Internship in ESA's Advanced Concepts Team
On
Inverse Material Design in the Wave Regime

European Space Research and Technology Centre
ESA ESTEC

Candidates interested are encouraged to visit the ESA website:
www.esa.int/gsp/ACT/

Topic description

Material design for spacecraft is a topic of great relevance - be it for solar panels, solar sails, or coatings. With recent advances in nanostructures new materials have become available and their exploration is of great interest for ESA.

Inverse material design is gaining much interest lately due to its powerful potential of finding materials and structures that can achieve certain properties, e.g., the reflection and absorption of a metamaterial coating on a spacecraft. With the Neural Inverse Design of Nanostructures (NIDN) module, the Advanced Concepts Team is developing a highly effective design tool for inverse material design in the low-frequency realm [1]. However, the rigorous coupled-wave analysis method [2] that is currently utilized by NIDN becomes numerically unstable when entering the so-called wave regime where wavelengths of the simulated spectrum and the size of the utilized nanostructures are of the same magnitude [3]. Thus, it is desirable to investigate if it is possible to expand the obtained results into the wave regime using a different solver for the Maxwell equations, e.g. one using a finite-difference time-domain method.

Candidate's tasks

- Integrate a wave regime solver into NIDN
- Investigate training neural networks for in the wave regime

References

[1] - https://www.esa.int/gsp/ACT/projects/radiflector_OSR_inverse_design/
[2] - https://www.osapublishing.org/josa/abstract.cfm?uri=josa-71-7-811
[3] - https://www.comsol.com/blogs/guide-to-frequency-domain-wave-electromagnetics-modeling/
[4] - https://en.wikipedia.org/wiki/Finite-difference_time-domain_method