

Frame-based Gaussian beam shooting analysis of monostatic scattering

Letrou C., Hariz M.

Samovar, Télécom SudParis, Institut Polytechnique de Paris, Evry, France

e-mail: christine.letrou@telecom-sudparis.eu, mosaab.hariz@telecom-sudparis.eu

Boag A.

School of Electrical Engineering, Tel Aviv University, Tel Aviv, Israel

e-mail: boag@tau.ac.il

This work is aimed at taking advantage of paraxial Gaussian beam properties to analyse very large monostatic scattering problems.

In the first step of the proposed frame-based Gaussian beam shooting algorithm, the incident field is expanded into superpositions of frame windows [1] on the planar faces of a surface exterior to the scattering environment. Each frame window radiates in the form of a Gaussian beam, which propagates from the first to the last reflecting surface through multiple bounces, in as much as the initial frame window parameters guarantee sufficient paraxiality of the radiated beam. This first step yields a frame-based transfer function of the scattering environment.

In the second step, the scattering cross section (SCS) is computed on a grid of directions. Due to their spectral confinement (down to a given threshold), only a small number of Gaussian beams contribute to each incident plane wave and to the corresponding scattered one in the opposite direction. Hence the complexity of the proposed algorithm is expected to be $O(BN)$, with B the maximum number of beam bounces and $N = (kR)^2$ the usual large parameter (k is the wavenumber and R is the radius of the circumscribing sphere).

Initial results of this research have been reported in [2], using “urban like” scenarios composed of rectangular parallelepipeds, as shown in Fig. 1. In Fig. 2, the SCS of such an environment is computed at the 0.01 m wavelength, for $S = 25$ m, $W = 20$ m, $H = 24$ m, and for various values of the frame window width parameter L .

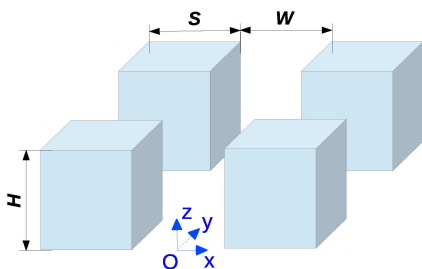


Fig. 1: “Urban like” scenario.

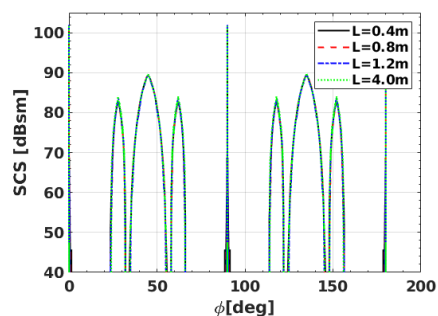


Fig. 2: Computed SCS for various values of L .

This communication will present further results of this ongoing work, exploring the conditions for given accuracy of the obtained results, by comparison with Physical Optics results, and discussing experimental computational efficiency of the method.

References

- [1] D. Lugara, C. Letrou, A. Shlivinski, E. Heyman, and A. Boag, Frame-based Gaussian beam summation method: Theory and application, *Radio Science*, **38**, 2, 8026, doi:10.1029/2001RS002593 (2003).
- [2] C. Letrou, M. Hariz, and A. Boag, Accuracy Study and Validation Techniques for Fast Beam-based Monostatic Scattering Computations, *ICEAA '19 International Conference on Electromagnetics in Advanced Applications*, Granada, Spain (2019).