17th International Conference on Innovative Computing, Information and Control (ICICIC2023)
Kumamoto, Japan, August 29-31, 2023

Paper ID: ICICIC2023-SS29-02

Dynamic Path Planning Algorithm for Fixed Wing UAV Based on DDPG

Ruijia Yang, Bin Xu* and Weixin Han

School of Automation, Northwestern Polytechnical University, Xi'an 710129, P. R. China
*Corresponding author: binxu@nwpu.edu.cn

Introduction

Existing dynamic path planning solutions for fixed wing UAV generally have problems such as the lack of security and stability. In order to cope with these problems, and achieve stably and safely dynamic path planning, this paper proposes a dynamic path planning scheme based on DDPG for fixed wing UAV which ensures the safety and stability of dynamic path planning process.

Research Questions

The main research question of this paper is how to realize safe and stable online path-planning of fixed-winged UAV.

Methodology

Deep deterministic policy gradient network

Table

TABLE 1. The configuration of net parameters

Parameters	*Value*
Dimension of the observation	1 x 14
Dimension of the action	1 x 3
Size of experience replay buffer	10^6
Minimum batch size	256
Learning rate of the Critic	0.1
Learning rate of the Actor	5 x 10^6

Mathematical Formulas

$$\begin{cases} \dot{x} = v_x = v\cos\gamma\sin\varphi \\ \dot{y} = v_y = v\cos\gamma\cos\varphi \\ \dot{z} = v_z = v\sin\gamma \end{cases} \quad (1)$$

$$P_{dir} = -5(d_{now} - d_{pre}) \quad (2)$$

$$P_{path} = -10 f_s - 20 f_r \quad (3)$$

$$r = P_{safe} + P_{dir} + P_{path} \quad (4)$$

$$r = P_{safe} + P_{dir} + P_{path} \quad (5)$$

Figure

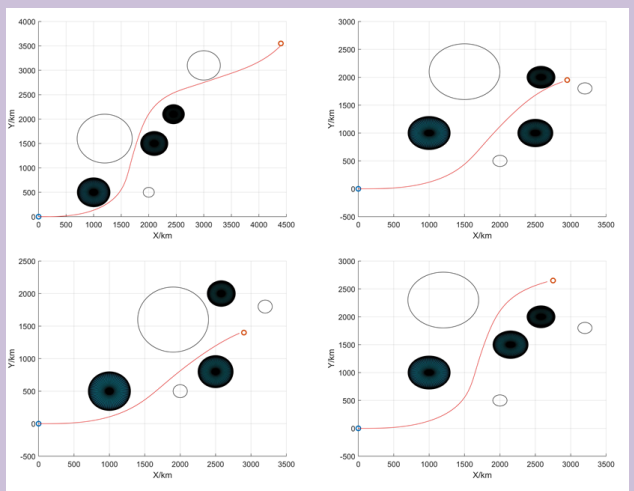

FIGURE 1. The results of experiments in different task environments

Conclusion

This paper presents a dynamic path planning method for fixed wing UAV based on DDPG agent. This method uses real-time status such as position and velocity as the observations of the agent to train the agent in the environment including a three degree of freedom UAV model and a series of obstacles. The trained agent can meet the task requirements under the action of reward function. Finally, the safety and stability of the method are verified by experiments in different environments.