Open Internship in the ESA Advanced Concepts Team in 2015
on

Monte Carlo Tree Search in Interplanetary Trajectory Design

Topic description

Monte Carlo Tree Search [1] is one of the state-of-the-art search techniques in AI for board games such as Go. Go has a much higher branching factor than chess and is therefore considered more "complex". Indeed, the playing level of Go programs compared to human performance is less advanced than the level of 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 several Global Trajectory Competitions [2]. 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 Monte Carlo simulation.

Candidate's tasks

The candidate will study the effectiveness of MCTS techniques on interplanetary trajectory design. He will conceive and implement a number of ideas on node selection and simulation. The performance of the resulting MCTS will be compared to standard depth-first search with pruning and breadth-first search with constant size frontier.

The ideal candidate

- Programming skills in C++ and Python
- Knowledge of tree search strategies
- Interest in interplanetary trajectories

References

[1] Browne et al.: "A survey of Monte Carlo Tree Search methods", IEEE transactions on computational intelligence and AI in games, 2012.http://www.cameronius.com/cv/mcts-survey-master.pdf
[2] http://sophia.estec.esa.int/gtoc_portal/