Internet Appendix A9: Computer Science

Figure A9.1 Illustrative Pitch Template Example in Robotics

Pitcher's Name	Lexie Yao (date completed: 12/9/14)
(A) Working Title	Alternative way to play multi-robot games: implementing genetic algorithms in game theory
(B) Basic Research Question	Optimizing multi-robot path finding with game theory and genetic algorithms
(C) Key paper(s)	I.A.Ismail et al., 2007. Game Theory Using Genetic Algorithms. Proceedings of the World Congress on Engineering, 1. (Conference paper) Meng Yan. 2008. Multi-Robot Searching using Game-Theory Based Approach. International Journal of Advanced Robotics Systems, 5(4), p.341-350. Semsar-Kazerooni, E. & Khorasani, K., 2009. Multi-agent team cooperation: A game theory approach. Automatica, 45(10), p.2205-2213.
(D) Motivation/Puzzle	Compared to a single robot, the use of multi-robot has advantage in greater efficiency and less time consumption, with huge potential in assisting human beings with field exploration, rescue operations, or even in military operations. However, efficient cooperation with accuracy and scalability among all robots is an enormous barrier towards achieving these goals. Other than efficiency, reliability can also be promoted with the development of optimal strategy. Of all usages, path finding is the fundamental objective to be accomplished. For all robots, it is essential to select the optimal path without conflicting with each other.
THREE	
(E) Idea?	Treating each robot as a player in a game, the use of genetic algorithms will produce a range of optimized overall robot behaviors. A robot is expected to be able to choose optimal behavior based on the behavior of other robots.
(F) Data?	"Data" for this project are experimental and thus will be created as part of the project design itself. Initial data (chromosomes) processed by the algorithm are data collected by external sensors on robots, including but not limited to range, proximity or positioning. A result pool should be produced after a number of rounds of mutations, which, will subsequently be used in comparison to the outcome calculated in game theory to reveal the optimal strategy.
(G) Tools?	Basic algorithms: genetic algorithms. The algorithms imitate Darwinian natural selection, encode a potential solution to a specific problem on a simple chromosome-like data structure, and apply recombination operators to these structures in such a way as to preserve critical information. Method chosen for determining optimal strategy among robots in co-operation: game theory. It is a mathematical study of strategies of interaction between different parties. All parties are expected to choose the strategy with the optimized payoff, given the information they have. Software for plotting experiment results: MATLAB Programming language: C
TWO	
(H) What's New?	Prior researches have already investigated multi-robot operations by implementing the concept of game theory in order to yield desirable co-operation strategies, the introduction of genetic algorithms into the research is expected to produce not only optimal solutions in reliable manner, but also a pool of solutions for higher error tolerance and to refine robot performance and scalability.

(I) So What?	Under certain circumstances multi-robots systems are superior to single robot as they greatly improve the time needed, range covered, and possibilities to accomplish more complex tasks. Implementation of algorithms offers them the ability to “think” and “decide”, maximizing performance outcomes while minimizing conflicts during executions among the team.
ONE	
(J) Contribution?	Identifying the optimal genetic algorithm for application in multi-robot searching.
(K) Other Considerations	Time and space complexity with applying genetic algorithms can be less-than-ideal. Little control over the quantity of output data from mutation operation. An adequate amount of data must be gathered in the initial stage of research.