Learnable and explainable coordination in multi-robot systems

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Abstract:

Effective communication is key to successful, decentralized, multi-robot coordination. Yet, it is far from obvious what information is crucial to the task at hand, and how and when it must be shared among agents. To side-step these issues and move beyond hand-crafted heuristics, I introduce a method based on graph neural networks (GNN) that automatically synthesizes local communication and decision-making policies for agents navigating in constrained workspaces. Our results demonstrate that planned paths are close to those of expert, centralized algorithms. However, the resulting policies are hard to interpret and, if they are to be deployed alongside humans, these policies need to be clear regarding 'how' and 'why' certain navigation decisions are made. We need to ensure that autonomous agents consider their liability and can express justification for their agency in a human-understandable way. As such, I then shift to presenting an argumentation-based architecture that leans on the notion of argumentative dialogues and generates explanations from the history of such dialogues. Our results show that explanations provide a significantly higher improvement in human performance when systems are more complex. Finally, I address the challenge of learning navigation policies for autonomous agents operating in a shared physical workspace, where the absence of collisions cannot be guaranteed. I conclude the talk by presenting a multi-vehicle mixed reality framework, that facilitates the process of safely learning multi-agent navigation behaviours.