PhD position: Automated Assessment and Intervention Models for Maximizing Situation Awareness in Human-Robot Interaction
IMT Atlantique, Nantes / Max Planck Institute for Intelligent Systems, Stuttgart
Duration: 36 months

We are looking for excellent candidates for a PhD project at the intersection of human-robot interaction and artificial intelligence in complex sociotechnical systems, with specific applications in healthcare and/or manufacturing settings. The PhD candidate will study approaches to predict and maximize human operator and team situation awareness using automatically detected signals of the team members, such as communication or physiological signals.

For example, laparoscopic surgery is now commonly performed using surgical robots, where the surgeon controls the instruments through an immersive console. This type of surgery offers a number of advantages: smaller skin incisions, shorter and less costly hospitalization, reduced post-surgery pain and faster recovery. But it also comes with new challenges, including a total reorganization of the operating room (OR), the equipment, and the operating team around the patient. This new organization constitutes a major challenge, in particular for the surgeon and the surgical team to maintain situation awareness (SA). SA is an essential skill that impacts decision making and medical outcomes; poor SA can lead to medical errors.

Existing methods to assess situation awareness rely on questionnaires and “freeze-probe” techniques which do not enable detailed investigations and are inherently unreliable as they depend on the participant’s recall of the situation and their current state of mind. SA in the wild is thus very difficult to assess or improve. Our objective is to test the hypothesis that an intelligent system could (a) automatically assess situation awareness from multimodal cues acquired from physiological, haptic and audio-visual devices in collaborative, high-stakes tasks involving robotic assistance devices and (b) suggest useful interventions and recommendations for maintaining and restoring situation awareness. The initial use-case domain will be the operating room during robotic assisted surgery, however we expect the proposed models, approaches and methodologies to be applicable to other scenarios, such as human-robot interaction in industrial scenarios. We will combine observational studies to acquire data in simulated and real operating rooms with multimodal machine-learning techniques to train real-time computational models capable of assessing teams and providing recommendations and interventions. Other scenarios, including shopfloor collaboration involving robotic assistance devices, will also be considered.

The PhD project will be primarily realised on the IMT Atlantique Nantes campus, and will involve close collaboration and research visits with the CHU de Nantes, and the Max Planck Institute for Intelligent Systems in Stuttgart, Germany. The student will be supervised by Caroline Cao and Mathieu Chollet from IMT Atlantique and Katherine Kuchenbecker from Max Planck Institute. The PhD student will be trained in data science and human factors applied to the complex socio-technical systems, especially in the medical field. It is expected that the doctoral student will present project’s research outputs at national and international conferences. If you are interested, please send your CV and a cover letter by email to mathieu.chollet@imt-atlantique.fr.

Student profile:
The ideal candidate should hold a master's degree in one of the following disciplines: Computer Science, Human Factors, Human-Computer Interaction, Medical Engineering, or Robotics.

Experience or training in the following areas would be preferred:
- Cognitive system engineering;
- Artificial intelligence, especially machine learning;
- Multimodal signal processing (physiological, audio-visual, haptic).

Fluency in English is required. Knowledge of German and/or French would be an advantage. The ideal candidate will have a strong interest in interdisciplinary research in the health domain.

Refs :
[1] Lechappe, A., Chollet, M., Rigaud, J., & Cao, C. G. (2020, October). Assessment of Situation Awareness during Robotic Surgery using Multimodal Data. In Companion Publication of the 2020 International Conference on Multimodal Interaction (pp. 412-416).
[2] Echeverria, V., Martinez-Maldonado, R., & Buckingham Shum, S. (2019, May). Towards collaboration translucence: Giving meaning to multimodal group data. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (pp. 1-16).
[3] Pradarelli, J. C., Yule, S., & Smink, D. S. (2020). Evaluating Non-Technical Skills in Surgery. In Health Services Research (pp. 125-135). Springer, Cham.
[4] Anderson-Montoya, B. L., & Scerbo, M. W. (2019). Human Factors Psychology in Surgery. In Comprehensive Healthcare Simulation: Surgery and Surgical Subspecialties (pp. 153-167). Springer, Cham.
[5] Wheelock, Ana, et al. "The impact of operating room distractions on stress, workload, and teamwork." Annals of surgery 261.6 (2015): 1079-1084.
[6] Vedula, S. Swaroop, Masaru Ishii, and Gregory D. Hager. "Objective assessment of surgical technical skill and competency in the operating room." Annual review of biomedical engineering 19 (2017): 301-325.