U.S. NAVAL RESEARCH LABORATORY

Image Science & Applications Branch
Remote Sensing Division
Machine Learning for SAR

OUR RESEARCH AT A GLANCE

Signal Processing

The branch focuses on novel signal processing techniques applied to remotely sensed data, particularly SAR complex data, to extract unique information regarding man-made and environmental phenomena.

Remote Sensing Operations

Working with the remote sensing community, particularly emerging commercial SAR Satellite vendors, the branch is investigating new and innovative approaches to operations and exploitation.

Maritime Surveillance

The branch's ocean surveillance algorithm improves maritime domain awareness for naval operations by providing automated ship detection and characterization from SAR data.

Machine Learning

Adapting commercially developed machine learning methods to the unique properties of SAR has provided new insights in streamlining routine image interpretation tasks and is revolutionizing automated target recognition.

R&D Sponsors

ONR, NAVSEA, NAVAIR, DARPA, Intelligence Community

Point of Contact

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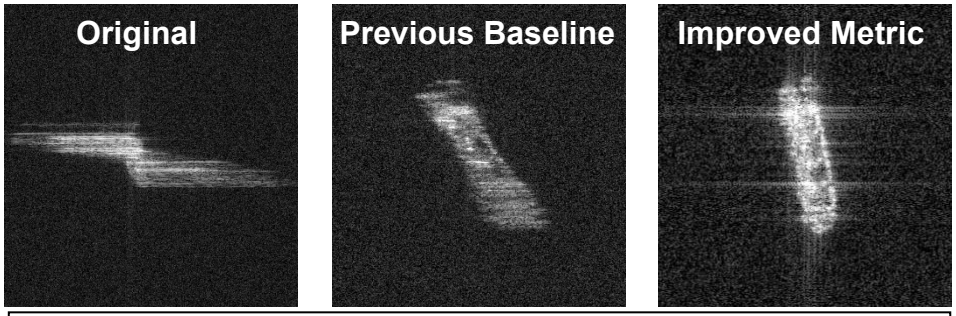
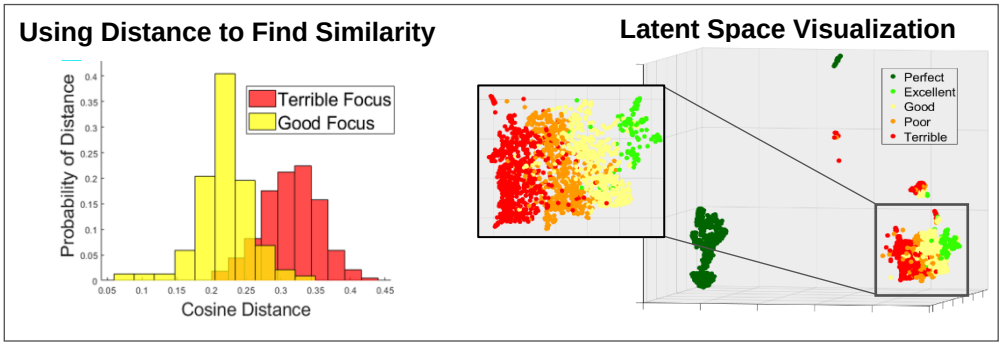


Improved signature focus through latent space analysis of CNN trained on commercial SAR data. Image source: © Capella 2024.

The Image Science and Applications Branch investigates novel methods of using machine learning (ML) for analysis of synthetic aperture radar (SAR). SAR images are fundamentally different from optical imagery and there are opportunities to envelop novel ML techniques. In SAR, moving objects appear blurry and difficult to identify, and current methods of focusing require hand-tuning by domain experts with computationally expensive algorithms. Branch research is pursuing cutting-edge methods of using the hidden layer of a CNN to quantitatively select the most interpretable signature.

By training a CNN to classify images into interpretability subgroups, we can extract the image embeddings and perform analysis on their distance in the latent space. We found that best focused images were close together in the latent space and their distance can be used as metric for interpretability. Latent space characterization outperformed the traditional algorithm based focusing. For the unique challenges of SAR imagery, the latent space provides deeper level of understanding.

The branch is engaged in basic and applied ML research programs focused on improving remote sensing system capabilities and image exploitation techniques. Research emphasizes novel ML techniques unique to the phenomena of SAR imagery while also pursuing improved methods for adapting traditional optical ML techniques for SAR imagery.



Latent space analysis to develop quantitative metrics for improved representation