LSGI & RILS RESEARCH SEMINAR

Urban PolSAR Decomposition: Challenges and New Directions for Emerging SAR Technologies

15 APR 2026 (WED)
3:00 PM - 4:00 PM
Z512, POLYU
ENGLISH

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ABSTRACT

Polarimetric synthetic aperture radar (PolSAR) decomposition, including model- and eigen-based methods, is widely used to interpret urban scattering mechanisms. As algorithms grow more complex and SAR technology advances, a review of developments, persistent limitations, and future directions is needed. Over the past two decades, model-based methods have demonstrated strong physical interpretability but rely on assumptions such as azimuthal symmetry and fixed geometries, limiting the use of polarimetric information and often overestimating volume scattering. Adding parameters increases computational cost and instability. Eigen-based methods avoid such assumptions, make fuller use of information, and conserve energy, yet their eigenvalues and eigenvectors often lack clear physical ties to scattering mechanisms. While refinements aim to map results to specific mechanisms, reliance on fixed eigen-components or empirical thresholds remains problematic. Evaluating representative algorithms with airborne and spaceborne PolSAR data across C-, L-, and P-bands reveals persistent issues: poor noise resilience, energy non-conservation, and volume-scattering ambiguity between oriented urban areas and forests. Radar system parameters also strongly influence outcomes, often dominating scattering variability. High-resolution data require a 4×4 covariance or coherency matrix to capture S_{HV} - S_{VH} inequality, thereby improving scattering-mechanism delineation. Reducing incidence-angle and wavelength effects enhances consistency in double- and volume-scattering estimates in urban settings. These findings underscore the need for hybrid, system-aware decompositions that balance physical interpretability with full data use and ensure consistent scattering characterization across SAR platforms.

BIOGRAPHY

Yong Wang obtained his Ph.D. from the University of California, Santa Barbara. Wang is currently a professor at the University of Electronic Science and Technology of China. His research focuses on synthetic aperture radar (SAR) imaging mechanisms and algorithms; information processing and applications of SAR and interferometric synthetic aperture radar (InSAR); microwave remote sensing modeling for forest applications and land surface parameter inversion; and cloud detection and removal in optical remote sensing data.

He has published nearly 230 papers in top-tier journals and academic conferences in the field of remote sensing and earth sciences. He has been featured in the annual "Career-long Impact" list of the World's Top 2% Scientists published by Elsevier (https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/8) for the years 2020-2025.

He currently serves as Co-Editor-in-Chief of the Journal of Electronic Science and Technology (JEST) and as an Associate Editor for the Remote Sensing of Environment (RSE).

Moderator:
Prof. Guoqiang SHI, Assistant Professor, LSGI, member of RILS

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