR. This will require the intern to understand the cutting edge techniques which were developed, and solve a few remaining problems. This internship will thus have very applied and practical aspects, but there will also be some theory involved, and great potential contributions to make. If successful, the results will be publishable in both the technical and medical literature. This internship is an opportunity to participate to a larger project and to contribute to the new trend of using AR for medical applications, with a direct impact of the patient’s life by improving the quality of surgery.

[1] Computer-Aided Laparoscopic Myomectomy by Augmenting the Uterus with Pre-operative MRI Data  
T. Collins, D. Pizarro, A. Bartoli, N. Bourdel and M. Canis  
ISMAR’14 - IEEE International Symposium on Mixed and Augmented Reality, Munich, Germany, Sep. 2014.

[2] Realtime Wide-Baseline Registration of the Uterus in Monocular Laparoscopic Videos  
T. Collins, D. Pizarro, A. Bartoli, M. Canis and N. Bourdel  

Software/Hardware needs and skills

Basics in 3D Computer Vision (camera models, features, tracking) are mandatory, as well as good coding skills (Matlab and C++) and some experience in OpenCV. GPU coding is a plus.