

عنوان مقاله:

Advances in Sensor Fusion : Techniques, Challenges, and Future Direction

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خلاصه مقاله:

Sensor fusion is a critical technology that combines data from multiple sensors to provide more accurate, reliable, and comprehensive information. This paper presents an overview of the latest advancements in sensor fusion techniques, emphasizing the integration of multimodal data to enhance system performance across various applications. We examine three primary fusion methods: data-level fusion, feature-level fusion, and decision-level fusion. Data-level fusion involves combining raw data from different sensors to improve the signal-to-noise ratio, while feature-level fusion integrates features extracted from sensor data to form a unified representation. Decision-level fusion aggregates the decisions from multiple classifiers to enhance the accuracy and robustness of the final output. Recent innovations driven by machine learning, particularly deep learning and ensemble methods, have significantly improved the effectiveness of sensor fusion systems. The paper also explores real-time processing techniques, the incorporation of edge computing, and the integration of multimodal data, highlighting their impact on applications such as autonomous vehicles, healthcare, and smart cities. Despite these advancements, challenges remain, including data heterogeneity, real-time processing, scalability, and the need for standardized frameworks. We discuss potential future directions, including the use of quantum computing, context-aware fusion, and the development of standardized protocols to address these challenges. By advancing sensor fusion techniques, we can develop more intelligent, robust, and efficient systems, driving innovation across various domains.

کلمات کلیدی:

sensor fusion, radar, lidar, camera, performance enhancement, multi-sensor fusion, data association, artificial intelligence, deep learning

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