

Title: Finite elements for electromagnetics compatible with de Rham diagram

Author: Vojtěch Rybář

Department: Department of Numerical Mathematics

Supervisor: prof. Ing. Ivo Doležel, CSc.

Abstract: The present work is devoted to the lowest-order finite elements for solving time-harmonic Maxwell's equations in two dimensions. Successful approximation of these equations requires the finite element spaces to be compatible with the de Rham diagram. However, the most often used basis functions (the Whitney functions) do not comply with this diagram. Therefore, we construct compatible bases and study their properties. Since the construction is not unique, we investigate the influence of the particular choice on the conditioning of the corresponding finite element matrices. Finally, we utilize the special structure of the stiffness matrices, propose a few iterative schemes, and compare their convergence.

Keywords: Maxwell's equations, edge finite element, de Rham diagram, finite element basis