# Some Aspects of High Order Finite Element Methods for Electromagnetism: Recovering Duality and Dispersion/dissipation Analysis

Francesca Rapetti
Dept. of Mathematics, Nice University
frapetti@unice.fr

## Abstract

The need for geometric flexibility is especially important in computational electromagnetism when dealing with complex wave phenomena, such as the mode propagation in waveguides and other transmission components.Today, such flexibility can be achieved by the well-known triangular/tetrahedral finite element methods. FE subspaces in Hcurl) or H(div) of higher degree exist thank to the celebrated pioneering works done by Nedelec and Bossavit at the origin of a huge literature on the same subject. They are spaces of vectors with polynomial components, chosen in such a way that the approximated field has inter-element continuity requirements (or conformity conditions) more complicated than for nodal elements. In this work, starting from the generators proposed, we consider two important numerical aspects when dealing with these high-order finite elements: we present an easy way to restore duality between generators and dofs,we analyse the dissipation and dispersion properties in 2D when these FEs are used for wave propagation.

## References

1. A. Bossavit. Computational electromagnetism.. Academic Press Inc., San Diego, CA, 1998.
2. J.-C. Nedelec. Mixed elements in R3. Numer. Math., 35 (1980) 315-341.
3. F. Rapetti and A. Bossavit. Whitney forms of higher degree. SIAM J. on Numerical Analysis, 47 (2009) 2369-2386.