PhD Position
SPRITE: Simulation of the Propagation above a Relief In a Three-dimensional Environment

ENAC: French National University of Civil Aviation, Toulouse, France
SIAE: Sino-European Institute of Aviation Engineering, Tianjin, China

General Information

Locations: French National University of Civil Aviation (ENAC), Toulouse, France
and Sino-European Institute of Aviation Engineering (SIAE), Tianjin, China
Supervision: Rémi Douvenot (ENAC), Alexandre Chabory (ENAC), and Hang Zhou (SIAE)
Funding: Doctoral School GEETS
Starting Date: between September and December 2022
Duration: 3 years
Candidate Profile: Engineering student / Master 2 in Electric Engineering. Skills in Radiowave propagation and/or signal processing

Context

Modelling the long-range propagation is of great importance for many applications, including surveillance (radar), communication (satellite TV), geoscience (radio-occultation), and navigation (GNSS).

One of the most used method for such modellings is the parabolic equation method. Based on a split-step Fourier algorithm (SSF), it is fast and accurate to describe the fields in 2D scenes. 3D versions of the parabolic equation have been developed. However, they are not used in practice because they are very compute-intensive.

These last years, a new 3D propagation method has been developed by Hang Zhou [1] under the supervision of Rémi Douvenot and Alexandre Chabory at ENAC. This method is also compute-intensive but ensures the stability of the computation. It has been accelerated by the use wavelets in 2D [2] and is currently extended in 3D. However, the relief is not yet accounted in this method.

Objectives

The aim of this PhD is to take into account the ground in the 3D split-step wavelet simulation technique. In a first time, a state of the art about the accounting of the relief in split-step techniques will be led. Some validation scenarii based on closed-form formulations or full-wave simulation techniques will be identified. A first technique without depolarisation will be developed. From the first results and the state of the art, the methodology for considering the relief will be chosen. Finally, this technique will be improved in terms of computational time and accuracy.

Applying

Candidates should demonstrate skills in one or more of the following fields: electromagnetic propagation, signal processing, numerical simulations. A good English level and good writing skills are also requested.

Interested candidates should send their CV via e-mail, accompanied by a cover letter, and the names and email addresses of three referees to:

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No country restriction. **Start of the thesis last quarter of 2022, applications are open.**

Bibliography

[1] H. Zhou, A. Chabory, and R. Douvenot, "A 3-D split-step Fourier algorithm based on a discrete spectral representation of the propagation equation," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 4, pp. 1988–1995, 2017.

[2] H. Zhou, R. Douvenot, and A. Chabory, "Modeling the long-range wave propagation by a split-step wavelet method," *Journal of Computational Physics*, vol. 402, p. 109042, 2020. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S002199911930748X