

# Department of Applied and Computational Mathematics and Statistics Colloquium



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## *I(mmer)sogeometric analysis in computational mechanics*

Difficulties caused by differences in geometry representation between engineering analysis models and computer-aided design (CAD) drawings motivated the introduction of isogeometric analysis (IGA), in which spline functions from CAD are used to approximate solutions to partial differential equations (PDEs). In addition to exactly capturing engineering geometries, these functions have approximation and smoothness properties that provide further advantages over standard finite element (FE) analysis. However, spline representations of geometry in CAD are not always directly amenable to IGA. Immersogeometric analysis (IMGA) uses immersed-boundary numerical methods to extend IGA to cases where spline spaces used for geometry representation do not conform to the desired PDE domain. Although these ideas show great promise, no standard, general-purpose implementations of them exist, leading me to explore novel formulations, algorithms, and data structures for bringing I(M)GA to bear on applications. This talk discusses examples from my research of the feedback loop between emerging I(M)GA technologies and the challenging problems to which they are applied: new analysis methods lead to new insights into problems, motivating further technology development, and so on. As case studies, this talk considers IMGA of heart valve fluid--structure interaction (FSI) and hybrid IGA--meshfree analysis of blast FSI. Some technologies for I(M)GA that grew out of (and now feed back into) these research efforts include: new fluid--structure coupling algorithms, nonlocal contact formulations, a hyperbolic model for phase-field fracture, parallelization of particle--grid methods using distributed graphs, and an open-source library, tIGAr, that leverages FE software from the FEniCS project to automate IGA.

**Friday, January 18, 2019**

**4:15 PM – 5:15 PM**

**127 Hayes-Healy Center**

Colloquium Tea 3:45 PM to 4:15 PM 101A Crowley Commons Room