Collaboration between humans and robots is a current high-stake research subject with numerous application areas (smart factories, therapeutic robot companion, …). We propose a PhD position in the framework of the Flying co-worker ANR project (started in 2019) whose aim is to combine Human Robot Interaction (HRI) and Aerial manipulation to demonstrate the possibility for an aerial robot to physically collaborate with a human worker in a safe and fluent manner.

More precisely, the proposed subject focuses on building the behavior (or the conditional plan) of an autonomous robot to assist a human worker to fulfill his tasks in the best possible way (meaning, minimizing a cost to define). This is a complex issue since (1) the robot has to estimate the objective of the human worker through partial observations of his activity, (2) the robot has to make decisions based on this partial information and (3) the human behavior might also depend on the actions undertaken by the robot.

In this PhD, we propose to address this issue in the context of a flying co-worker assisting a human worker in tasks such as installing, dismantling or repairing a device placed at height. While the global task to perform can be known in advance, sources of uncertainty are numerous, calling for online decisions that take into account human preferences and abilities.

To do so, this PhD aims at extending contributions linked to the concept of Human Robot joint action and at using models for decision making under uncertainty (Markov Decision Processes, Partially Observable Markov Decision Processes). This will involve (1) modelling the human worker behavior; his objectives and the task sequence he tries to accomplish in a flexible way; (2) using this model to infer distributions on the current objective of the human worker based on partial observations (Bayesian inference, HMM [7]); (3) deciding which actions to perform in order to help the human worker while considering uncertainties about his state and his evolving objectives by using POMDP models and solvers; (4) controlling the execution of the proposed plan and verifying the state of the human-robot interaction during the execution, in order to react accordingly.

Inria, the Institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever des défis des sciences informatiques et mathématiques, souvent à l'interface d'autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.
Then, in a second step, the PhD student will address the questions cited previously: first by finding a way to model the human objective \([3, 4]\) and his adaptation to the robot actions \([6]\), and then by proposing algorithms to build the optimal behavior of the agent based on these models \([2]\) and on reasoning on Human Robot joint action \([5]\).

Finally, the PhD student will investigate several aspects which are not usually considered and seem of paramount importance in Human-Robot interaction context:

1. how to model the mental state of the human agent and to take it into account for selecting an approach and a communication strategy to improve the mutual understanding of their activities and intentions?
2. how to model explicitly the durations of the human activities and to take them into account for planning the flying co-worker behaviour?
3. how may the flying worker act to gather more information about the human task (with the help of active sensing models and algorithms \([7]\))? 

Write ****

- Test, change up until validation
- Distribute the **** via ****
- Provide user training for the service's main clients
- Lead a user community
- Present the works' progress to partners, ****to an audience of financiers ****
- Other ****

Compétences

We are looking for excellent candidates with a strong interest for artificial intelligence planning, both from a theoretical (maths) and practical (programming) point of view.

Knowledge of English is mandatory.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training (French courses...)
- Social security coverage

Rémunération

Salary:

1982€ gross/month for 1st and 2nd year. 2085€ gross/month for 3rd year.

Monthly salary after taxes: around 1596,05€ for 1st and 2nd year. 1678,99€ for 3rd year. (medical insurance included).