Conservative DEC Discretization of Incompressible Navier-Stokes Equations on Arbitrary Surface Simplicial Meshes[1] MAMDOUH MOHAMED, King Abdullah University of Science and Technology, ANIL HIRANI, University of Illinois Urbana Champaign, RAVI SAMTANEY, King Abdullah University of Science and Technology — A conservative discretization of incompressible Navier-Stokes equations over surfaces is developed using discrete exterior calculus (DEC). The mimetic character of many of the DEC operators provides exact conservation of both mass and vorticity, in addition to superior kinetic energy conservation. The employment of signed diagonal Hodge star operators, while using the circumcentric dual defined on arbitrary meshes, is shown to produce correct solutions even when many non-Delaunay triangles pairs exist. This allows the DEC discretization to admit arbitrary surface simplicial meshes, in contrast to the previously held notion that DEC was limited only to Delaunay meshes. The discretization scheme is presented along with several numerical test cases demonstrating its numerical convergence and conservation properties. Recent developments regarding the extension to conservative higher order methods are also presented.

Ravi Samtaney
King Abdullah University of Science and Technology