MSc. Thesis TNO/TU Delft

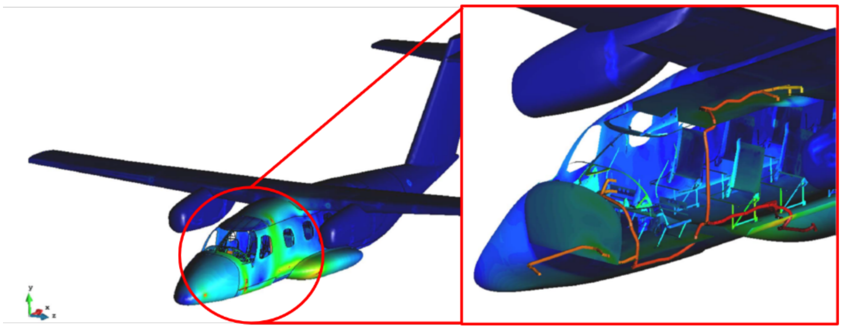
Title: Realistic Computational Prototyping for Applied Electromagnetics.

Who supports you: Numerical Analysis – Delft Institute of Applied Mathematics (contact: Artur Palha a.palha@tudelft.nl, Carolina Urzúa-Torres c.a.urzuatorres@tudelft.nl) / Electromagnetic Signatures & Propagation (EMSP) department at TNO (contact: Mario Echeverri Bautista mario.echeverribautista@tno.nl). **Research line:** Computational Electromagnetics.

Observations: this is a ***paid*** MSc thesis project.

General description:

Computational prototyping is a workhorse in both industry and research environments, especially in Applied Electromagnetics (EM), where the complexity of realistic structures poses a challenge to most analysis and design methodologies.



The idea of the project is to extend the capabilities of BEMPP (www.bempp.com), an open source, full-wave EM solver using Boundary Elements formulations (BEM). The new functionality will enable BEMPP to analyze complex EM systems containing metallic wires and surfaces contemporarily. This contribution will allow TNO and TU Delft to exploit the new features in real-life applications, like Electromagnetic Compatibility; moreover, the analysis and implementation of the "wire" and "wire-junction" functions in the context of proper EM functional spaces is a very relevant addition for the numerical EM community.

Detailed description:

In the specifics, the project consists of:

1. Review the literature on the Boundary Elements Method, also known in the EM community as the Method of Moments, in particular the formulations for wires, surfaces and wire-surface junctions.
2. Familiarize themselves with BEMPP, in particular the "big-picture" regarding compatible BEM vector spaces used in EM, e.g. Raviart-Thomas (or Rao-Wilton-Glisson, a.k.a. RWG), Nédélec, and Buffa-Christiansen spaces.

3. Familiarize themselves with state-of-the-art scientific software development, in particular understanding the different levels involved in modern numerical tools development and proper design (e.g. documentation, version control, object oriented design, testing, etc.).
4. Implement Pocklington's formulation for wires and wire-surface junctions in BEMPP (at least the Numba kernels), following BEMPP guidelines for contributions in the context of open source, e.g. use of support tools like Issues and Pull requests for collaborative development in platforms such as GitHub, among others.
5. Validate the implemented solution with available tools, such as commercial solvers or else.

References

1. BEMPP website: https://bempp.com/
2. H. C. Pocklington, *Electrical oscillations in wires*, Proc. Cambridge Philosophical Society, 1897.
3. X.Claeys, *On the theoretical justification of Pocklington's equation*. Math. Models and Meth. Appl. Sci. 19, no. 8, 1325–1355, 2009.
4. N. J. Champagne, W. A. Johnson, D. R. Wilton, *On Attaching a Wire to a Triangulated Surface*, IEEE APS International Symposium, San Antonio, TX, USA, 2002.