A GOAL-ORIENTED FINITE AND INFINITE ELEMENT BASED *HP*-ADAPTIVE APPROACH TO RELIABLE AND EFFICIENT DETERMINATION OF RADAR CROSS-SECTION

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We present a finite/infinite element method for numerical simulation of electromagnetic wave scattering problems. The technique consists in using finite elements to model a possibly small computational domain containing the scatterer and infinite elements to cover the remaining unbounded part of the 3D space. We use an *hp*-adaptive finite element method allowing for generating meshes with nonuniform distribution of element sizes h and spectral orders p by performing combined h and p refinements. The refinements are governed by a goal oriented *a posteriori* error estimates targeting the radar cross section (RCS) parameters as a goal of the simulation. The goal oriented estimates are based on various versions of the residual error estimation techniques.

The electromagnetic wave scattering on deep cavities are of particular interst in this study. For real life large scale problems with length scales $O(100\lambda)$ a direct frequency domain FE-based solution method relying on sparse Gaussian elimination with typical operation count $O(nb^2)$ becomes impractical.
Fortunately, the linearity and structure of the reduced wave equation lend itself to a dynamic substructuring technique which seem to offer possibilities worth exploiting without introducing any modelling error. Subdomains modelled by direct FE may be mixed with subdomains modelled using a normal mode projection technique. The largest gains can be achieved when the discretisation can be arranged so that it is possible to exploit analytical normal modes.

The use of a truncated set of subdomain interpolation bases introduces additional non-standard discretisation errors which must be taken into account in the goal-oriented error estimation driven adaptivity. Traditionally propagating waveguide modes are used to model the RCS of semi-open cavities. We present a novel $H(curl)$-conforming *hp*-adaptive FE-approach relying on highly accurate Maxwell resonant 3D cavity modes. The determination of the RCS for cavities with such modal bases is shown.

References

[1] W. Rachowicz, and L. Demkowicz, "An *hp*-adaptive finite element method for electromagnetics–part II: A 3D implementation," *International Journal for Numerical Methods in Engineering*, v. 53, p. 147-180, 2002.