"Study of Metasurface Excitation with a Method of Moments"

Keyword: Numerical methods, method of moment, metasurfaces, antennas, periodic problems.

A master internship position is offered at Sorbonne University, in Paris (duration of 4 to 6 months, depending on candidate availability), with a possibility to pursue a PhD afterwards.

Context: Higher data rates and shared platforms among users are stimulating a revolution in technologies for the next 5G standards and satellite communications. New antennas are required at millimeter waves (30 GHz or higher), being wide-bandwidth, light-weight, low-cost. Unfortunately existing technologies are currently very bulky, lossy, heavy, and expensive.

To overcome these limitations, new devices based on artificial surfaces (metasurfaces) are emerging. Metasurfaces are formed by a periodic distribution of objects on a surface (Fig. 1), modifying the electromagnetic behavior of the waves propagating on it. Metasurfaces can realize artificial flat lenses, focusing the field where required (Fig. 2).

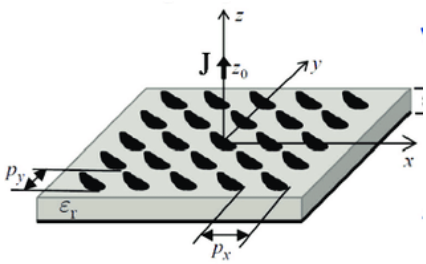

Fig. 1 Example of a periodic metasurface from [1].

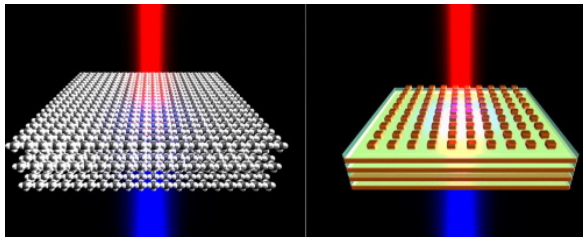

Fig.2 Active metasurfaces modifying the frequency of an incident field, from [2]

Internship: In this internship, a numerical method based on the Method of Moments (MoM) will be developed for the study of a periodic metasurface, starting from an existing MoM code which discretizes with a triangular meshing a unit cell of the surface and enforces an electric-field integral equations with periodic boundary conditions (Fig. 3).

Here we want to modify this code in order to study a single localized excitation which illuminates the surface. This will be accomplished with the Array Scanning Method [4], which allows to decompose a non-periodic problem into an integral superposition of auxiliary periodic problems.

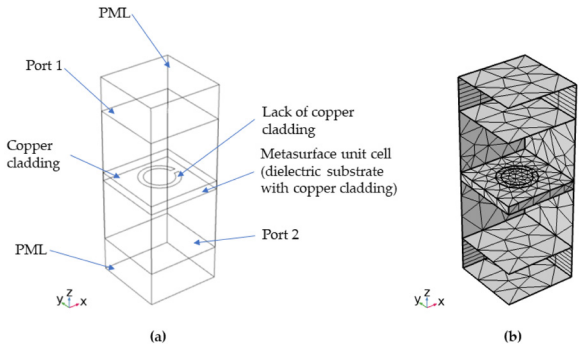

Fig. 3 Example of unit cell of a metasurface and its meshing with triangular basis functions from [3].

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Requirements

- The applicant should be enrolled in a master program with a strong background in electromagnetic devices or electromagnetic theory.
- She/he should have successfully validated a unit of Numerical Methods. Knowledge of MoM is not necessary, but would be helpful.
- The applicant should have good knowledge of Python.
- The candidate should be highly motivated, autonomous, and willing to pursue her/his career with a PhD.

Duration: 4 to 6 months.

Scholarship

A scholarship of about 600€ per month will be provided as well as guidance in finding an accommodation.

Place of the internship

The applicant will work at Sorbonne University, GeePs laboratory (https://www5.geeps.centralesupelec.fr/) at Campus Pierre et Marie Curie, located in Paris (Métro Jussieu).

Starting date

Anytime between January and April 2022 (The potential PhD should start afterwards, between September and November 2022).

Supervisor:

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[2] A. Krasnok, M. Tymchenko, and A. Alù, "Nonlinear metasurfaces: a paradigm shift in nonlinear optics," *Materials Today*, vol. 21, no. 1, 2018.
[3] P. Lopato and M. Herbko, "Evaluation of Selected Metasurfaces' Sensitivity to Planar Geometry Distortions," *Applied Sciences*, vol. 10, no. 1, p. 261, Dec. 2019.
[4] G. Valerio, P. Burghignoli, P. Baccarelli, and A. Galli, "Input impedance of nonperiodic sources exciting 1-D periodic shielded microstrip structures," *IEEE Trans. Microw Theory Tech.*, vol. 58, no. 7, pp. 1796-1806, Jul. 2010.