Checking and improving the geometric accuracy of non-interpolating curved high-order meshes

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ABSTRACT

We define an L2-disparity measure between curved high-order meshes and parameterized manifolds in terms of an L2 norm. The main application of the proposed definition is to measure and improve the distance between a curved high-order mesh and a target parameterized curve [1] or surface [2]. The approach allows considering meshes with the nodes on top of the curve or surface (interpolative), or floating freely in the physical space (non-interpolative). To compute the disparity measure, the average of the squared point-wise differences is minimized in terms of the nodal coordinates of an auxiliary parametric high-order mesh. To improve the accuracy of approximating the target manifold with a non-interpolating curved high-order mesh, we minimize the square of the disparity measure expressed both in terms of the nodal coordinates of the physical and parametric curved high-order meshes. The proposed objective functions are continuously differentiable and thus, we are able to use minimization algorithms that require the first or the second derivatives of the objective function. Finally, we present several examples that show that the proposed methodology generates high-order approximations of the target manifold with optimal convergence rates for the geometric accuracy even when non-uniform parameterizations of the manifolds are prescribed. Accordingly, we can generate coarse curved high-order meshes significantly more accurate than finer low-order meshes that feature the same resolution.

References

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