Monte Carlo Tree search method for MGAs

Stage topic Description

Monte Carlo Tree Search is one of the state-of-the-art search techniques in AI for games such as GO. GO has a much higher branching factor than chess and is therefore considered more "complex" than chess. Indeed, the playing level of GO programs compared to human performance is less good than for chess programs. Interplanetary trajectory problems share many similarities with the complexity of GO and tree search methods are often the key to search efficiently the design space, as shown in the Global Trajectory Competitions (GTOC4, GTOC5, GTOC6). While MCTS can be applied off-the shelf to any problem, its real value is revealed when knowledge is put in the search, both in the node selection and in the node simulation.

Candidate's tasks

The candidate will study the effectiveness of MCTS techniques on complex interplanetary trajectory problems such as gtoc4, gtoc5, gtoc6. He will produce and implement a number of ideas on node selection and node simulation to eventually select the good ones. The challenges include the manner in which to determine what should constitutes a node, how nodes should be selected during selection, default policy, etc.

The ideal candidate

Knowledge of tree searches startegies

Programming skills in C++ and Python

Curiosity and knowledge on interplanetary trajectories

References

Browne et al.: "A survey of Monte Carlo Tree Search methods",IEEE transactions on computational intelligence and AI in games, 2012 (Link to the article)

Izzo, D. http://www.esa.int/gsp/ACT/mad/pp/GTOC/index.htm (Accessed Oct 2012)

Izzo, D. "Global Trajectory Optimization. Results of the First Competition Organised by the Advanced Concepts Team (ACT) of the European Space Agency (ESA)," Acta Astronautica, Vol. 61, Issue 9, pp. 729-816, Ed. Franco Ongaro, Leopold Summerer and Dario Izzo, Nov. 2007.