



THE UNIVERSITY OF CHICAGO

COMPUTATIONAL AND APPLIED MATHEMATICS COLLOQUIUM

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Discrete Covariant Derivative of Vector Fields on Triangle Meshes

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Jones 226, 5747 South Ellis Avenue

ABSTRACT

We introduce a discrete definition of connection on simplicial manifolds, involving closed-form continuous expressions within simplices and finite rotations across simplices. The finite-dimensional parameters of this connection are optimally computed by minimizing a quadratic measure of the deviation to the (discontinuous) Levi-Civita connection induced by the embedding of the input triangle mesh, or to any metric connection with arbitrary cone singularities at vertices. From this discrete connection, a covariant derivative is constructed through exact differentiation, leading to explicit expressions for local integrals of first-order derivatives (such as divergence, curl, and the Cauchy-Riemann operator) and for L2-based energies (such as the Dirichlet energy). We demonstrate the utility of our discrete formulations for the design and analysis of vector, n-vector, and n-direction fields.

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