Cooperative situational awareness of multi-UAV system based on improved D-S evidence theory

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1 Introduction

We consider the cooperative situational awareness (CSA) problem of multi-UAV system crossing three-dimensional obstacle belt without any priori information of obstacles. The main contributions are: (1) A CSA method of multi-UAV system is developed to improve the accuracy of information acquisition; (2) Multiple uncertainties are modeled and characterized; and (3) The conventional D-S evidence theory is modified to solve high evidence conflict. Pearson coefficient is utilized to measure the correlation between evidence and define the credibility. Subsequently, the uncertainty based on interval probability is introduced to modify the reliability and obtain the weight. Lastly, the original evidence is weighted and averaged, and the D-S combination rule is adopted for synthesis. Compared with other improved methods, our method can identify the correct propositions more accurately.

2 CSA based on D-S evidence theory

Notably, achieving CSA is challenging due to the randomness of obstacle distribution and detection uncertainties [1]. In this part, an information fusion method is adopted by introducing and modifying the traditional D-S evidence theory, which is presented in Fig. 1.

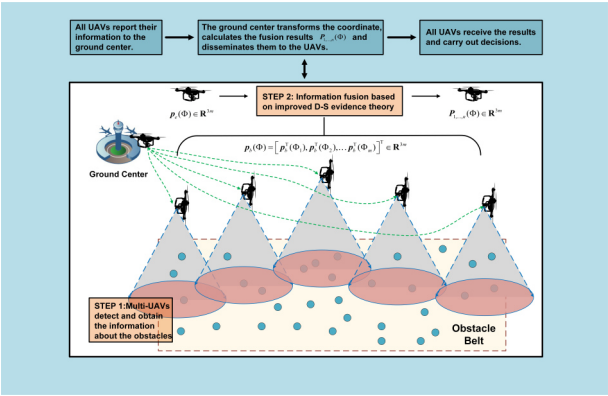

Fig. 1. Schematic diagram of the CSA method.

3 Method improvements

In this study, Pearson coefficient is adopted to build the correlation measure between evidence and determine the evidence credibility [2], whereas evidence uncertainty is evaluated comprehensively. Additionally, this study combines the credibility and uncertainty to determine the weight coefficient of the evidence, revise the original evidence, average the BPA of the revised evidence, and then use the Dempster combination rule to fuse it, so as to solve the evidence conflict. The flow chart of the improved method is illustrated in Fig. 2.

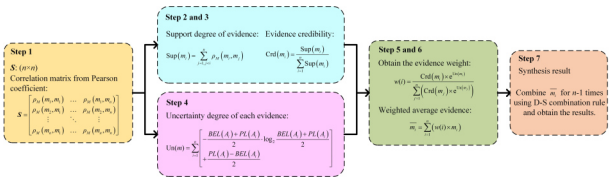

Fig. 2. The flow chart of improved combination method.

4 Conclusion

Based on the background of UAV detection, this study applies the improved D-S evidence theory to CSA of multi-UAV system to conduct the information fusion detected by airborne sensors. Our CSA scheme of mutli-UAV system can significantly detect more obstacles while being aware of the obstacles more accurately. Additionally, compared to existing modified D-S evidence theory methods, our improvement is superior in improving the detection accuracy and achieving an accurate CSA of multi-UAV system.

References

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