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Editorial

Electromagnetic Wave Sensing in Complex Scenarios: Scattering Models and Applications

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Recent progress in wave sensing techniques and technologies has resulted in the development of applications in disparate fields, including radar imaging, remote sensing, and communication. Within this context, electromagnetic modeling plays an important role, since scattering models have explicitly or implicitly been used in wave sensing applications or integrated within the inherent signal processing schemes. Scattering models, as abstractions of the real world given in terms of computable mathematical functions, are effective according to their predictive capabilities in describing the wave interaction phenomenon under investigation. Depending on the adopted methodological approach, scattering models may be analytical or numerical, continuous or discrete, and either deterministic or stochastic, with some of them being more appropriate, in terms of accuracy and computational cost, for a specific application scenario. Scattering modeling, pertaining to either man-made or natural complex structures or environments, extends to the vast field of practical sensing applications, thus still posing challenging problems of theoretical, computational, and experimental relevance.

This special issue reports contribution to the research in the area of electromagnetic wave sensing, thus describing recent advancements, developments, and applications, with a special emphasis on the scattering modeling in complex scenarios.

The technical contributions in the accepted papers range from theoretical to numerical modeling, with application to remote sensing, optics, and wireless communications.

The paper titled "Replacement of Ensemble Averaging by the Use of a Broadband Source in Scattering of Light from a One-Dimensional Randomly Rough Interface between Two Dielectric Media", by A.A. Maradudin and I. Simonsen, presents a theoretical investigation based on phase perturbation theory. Specifically, authors demonstrate that illuminating one realization of a rough interface by a broadband Gaussian beam produces an intensity profile of the scattered field that closely matches the one produced by averaging the intensity of the scattered field, produced by a monochromatic incident beam, over the ensemble of realizations of the random surface profile function.

A review of methodologies for the EM scattering in layered media has been presented in the paper titled "Modelling Scattering of Electromagnetic Waves in Layered Media: An Up-to-date Perspective" by P. Imperatore et al., thus covering the recent progress achieved with different approaches.

The goal of the paper titled "An Efficient Hybrid Method for 3D Scattering from Inhomogeneous Object Buried beneath a Dielectric Randomly Rough Surface" by H. He et al. is to develop an iterative analytical-numerical method. The proposed strategy encompasses both Kirchhoff

approximation (KA) and finite element method (FEM) combined with the boundary integral method (BIM).

The paper titled "Application of a Sparsity Pattern and Region Clustering for Near Field Sparse Approximate Inverse Preconditioners in Method of Moments Simulations" by C. Delgado et al. presents an improved preconditioning approach for method of moments (MoM) problems using multiple regions. More precisely, it presents a technique for the generation of sparse inverse preconditioners based on the near-field coupling matrices of MoM simulations, where the geometry has been partitioned in terms of regions.

A maritime application is considered in the paper by L. Guo and T. Feng, "Electromagnetic Scattering of Electrically Large Ship above Sea Surface with SBR-SDFM Method". In particular, a hybrid method is proposed for predicting the electromagnetic scattering by electrically large ships above the sea surface.

The paper titled "Modeling and Characterization of the Uplink and Downlink Exposure in Wireless Networks", by A. Krayni et al., combines FDTD simulations, a simplified propagation model and measurements to evaluate both global and local radio wave exposure induced by a wireless network.

A roadside scattering environment is considered by X. Chen et al. in the paper entitled "Research on Spatial Channel Model for Vehicle-to-Vehicle Communication Channel in Roadside Scattering Environment". Impact on vehicle speed, traffic density, and other statistical performances of the proposed vehicle-to-vehicle communication channel is discussed.

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