Going Beyond Single Sensors – Open Challenges in Modern Remote Sensing

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Abstract – The rapid proliferation of spaceborne sensing systems is reshaping modern remote sensing research. Today's constellations include true-color (RGB) cameras, multispectral imaging (MSI) and hyperspectral imaging (HSI) optical sensors, and synthetic aperture radar (SAR) systems. Although these data are represented as images, they are not merely pictures: each pixel encodes a physically-meaningful measurement. RGB imagery captures reflected sunlight in three visible bands and is often analyzed through spatial patterns, whereas MSI, HSI, and SAR provide quantitative per-pixel signals (radiance spectra or coherent backscatter) that require physics-aware interpretation. As spaceborne sensors proliferate and revisit rates increase, a central challenge is developing scalable methods that respect underlying measurement physics while operating across spectral, spatial, temporal, and modal variability. This plenary highlights open research problems in modern remote sensing analysis and advocates for scalable, physics-aware approaches that bring together remote sensing scientists and the broader image analysis community.

Biosketch – Amanda Ziemann is an imaging scientist in the Space Remote Sensing & Data Science Group at Los Alamos National Laboratory. She holds a B.S. in Applied Mathematics, an M.S. in Applied & Computational Mathematics, and a Ph.D. in Imaging Science, all from Rochester Institute of Technology. She has been at Los Alamos since 2015, and after completing an Agnew National Security Postdoctoral Fellowship, she became a permanent staff scientist. Amanda's work supports geospatial analysis with a focus on developing signal detection algorithms for ground-based, airborne, and spaceborne sensors; her experience is primarily with multispectral and hyperspectral imagery, and has more recently included synthetic aperture radar and RF data, as well as combining these modalities with non-traditional data (e.g., social media). Amanda also serves as an Associate Editor for IEEE Geoscience and Remote Sensing Letters and for SPIE Optical Engineering, as a committee member for two SPIE conferences and for the Military Sensing Symposia Battlefield Survivability and Discrimination conference, as a US representative to a NATO Research Task Group on hyperspectral image analysis, and as the Member-at-Large for Hyperspectral Sensing on the NATO Sensing Technology Committee.