Title: "Dimensionality reduction using an edge finite element method for periodic magnetostatic fields in a symmetric domain"

e-mail: albert@tugraz.at
www: https://itp.tugraz.at/~ert/
Technische Universität Graz
Institut für Theoretische Physik - Computational Physics
Petersgasse 16, A-8010 Graz

Abstract:
Symmetric (e.g. prismatic or axisymmetric) domains are common in practical problems in acoustics, electromagnetism, fluid mechanics, etc. and often allow for a simplified treatment of an originally three-dimensional problem in a reduced two-dimensional domain. This is usually achieved by a Fourier series expansion in the symmetry coordinate which leads to a new equation for each harmonic that can be solved numerically by the finite element method [1,2]. For the formulation of magnetostatics via the curl-curl equation it is possible to eliminate one component of the vector potential by a gauge transformation for all except the zeroth harmonic. This leads to a fully two-dimensional problem for two-component vectors [3] that is efficiently solved via Nedelec edge elements. In this talk, the general derivation of the method as well as its application in magnetic confinement fusion devices [4] and other cases will be demonstrated.

[1] Lacoste, P. "Solution of Maxwell equation in axisymmetric geometry by Fourier series decompostion and by use of H (rot) conforming finite element." Numerische Mathematik 84.4 (2000): 577-609.
[2] Belhachmi, Z, et al. "A truncated Fourier/finite element discretization of the Stokes equations in an axisymmetric domain." Mathematical Models and Methods in Applied Sciences 16.02 (2006): 233-263.
[3] Albert, CG, et al. "A two-dimensional vector potential formulation for periodic magnetostatic fields in symmetric domains", Manuscript in preparation (2016).
[4] Albert, CG, et al. "Kinetic modeling of 3D equilibria in a tokamak", JPCS / Varenna-Lausanne Workshop on Theory of Fusion Plasmas (forthcoming, 2016).