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OPTIMIZATION, ADAPTIVITY, AND SURFACE FITTING OF HIGH-ORDER MESHES

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We present a framework for adaptive optimization of high-order curved meshes. The optimization process is driven by information that is provided by the simulation in which the optimized mesh is being used [1]. We make the important choice to require only discrete description of the simulation feature to which to adapt to, e.g., the feature can be described as a finite element function on the mesh. This is a critical step for the practical applicability of the algorithms we propose and distinguishes us from approaches that require analytical information.

The discrete problem is formulated as a variational minimization of a chosen mesh-quality metric, utilizing a finite element extension to the Target-Matrix Optimization Paradigm [2]. The method primarily relies on node movement (r-adaptivity), but also has the capability to perform h-adaptivity steps when this can produce to the desired local mesh size [3]. We will also discuss our latest capabilities for surface fitting and tangential relaxation, which are enforced weakly by adding penalty terms in the objective [4]. These penalty terms connect the concept of mesh motion to the discrete finite element function that defines the desired node position.

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