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P. Robert Kotiuga* (prk@bu.edu), Boston University, ECE Dept., 8 Saint Mary's Street, Boston, MA 02215. *Whitney-form Finite Element Discretizations of Helicity Functionals: A Discrete Visual Understanding of Global Aspects.*

Whitney-form discretizations of Helicity functionals have been studied for over 20 years. We rephrase established results in terms of a complex with some additional structure. A nice duality between 1-simplices and their "links" is at the center of the identification of the exterior derivative's domain mod its kernel, with its range mod cokernel. Consequently it:

- 1) Relates to the preprints of Sullivan and Wilson (below).
- 2) Provides an easily understandable connection to "logically rectangular meshes". It also gives a very geometric way of thinking about Reidemeister torsion as an obstruction to having "logically rectangular meshes".
- 3) Invites a discussion of topologies on the space of cochains which preserve continuum structure.
- 4) Naturally extends to the exterior derivative on $2k-1$ -forms in a $4k-1$ -dimensional space, with a combinatorial interpretation.

P. R. Kotiuga, "Theoretical Limitations of Discrete Exterior Calculus in the Context of Computational Electromagnetics". IEEE Trans. Mag, 44(6) 1162-1165

S. O. Wilson, "Differential forms, fluids, and finite models" submitted to Proc. of AMS, Jan. 2010.

D. Sullivan, "Algebra, Topology and Algebraic Topology of 3D Ideal Fluids" ArXiv: 1010.2721v1 [math.AT] (Received December 21, 2010)