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Teamwork with robots

This thesis contributes a novel case-based approach for action selection and coordination in joint multi-robot tasks in real environments, based on a case to reuse. The ideas presented are applicable to domains such as disaster rescue operations, exploration of unknown environments and underwater surveillance, among others.

Designing the decision-making engine of a team of robots is a challenging task, not only due to the complexity of the environment where the robots usually perform their task, which include uncertainty, dynamism and imprecision, but also because the coordination of the team must be included in this design. The robots must be aware of other robots' actions to cooperate and to successfully achieve their common goal. Besides, decisions must be made in real-time and with limited computational resources.

This thesis contributes a novel case-based approach for action selection and coordination in joint multi-robot tasks in real environments. This approach has been applied and evaluated in the representative domain of robot soccer, although the ideas presented are applicable to domains such as disaster rescue operations, exploration of unknown environments and underwater surveillance, among others.

The retrieval process proposes a case to reuse, evaluating the candidate cases through different measures to overcome the real world characteristics, including the adversarial component which is a key ingredient in the robot soccer domain. Unlike classical case-based reasoning engines, the case reuse consists in the execution of a set of actions through a team of robots. Therefore, from the multi-robot perspective, the system has to include a mechanism for deciding who does what and how. In this thesis, we propose a multi-robot architecture along with a coordination mechanism to address these issues.

We have validated the approach experimentally both in a simulated environment and with real robots. The results showed that our approach achieves the expected goals of the thesis, i.e. designing the behavior of a cooperative team of robots. Moreover, the experimentation also showed the advantages of using collaborative strategies in contrast to individualistic ones, where the adversarial component plays an important role.

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References

"Action selection in cooperative robot soccer using case-based reasoning". Doctoral thesis directed by Ramón López de Mántaras i Badía, and readed by Raquel Ros Espinoza in the Department of Ciències de la Computació of Universitat Autònoma de Barcelona on march, 2008.

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