Internship Subject: Surgical Workflow Recognition of robotic assisted hysterectomies

Localization: Laboratoire Traitement du Signal et de l'Image (LTSI), MediCIS Team

Contacts: Arnaud Huaulmé (arnaud.huaulme@univ-rennes1.fr) and Pierre Jannin (pierre.jannin@univ-rennes1.fr

Keywords: Surgical robotic; Deep Learning; Workflow recognition.

Context

Under a collaboration with a major company developing surgical robots and the obstetrical surgery department of Rennes University Hospital, we have access to a large and rare dataset composed of more than 70 hysterectomies. This dataset is composed of surgical video, robotic arms kinematics, and the surgical workflow description. Video and kinematics data are automatically recorded, but the surgical workflow description has been manually annotated by surgeons. The data acquisition is still in progress, but the manual annotation of surgical workflow is time-consuming [1]. To include new surgeries, it is necessary to develop an automatic workflow recognition method. For this, convolutional neural networks, recurrent neural networks, or transformers [2] could be used.

The objective of the development of such method is to increase the database in order to study surgical workflows specific to patient's anatomical characteristics, surgical team's habits or preferences. In previous studies, we have demonstrated the existence of such preferences on the procedural aspect [1,2]. We have highlighted sequence of activities specific to the level of experience and also specific to each surgeon individually.

Objective of the internship

The objective of this work is to develop automatic workflow recognition deep-learning methods based on video and/or kinematic data. To achieve this goal, the internship will be divided into 3 steps:

- Study the state of the art on automatic workflow recognition;
- Develop automatic workflow recognition deep-learning methods-based video and/or kinematic data;
- Compare the performances between methods on surgical available data.

Profile researched

The candidate must have knowledge in deep learning, data analysis, computer science and programming (python).

Duration: 5 to 6 months

Salary or allowance: Standard internship allowances

[1] A. Huaulmé, F. Despinoy, S. A. H. Perez, K. Harada, M. Mitsuishi, and P. Jannin, "Automatic annotation of surgical activities using virtual reality environments", *Int. J. Comput. Assist. Radiol. Surg.*, vol. 14, no. 10, pp. 1663-1671, June 2019.

[2] A. Huaulmé, P. Jannin et.al. "PEg TRAnsfer Workflow recognition challenge report: Does multi-modal data improve recognition?", *ArXiv,* 2022.

[3] A. Huaulmé, S. Voros, L. Riffaud, G. Forestier, A. Moreau-Gaudry, and P. Jannin, "Distinguishing surgical behavior by sequential pattern discovery," *J. Biomed. Inform.*, vol. 67, pp. 34–41, May 2017.

[4] A. Huaulmé, K. Harada, G. Forestier, M. Mitsuishi, and P. Jannin, "Sequential surgical signatures in micro-suturing task," *Int. J. Comput. Assist. Radiol. Surg.*, vol. 13, no. 9, pp. 1419–1428, May 2018.