

Discrete Hodge star operators

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Abstract

Provided one adopts cochains as discrete representations of fields, error free finite difference formulas for the operators gradient, divergence and curl can be obtained from the (generalized) Stokes Theorem. Discrete analogs of the Hodge star operator then arise naturally when one solves div-grad and curl-curl systems (for example, diffusion and eddy current problems). Discrete Hodge star operators encode both physical (material properties) and metric (grid geometry) information. A construction based on proxy field reconstruction will be presented. We will argue that the common requirement that the matrix representation of the discrete Hodge star operator be symmetric positive definite is needlessly strict. Finally, superconvergent discrete Hodge star operators will be presented.