IAF SPACE OPERATIONS SYMPOSIUM (B6)
Mission Operations, Validation, Simulation and Training (3)

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GAME THEORY BASED COOPERATIVE ACTION SELECTION IN SPACE ROBOT OPERATION

Abstract

For the deep space exploration, such as the upcoming lunar surface exploration activities, The application for autonomous in-space operation is the trend in the future. Since it is very hard for astronauts to expose outside for long time, robots are undoubtedly the protagonists. The robots would perform missions such as environment detection, resource storage, material handling and building constructions etc. These missions would often require different types of robots to collaborative carry tasks to achieve the overall target. Basically the task could be allocated through recent technologies such as dynamic planning, multiple Agent System, Multiple Agent Deep Reinforcement Learning. In most cases, The cooperative strategies would be achieved by dynamic planning or learning in planning phase and then executed by each member of robot team in distributed way during the implement phase. But for the robots who work outdoors for long time, will be often faced with the change of environments that not included in the case in rehearsal. Thus distributed decision making would be good option to solve such problems. A distributed decision making approach is presented for building cooperative control strategy in a robotic team based on game theory. Each robot of the team predicts the other robots' actions and select its own action to maximize the global expected reward that depends on the reward for joint successful completion of the task. Actions selection could be interpreted as an n-player cooperative game or negotiation process in multiple agent schema. The iteration negotiation process will convergence to the optimum if their individual and group rewards are suitably defined. The approach could enable the robots to efficiently complete their tasks by coordinating their actions. The performance is tested on simulation scenarios including the one that coordination material handling between two robots, and the one that building assembling by a team of robots.

KEYWORDS: cooperated robots team, multiple agent, game theory