Contribution ID: **107** Type: 海报展示

Application and Prospects of Multimodal Data Fusion UAV Systems for Landmine Detection

摘要

当前国际形势纷繁复杂，局部冲突和动荡频发，地雷探测面临日益严峻的挑战，特别是在俄乌冲突、巴以冲突等局部冲突中，地雷的大量使用，使地区安全风险直线上升。传统以基于人工为主的地雷探测方法，效率和准确性都满足不了需求，无人机正在成为地雷探测关注的热点。无人机配上各种传感器，通过整合光学、红外、雷达、磁力计等这些传感器的数据，可以有效克服单一传感器所带来的局限性，从而显著增强地雷探测的精确度和可靠性。本文详细分析了多模态数据融合无人机地雷探测的架构，并讨论了数据融合在地雷探测数据处理中的重要作用。最后，论文探讨了无人机地雷探测技术当前研究的热点和主要挑战，及可能的未来发展趋势。

关键词

地雷探测，多模态，数据融合，无人机

Abstract

The current international situation is complex, with frequent local conflicts and turmoil, which bring huge and increasing challenges to landmine detection. Especially in some local conflicts, such as the Russia-Ukraine and Israel-Palestine conflicts, the extensive use of landmines sharply increases regional security risks. Traditional landmine detection methods mainly rely on manpower and cannot meet the demands for efficiency and accuracy. Currently, UAVs are becoming a new method for landmine detection. With equipped multifarious sensors, UAVs integrate data from optical, infrared, radar, and magnetometer sensors, which effectively overcomes the limitations of a single sensor, thereby significantly improving the precision and reliability of landmine detection. This paper presents a comprehensive study of the architecture of a multimodal data-fusion UAV system for landmine detection and discusses the critical role of data fusion in processing landmine-detection data. In addition, we discuss current research hotspots, major challenges, and potential future development trends in UAV landmine detection technology. The present review attempts to serve as a reference for research and practice in the field of landmine detection and believes that multimodal UAV technology will be increasingly integrated into global demining.

Keywords

landmine detection, multimodal, data fusion, UAVs

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Session Classification: 海报展示

Track Classification: 02 海报展示: 海报展示