THESIS TOPIC

Subject N° (to be completed by the ED): [ ] FUNDING: [ ] Requested [ ] Acquired

Thesis title: Study of physiological characteristics in the learning process of surgical skills in simulation

Unit / team: LTSI UMR1099

Supervisor’s name: Xavier Morandi

Socio-economic and scientific context (approximately 10 lines):
Surgical simulation has become an important part of the training curriculum for young surgeons. Learners need to practice repeatedly on these simulators to improve their skills and performance. In theory, they should be supervised by experienced surgeons so that the learner acquires all the right gestures for the accomplishment of a task. In reality, learners are generally left to their own devices and are only given feedback on evaluation metrics based on results directly measurable by the simulators: completion time, instrument collisions, overlapping workspaces, length of movements, etc. These metrics reflect some of the technical skills required to perform surgery, but neglect the importance of non-technical skills in the performance of the procedure.

Working hypothesis and aims (approximately 8 lines):
The main hypothesis of this research project is the following. Some of these non-technical skills can be objectively assessed using a sensor-based approach. The analysis of data from different sensors, such as depth videos (RGBD), electrocardiographic (ECG) and electromyographic (EMG) sensors would allow us to access different information on the physical and physiological state of the learner during the simulator task: posture for RGBD videos, and stress and HRV for ECG data, for example.

Main milestones of the thesis (approximately 12 lines):
The objective of this research topic is to study a data analysis methodology based on a deep machine learning methodology of artificial intelligence to analyze separately and then jointly these multimodal data to better characterize and understand the impacts of the physical and physiological dimensions of the learner during the realization of a task on its success. We will initially rely on data being acquired during training sessions on arthroscopy simulators of 90 orthopedic surgeons. We also plan, during the course of the thesis, to build a second database acquired during training sessions of robotic surgery in gynecology.

Scientific and technical skills required by the candidate (2 lines):
Data analysis, machine learning, deep learning

Funding origin: CD UR1

3 keywords: Surgical Training; Surgical Simulators, Machine Learning

Phone number: [ ] Email address: xavier.morandi@chu-rennes.fr

3 publications from the team related to the topic (last 5 years):

National and international collaborations:
Main scientific partners: Pr. E. Michinov, LP3C (LP3C), Université Rennes 2, Pr. P. Poignet, Directeur du Département Robotique, LIRMM, Université de Montpellier, S. Voros CR Inserm, TIMC-IMAG CNRS UMR 5525, Grenoble, Pr. G. Forestier, PU, Université de Haute Alsace à Mulhouse
Main industrial partners: Stryker (Germany), Intuitive Surgical (USA), Syneika (France), Virtamed (Suisse)
Main international collaborations: Pr. M. Hashizume, Department Of Advanced Medical Initiatives Faculty of Medical Sciences, Kyushu University, Japan, Pr. M. Mitsuishi, Department Of Advanced Medical Initiatives Faculty of Medical Sciences, The University of Tokyo, Japan, Pr. A. Malti, University of Tlemcen (Algeria)