Dissertation topic summary

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### Dissertation topic

My dissertation topic aims at the problems of robotic intelligence with a human in the loop.

The import of the human factor naturally impacts the autonomous behavior of a robot. We look at one case that a human and a robot collaborate in a search task. By defining the roles of the human and the robot in the team, the human brings the constraints to the motion planning of the robot. We submitted a paper “Informative Path Planning with a Human Path Constraint” to 2014 IEEE conference on SMC. The robot and the human collaborate in a search task, which is modelled as an information maximization problem using coverage observation models. The human behavior becomes constraint to the optimization problem for the robot. We proposed an algorithm on this constrained submodular problem in a graph topology and theoretically analyzed the performance.

Understanding the intent of each other is another important factor that determines the performance. There exists the inconsistency between the way of defining the objectives between the human and the robot. How to convert the human’s intent (usually in semantic form) into a math model that robot can understand is a challenge. Moreover, the adverb element in human language expression usually import multi-objective optimization problem. For the problems that can be easily converted into a weighted sum of several objectives, we propose a sliding interactive method to solve this multi-objective optimization problem. However, a couple of problems contain incomparable objectives. We have to import a Pareto interactive method for problem solving. The representation of Pareto front of the solutions can be used to help the human finds the solution satisfying his/her true intent. This looped interaction between the human and the robot could enhance the team performance by strengthening the forms of information communication.

Currently our focus is still about peer-to-peer interaction. In the next phase, we are going to work on the interaction topology that involves both humans and robots as nodes. This actually forms a multi-agent system that is organized by both the humans and the robots. The topology of human-robot interaction can help solving many optimization problems, which include path planning, formation control, object tracking and localization.

### Relevance of AI techniques

My research topics connect to many topics in artificial intelligence and robotics. All the research problems are on robot problems, sometimes with a particular focus on the human factor. My dissertation topic is exactly about the artificial intelligence with a focus on robotics. I am also interested with a lot of machine learning and optimization methods. I recently just finished a paper about theoretic analysis on some evolutionary algorithm.

I currently work a lot on Turtlebot. I am adding a lot of features to the Turtlebots, which include map-guided navigation, vision and ways of human interaction.

I am also going to teach “Introduction to Artificial Intelligence” for undergraduate students in next spring term. I am hoping an experience from the top conference in AI field can give me more knowledge on how artificial intelligence techniques connect with all sorts of problems. I wish my teaching could make more students interested with this field.