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Physical Optics for Microwave and Antenna Modelling: *Balancing Accuracy and Simplicity*

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Full-wave simulators are widely used for analyzing and designing microwave and antenna devices, relying on three well-established techniques: the Method of Moments, the Finite Difference Time Domain method, and the Finite Element Method. While these methods offer high accuracy, they require sub-wavelength meshing, making simulations of electrically large structures computationally intensive and sometimes prone to inaccuracies.

This presentation explores how ray tracing and physical optics can serve as efficient alternatives in many practical cases, achieving exceptional accuracy while significantly reducing simulation time, particularly for electrically large structures [1]. I will demonstrate how these techniques can efficiently simulate large lens antennas, radomes with integrated arrays, mutual coupling between sources, as well as early-time effects in reverberation chambers.

For lens antennas and radomes, this technique has been used to compute radiation patterns, gain, directivity, and radiation efficiency [2]. Its versatility has been demonstrated, proving highly accurate for both geodesic [3] and dielectric [4] lens antennas. Additionally, for mutual coupling and reverberation chambers, the technique has been applied to calculate scattering parameters and losses in complex media.

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3. Q. Liao, N. J. G. Fonseca, M. Camacho, A. Palomares-Caballero, F. Mesa, O. Quevedo-Teruel, "Ray-Tracing Model for Generalized Geodesic Multiple Beam Lens Antennas", *IEEE Transactions on Antennas and Propagation*, vol. 71, no. 3, pp. 2640-2651, March 2023.

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