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ALL YOU NEED IS A SINGLE MESH... A UNIVERSAL MESH

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Abstract. Difficulties with automatically and efficiently constructing meshes, particularly for problems with changing domains, has helped spawn many of the core research themes in computational mechanics in the last few decades. This has been among the core motivations for the development of meshless methods, extended finite element methods, and embedded or immersed boundary methods, among others.

For a smooth domain and a refined enough mesh, just staring at a picture of the domain immersed in the mesh begs the question: "Would it be possible to slightly perturbe the mesh around the domain boundary so that the resulting mesh conforms to it?"

This is the question we are answering as we develop the concept of a "Universal Mesh," and is the central theme of the presentation. In a nutshell, we found that it is possible for meshes of triangles or tetrahedra in which a few selected angles are acute, and in which the mesh size is locally small compared to the local features of the boundary. Conversely, given a mesh, these conditions define a class of domains that can be meshed with it, and hence we call such mesh a "Universal Mesh" for such a class.

We will show the application of these ideas to the formulation of high-order methods for fluid-structure interaction problems, and to the computation of brittle crack propagation.