hp-FINITE ELEMENTS FOR MAXWELL EQUATIONS
Discrete Compactness and hp-Convergence for Maxwell Eigenvalues

L. Demkowicz

Institute for Computational Engineering and Sciences
The University of Texas at Austin

We will present the Finite Element discretization of time-harmonic Maxwell equations. We shall start with a variational formulation, and discuss the so-called stabilized formulation that reveals that we are dealing with a mixed problem. The satisfaction of two Brezzi's inf-sup conditions leads then to the discrete exact sequence property, and the analysis of the corresponding Maxwell eigenvalue problem. We shall introduce then the Kikuchi's idea of discrete compactness property, and dicuss how it implies the convergence of the Maxwell eigenvalues. Finally, we will present a proof of the discrete compactness for a two-dimensional hp-method based on Nédélec's rectangle of the first kind. The result is a joint work with D. Boffi, M. Dauge and M. Costabel, see [2, 1].

References

[1] D. Boffi, M. Dauge, M. Costabel, and L. Demkowicz. Discrete compactness for the hp version of rectangular edge finite elements. *SIAM J. on Numer. Anal.*, 2005. accepted, see also *ICES Report* 04-29.

[2] D. Boffi, L. Demkowicz, and M. Costabel. Discrete compactness for p and hp 2D edge finite elements. *Math. Models Methods Appl. Sci.*, 13(11):1673–1687, 2003.

Leszek F. Demkowicz is Assistant Director of the Institute for Computational Engineering and Sciences (ICES) and a Professor in the Department of Aerospace Engineering and Engineering Mechanics, at the University of Texas at Austin. He has a M.S. in mathematics from Jagiellonian University, and M.S. (Hons.), Ph.D. and Sc.D. degrees in mechanics from Cracow University University of Technology, Poland. Prior to joining the University of Texas faculty, he held various positions at Cracow University University of Technology. In years 1990-1993, he was the head of Section of Applied Mathematics and Director of Computer Center.

Dr. Demkowicz authored a monograph on adaptive methods (in Polish), co-authored with Prof. J.T. Oden a textbook on Functional Analysis (CRS Press, 1996), and co-edited two books. Dr. Demkowicz has also authored over 120 journal articles, conference proceedings, book chapters and technical reports in the general area of computational mechanics and mathematics. He is Associate Editor of four international journals. Dr. Demkowicz was the founding member of Polish Association for Computational Mechanics and served as its first President. He is a fellow of both U.S. and International Associations for Computational Mechanics and a member of several other professional organizations. He graduated 8 Ph.D. and numerous M.S. students.

His work and scientific interests span across numerical analysis, adaptive finite element methods, and wave propagation problems, including acoustics, elastodynamics and electromagnetics. Among other applications, Dr. Demkowicz and his group developed original numerical methods for structural vibrations, analysis of acoustics of human ear, dynamic modeling of gears, analysis of optical waveguides, calculation of Radar Crossections, borehole electromagnetics and acoustics. He has given numerous invited talks on the subjects. His work has been sponsored by NSF, Navy, Air Force, DOE, Schlumberger, Baker-Hughes and Boeing. His research on high accuracy adaptive methods has recently been summarized in a book - *Computing with hp Elements* (Francis & Taylor, in press). He has also recently got involved with new applications including a multiscale modeling of imprint lithography (with J.T. Oden and G. Wilson) and bioengineering applications.