High-order Hodge Stars Operators for Discrete Exterior Calculus on Voronoi-Delaunay Biperiodic Meshes

João Gomes[*1] and Pedro Peixoto[1]

[1]Institute of Mathematics and Statistics [Sao Paulo] – Brazil

Abstract

In recent years, the fields of geometry and topology have become essential tools for representing physical systems in mathematical and computational contexts. Discrete Exterior Calculus (DEC) is one such tool that adapts concepts from smooth, continuous exterior calculus to a discrete setting, making it highly applicable in computational simulations for physics, engineering, and applied mathematics. This work focus on the development of high-order Hodge star operators, which are important for improving the consistency and accuracy of the Laplace operator within DEC. By employing interpolation methods, we aim to achieve a higher-order consistency for Laplace operator on Voronoi-Delaunay periodic meshes. Additionally, we investigate the discretization of the Lie derivative in advection problems by selecting a Hodge operator, analyzing the connections between Discrete Exterior Calculus (DEC) and established Finite Volume methods.

Keywords: Discrete Exterior Calculus, Discrete Differential Forms, Discrete Hodge Star, Mimetic Methods

---

[*]Speaker