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Abstract:
Objective [单击此处键入摘要]
Methods [单击此处键入摘要]
Results and Discussions [单击此处键入摘要]
Conclusions [单击此处键入摘要]
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《电子与信息学报》“英文长摘要”格式要求

一、 篇幅：英文长摘要篇幅要求在 800~1200 字（单词数）。

二、 结构：

1. 题目、作者和单位：与中文信息对应；
2. 英文长摘要正文：

(1) 研究目的(**Objective**)：(突出所做工作的重要性和必要性)；

(2) 研究方法(**Methods**)；

(3) 创新性结果(**Results and Discussions**)：请标示出文字内容对应图表编号，以括号标注。如“…(Fig.1)，…(Table 2)，…(Algorithm 1)”等，括号内容不作为句子成分(删除与否，不影响表达)；

(4) 结论(**Conclusions**)；

(5) 以上要素内容，每部分单独分段、顶格排列，段前标注要素名称；

(6) 综述文章可根据研究内容灵活划分/搭配要素名称，常见要素包括但不限于：意义（Significance）、进展（Progress）、结论（Conclusions）、展望（Prospects）等。

3. 关键词(**Key words**)：与中文对应。

三、 书写：英文长摘要使用 Euclid 字体，16 磅行距。论文题目中单词首字母请大写（介词除外），英文缩写对应单词字母大写，使用半角标点符号。

四、 表达：建议使用第三人称、被动语态和一般现在时，客观地描述文章内容，遵循英文语法习惯，语言准确精炼。

五、 文献：不要加参考文献，如需引用其他文章，建议转述。

六、 位置：以上内容请放在文末，作者简介后，空 2 行。

七、 本要求自 2025 年第 1 期起开始实施。

附研究论文参考示例：

A Decision-making Method for UAV Conflict Detection and Avoidance System

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Abstract:

Objective With the rapid increase in UAV numbers and the growing complexity of airspace environments, Detect-and-Avoid (DAA) technology has become essential for ensuring airspace safety. However, the existing Detection and Avoidance Alerting Logic for Unmanned Aircraft Systems (DAIDALUS) algorithm, while capable of providing basic avoidance strategies, has limitations in handling multi-aircraft conflicts and adapting to dynamic, complex environments. To address these challenges, integrating the DAIDALUS output strategies into the action space of a Markov Decision Process (MDP) model has emerged as a promising approach. By incorporating an MDP framework and designing effective reward functions, it is possible to enhance the efficiency and cost-effectiveness of avoidance strategies while maintaining airspace safety, thereby better meeting the needs of complex airspaces. This research offers an intelligent solution for UAV avoidance in multi-aircraft cooperative environments and provides theoretical support for the coordinated management of shared airspace between UAVs and manned aircraft.

Methods The guidance logic of the DAIDALUS algorithm dynamically calculates the UAV's collision avoidance strategy based on the current state space. These strategies are then used as the action space in an MDP model to achieve autonomous collision avoidance in complex flight environments. The state space in the MDP model includes parameters such as the UAV's position, speed, and heading angle, along with dynamic factors like the relative position and speed of other aircraft or potential threats. The reward function is crucial for ensuring the UAV balances flight efficiency and safety during collision avoidance. It accounts for factors such as success rewards, collision penalties, proximity to target point rewards, and distance penalties to optimize decision-making. Additionally, the discount factor determines the weight of future rewards, balancing the importance of immediate versus future rewards. A lower discount factor typically emphasizes immediate rewards, leading to faster avoidance actions, while a higher discount factor encourages long-term flight safety and resource consumption.

Results and Discussions The DAIDALUS algorithm calculates the UAV's collision avoidance strategy based on the current state space, which then serves as the action space in the MDP model. By defining an appropriate reward function and state transition probabilities, the MDP model is established to explore the impact of different discount factors on collision avoidance. Simulation results show that the optimal flight strategy, calculated through value iteration, is represented by the red trajectory (Fig.7). The UAV completes its flight in 203 steps, while the comparative experiment trajectory (Fig.8) consists of 279 steps, demonstrating a 27.2% improvement in efficiency. When the discount factor is set to 0.99 (Fig.9, Fig.10), the UAV selects a path that balances immediate and long-term safety, effectively avoiding potential collision risks. The airspace intrusion rate is 5.8% (Fig.11, Fig.12), with the closest distance between the threat aircraft and the UAV being 343 meters, which meets the safety requirements for UAV operations.

Conclusions This paper addresses the challenge of UAV collision avoidance in complex environments by integrating the DAIDALUS algorithm with a Markov Decision Process model. The proposed decision-making method enhances the DAIDALUS algorithm by using its guidance strategies as the action space in the MDP. The method is evaluated through multi-aircraft conflict simulations, and the results show that: (1) The proposed method improves efficiency by 27.2% over the DAIDALUS algorithm; (2) Long-term and short-term rewards are considered by selecting a discount factor of 0.99 based on the relationship between the discount factor and reward values at each time step; (3) In multi-aircraft conflict scenarios, the UAV effectively handles various conflicts and maintains a safe distance from threat aircraft, with a clear airspace intrusion rate of only 5.8%. However, this study only considers ideal perception capabilities, and real-world flight conditions, including sensor noise and environmental variability, should be accounted for in future work.

Key words: UAV systems, Detect-and-Avoid (DAA), Markov Decision Process (MDP), Reward fun