MVAE-ACGAN: A Generative Framework for Imbalanced Few-shot Multi-band SAR Target Detection

The paper proposes MVAE-ACGAN, a generative framework designed to improve vehicle detection in few-shot, imbalanced multi-band Synthetic Aperture Radar (SAR) images. It combines three techniques: pre-augmentation to increase the limited target samples, a modified variational autoencoder (VAE) reconstruction loss to preserve band-specific features, and a feature-perceptual mechanism to generate more realistic and discriminative target samples.

Experiments on a four-band SAR vehicle dataset (P, S, C, and Ka bands) show that the proposed method improves detection performance compared with conventional augmentation, VAE, and VAE-ACGAN approaches. It achieves the best overall results in detection probability, false-alarm rate, AUC, F1-score, and average precision.

Main contribution: The study demonstrates that incorporating multi-band characteristics into generative data augmentation can improve vehicle detection when SAR training data are scarce and imbalanced.

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