

Task Reallocation Techniques for Flight Formation Systems

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Abstract

With the increasing complexity of flight environments and the growing diversity of mission requirements, a single aircraft is no longer sufficient to reliably accomplish high-precision tasks. Inspired by the autonomy and intelligence observed in biological swarms, cooperative operation of multiple aircraft has therefore attracted extensive attention. Flight formation systems are highly interconnected and complex, requiring each vehicle to maintain a high level of reliability and safety. Malicious attacks on individual aircraft or internal faults within the formation can significantly degrade mission performance. Moreover, due to the interconnection among aircraft, a faulty individual may pose a threat to neighboring aircraft or even to the stability of the entire formation, thereby undermining the benefits of cooperative operation. This report focuses on fault-related challenges in flight formation systems and presents recent research progress on game-theoretic task reallocation methods.



Yajie Ma is a Professor and Ph.D. Supervisor, a Young Scholar of the National Major Talent Program, Distinguished Young Scholar of MIIT, Jiangsu Distinguished Young Scholar, and Jiangsu Excellent Young Scholar. He received his Ph.D. degree from Nanjing University of Aeronautics and Astronautics in 2015 and was exceptionally promoted to Professor and Ph.D. Supervisor in 2021. He has long been engaged in research on aircraft fault diagnosis and fault-tolerant control. He has published more than 90 academic papers in leading journals, including AIAA Journal of Guidance, Control, and Dynamics, IEEE Transactions, Science China, Acta Automatica Sinica, and Acta Aeronautica et Astronautica Sinica. He serves as the Deputy Director of the Jiangsu Key Laboratory of "Low-Altitude Intelligent Internet of Things and Autonomous Safety Control" and is an Editorial Board Member for Drones. He also serves as a Youth Editorial Board Member for journals including Systems Engineering and Electronics and the Journal of Astronautics. Additionally, he acts as the Deputy Secretary-General of the Technical Committee on Fault Diagnosis and Safety of Technical Processes. He has presided over projects that received the First Prize of the Natural Science Award of CAA, the First Prize of Science and Technology of the Jiangsu Association of Automation, and the Jiangsu Association of Automation Young Scientist Award. He has also participated in projects awarded the First Prize of the Jiangsu Science and Technology Award, the First Prize of the National Defense Science and Technology Progress Award, and the First Prize of the Teaching Achievement Award of CAA. He has supervised students who have won the Feng Ru Best Paper Award at the International Conference on Guidance, Navigation, and Control on two occasions.