Sujet de stage: Social learning for collaborative robots in manufacturing situations

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Context:
Most collaborative robots will be dropped in human environment where they will have to accomplish missions. They will be engaged in interaction with human individuals concerned by these missions. Optimizing and personalizing robot behaviors in such situations will require having a detailed perception of psychological and emotional features of human co-workers as well as mechanisms of mutual adaptation.
Actually, existing collaborative robots in manufacturing situations do not interact with human being by explicitly taking into account co-workers' social traits. In addition, most of missions are specified from an operational point of view without taking into account behavior particularities of expected or unexpected interactions: it is supposed that, assuming qualified workers have the same training, they will process their tasks with same emotional and concentration assets.
Several approaches grounded in social robotics and machine learning have been proposed that target educational tasks, assistive robotics, service robotics… However, mutual adaptation using social cues is less addressed in the case of purely technical missions such as co-working with a robot in an assembly line.

Objectives:
The main objective of this work is to develop models of mutual adaptation during interactions with robots during purely technical missions using different kind of cues such as gaze, reactivity and/or engagement. The models aim to be integrated in assembling and manufacturing processes. Collaboration between ISIR and an industrial partner will facilitate the deployment; We target robots such as Baxter, robot arm (Franka Emika or similar)
The main steps are:

- Development of a collaborative task similar to [Tabrez2019] with a Baxter or Franka Emika and grounded in technical missions in collaboration with an industrial partner (APSYS/AIRBUS).
- Analysis of collaborative cues such as gaze, reactivity and engagement [Ivaldi2017]
- Develop mutual adaption strategy using machine learning techniques able to modify online robot policy
- Experimental evaluation of mutual adaptation strategies

[Tabrez2019] Aaquib Tabrez, Shivendra Agrawal, and Bradley Hayes. (2019). Explanation-based Reward Coaching to Improve Human Performance via Reinforcement Learning. To Appear: Proceedings of the 2019 ACM/IEEE International Conference on Human Robot Interaction (HRI 2019).
[Ivaldi2017] Ivaldi S., Lefort S., Peters J., Chetouani M., Provasi J., Zibetti, E. (2017), Towards engagement models that consider individual factors in HRI : on the relation of extroversion and negative attitude towards robots to gaze and speech during a human-robot assembly task. International Journal of Social Robotics, Vol 9 No 1 Pages 63-86 doi :10.1007/s12369-016-0357-8.

Skills: Python, Machine learning
Duration: 5-6 months