3D path planning problem for fighter Aircraft with multiple constraints

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Abstract

Abstract: Path planning is a crucial component for ensuring the safety and efficiency of flight missions, especially for fighter aircraft. To enhance the combat effectiveness of fighter aircraft, it is important to consider how to avoid danger sources and terrain obstacles, reduce fuel consumption, and utilize the aircraft's own performance to accomplish the mission objectives. In the modern battlefield environment, the shortest path is not the only criterion for planning, but also other factors such as the threat level to the aircraft, fuel consumption, mission completion time, and minimum turning radius. In this paper, we propose a multi-constraint path planning method for fighter aircraft that incorporates these factors into an improved particle swarm algorithm. We transform the constraints of three-dimensional terrain, threat source, fuel consumption, and mission time into an aggregated fitness function. We construct a limit curvature matrix to evaluate the feasibility of the generated path. We also introduce an adaptive adjustment strategy based on the activation function for the parameters in the particle swarm algorithm. The weights of each constraint are determined according to the actual demand. The experiment results show that our method can efficiently plan the optimal path that satisfies the requirements. Compared with other improved particle swarm algorithms, our method has higher optimal search efficiency and better convergence effect. We also provide optimal values for important parameters such as mission energy consumption, mission time, flight speed and others to support the overall mission planning. Our method has certain practical application value.

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