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TWO-PHASE AI PREDICTION TECHNIQUES FOR ONBOARD SAR DATA PROCESSING

Abstract

Synthetic Aperture Radar (SAR) is a powerful tool for remote sensing, offering the unique advantage of reliable operation across various weather conditions. This capability is essential for applications requiring continuous monitoring, such as maritime surveillance and disaster response, where consistent data collection is crucial regardless of environmental challenges. Unlike other imaging methods, SAR can penetrate cloud cover and operate day and night, ensuring uninterrupted data flow. However, SAR's detailed imaging generates substantial data volumes, presenting significant challenges for real-time artificial intelligence (AI) processing. The need for high computational resources and the costs associated with data transmission to ground stations can delay critical responses, especially in time-sensitive scenarios like ship detection.

To overcome these challenges, we introduced a novel two-phase AI prediction framework aimed at optimizing SAR data handling. This framework incorporates an onboard data processing technique that significantly reduces data volume before transmission. By processing data directly on the satellite, we minimize the need for extensive bandwidth and reduce transmission costs, facilitating quicker decision-making processes. Our targeted tests for ship detection demonstrate that this method not only maintains high detection accuracy but also ensures rapid data processing and transmission.

Our approach exemplifies the potential of onboard AI computing to enhance SAR's utility in urgent, weather-independent applications. By effectively reducing data volume without compromising detection accuracy, we offer a scalable solution to the challenges posed by SAR's data intensity. This advancement represents a pivotal step in remote sensing, enabling more efficient, reliable, and cost-effective use of SAR technology for global monitoring and response initiatives.