Post-doc Proposal : High performance numerical modelling for nonlinear photonic devices

Duration : 12 months

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Cavity Resonant Integrated Grating Filter (CRIGF) are promising structures composed of a grating coupler (GC) surrounded with two Distributed Bragg Reflectors (DBR)[1]. The excitation of an eigenmode of the structure through one diffraction order of the GC generates a resonance peak in the reflectivity spectrum [1]. We intend to take advantage of the field enhancement caused by the excitation of a confined mode with a focused beam in CRIGF to improve the efficiency of nonlinear optical effects, especially Second Harmonic Generation (SHG).

Yet, CRIGF are large (>100 wavelengths), highly resonant components, patterned at the subwavelength scale, and their modelling is not trivial. The finite element method appears to be a good candidate for such kind of modelling, but typically current studies performed in 2D case (with one axis of invariance) have shown for example the need to use high order interpolatory basis functions in order to accurately model the frequency response of such devices.

The work proposed, during this full-time 1-year, postdoctoral appointment is dedicated to the development of a 3D finite element software in order to study such kind of realistic configuration. Based on an already existing source code developed in our lab, the candidate will focus its future work in the implementation of new functionalities like :

- Use of high order basis functions dedicated to the scattering of 3D objects.
- The extension to the 3D case of domain decomposition techniques (FETI method [2]) and its application to anisotropic materials with the implementation of different types of local and global preconditioners.
- All the numerical developments will be considered as being used in a parallel environment.

A candidate with a PhD degree, preferably within the last 3 years, in Computer Science, Computational Sciences, Applied Mathematics, or a related technical field. A good expertise in Fortran/C and OpenMp/MPI programming is required.

[1] Chaumet, Patrick and Demesy, Guillaume and Gauthier-Lafaye, Olivier and Sentenac, Anne and Popov,Evgeny and Fehrembach, Anne-Laure Opt. Lett. 41, 2358-2361 (2016).
[2] Ivan Voznyuk, Hervé Tortel, and Amelie Litman. 3-D Electromagnetic Scattering Computation in Free-Space With the FETI-FDP2 Method Scattered Field Computation with an Extended Feti-Dpem2Method. IEEE Trans. Ant. Prop., 63(6), 2015. 10, 29