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Title

Simultaneous Arrival Strategy by Using Learning-Based Approach

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Abstract

Simultaneous arrival strategies have been applied to overcome misbehaving interceptor [1], numerical singularity [2] and actuation failure [3] problems in recent years. Li and Ding [1] proposed a robust cooperative guidance law for the solution of cooperative simultaneous arrival problem in the presence of misbehaving interceptors. Multivehicle simultaneous arrival without numerical singularities have been studied in [2]. Li et al. [3] proposed an adaptive fault-tolerant cooperative guidance law for simultaneous arrival under the actuation failures.

This paper proposes simultaneous arrival strategy by using learning-based approach to solve multi-UAV target simultaneous interception problem. The arrival time to the target is estimated by using deep neural network for each quadcopter that uses a guidance algorithm to reach the target. Guidance commands created by the deep reinforcement learning algorithm are added to the commands produced by the guidance algorithm to ensure the equalization of the arrival times of the quadcopters to the target. The quadcopters have full knowledge of relative position, relative velocity and heading angle information which allows the environment to be formulated as fully observable MDP. The space consisting of guidance commands that can be added to the guidance commands generated by guidance algorithm is defined as the action space. A reward function is defined that aims to enable quadcopters to simultaneously intercept the target without colliding with each other. The simulation results under different conditions show the effectiveness of the proposed strategy in achieving successful simultaneous interceptions.

References

[1] Li, Zhenhong, and Zhengtao Ding. "Robust cooperative guidance law for simultaneous arrival." *IEEE Transactions on Control Systems Technology* 27.3 (2018): 1360-1367.
[2] Li, Kang, et al. "Distributed cooperative guidance for multivehicle simultaneous arrival without numerical singularities." *Journal of Guidance, Control, and Dynamics* 43.7 (2020): 1365-1373.
[3] Li, Guofei, Yunjie Wu, and Pengya Xu. "Adaptive fault-tolerant cooperative guidance law for simultaneous arrival." *Aerospace Science and Technology* 82 (2018): 243-251.