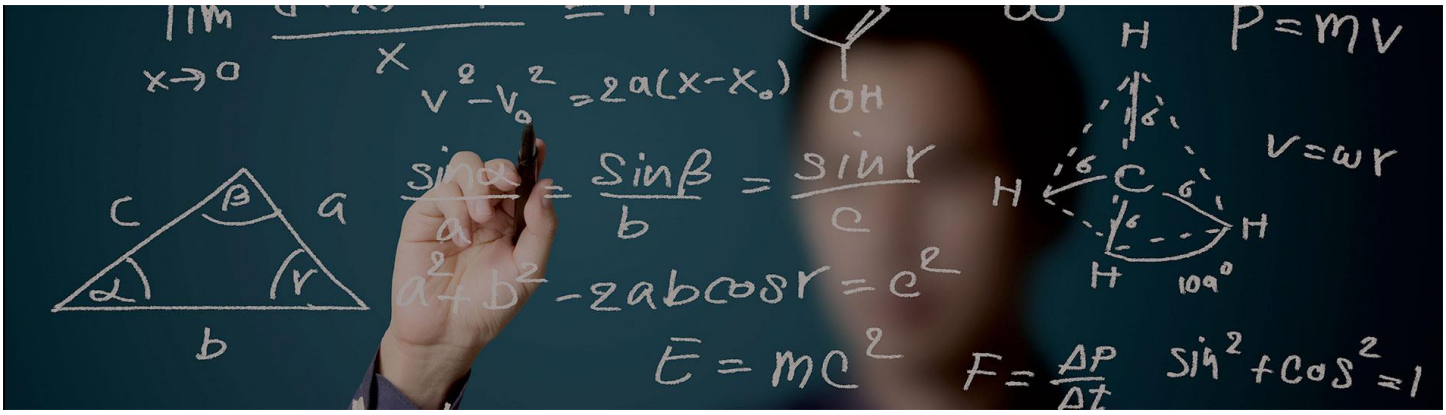

FALL 2018

RENSSELAER POLYTECHNIC INSTITUTE

DEPARTMENT OF MATHEMATICAL SCIENCES COLLOQUIUM

"Spatially compatible meshfree discretization through GMLS and graph theory"

Abstract:

Spatially compatible discretization is a term that broadly encapsulates numerical discretizations of PDEs that possess some mimetic property of the continuum operators, such as conservation, maximum principles, H(div)/H(curl) - conformity, or discrete preservation of an exact sequence. The construction of such methods is greatly facilitated by employing the exterior calculus framework and the duality between the boundary operators and the exterior derivative in the generalized Stokes theorem. In a finite element context, such tools form the so-called finite element exterior calculus (FEEC) which have unified mixed finite element theory. Meshfree methods, on the other hand, seek to solve a PDE strictly in terms of point evaluations (0-forms) to facilitate automated geometry discretization and large deformation Lagrangian mechanics. This has historically precluded the use of exterior calculus ideas; for example, conservation in transport problems in 3D is governed by the divergence theorem relating face fluxes (2-forms) to integrals of divergences (3-forms). Meshfree methods are therefore not equipped with the requisite differential forms and boundary operators to naturally define a discrete divergence theorem, and as a result meshfree methods have historically struggled to simultaneously achieve conservation and consistency. We present a constructive framework to remedy this, whereby we combine generalized moving least squares (GMLS) approximation theory together with combinatorial Hodge theory to achieve a mimetic meshfree framework…

Nathaniel Trask (Sandia National Labs)

Monday, November 26, 2018

4-5pm

Amos Eaton 214

Host: Joe Klobusicky

Refreshments served 3:30-4pm Amos Eaton 4th Floor Lounge