# Single Surface Spline Reconstruction by Distortion-Minimizing Flattening

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**Abstract**

Structural integrity of a variety of engineering structures is frequently best assessed using a two-dimensional shell midsurface embedded in three-dimensional space, rather than the full volumetric representation of the model. However, computer-aided geometric design models are seldom suitable for downstream operations, including structural analysis, because the models are comprised of multiple trimmed surfaces that prove problematic when coupled using known solver methods. In this research, we present automated, theory-based techniques to convert open B-rep and mesh surfaces into analysis-ready spline models represented as a single trimmed spline surface—a representation used in many state-of-the-art isogeometric analysis representations. Here, a parametric domain of an open geometric model is defined by flattening a surface into the Euclidean plane and then optimizing its geometry to approximate an isomorphism. An approximating spline is then defined based on the correspondence between the original surface and its parametric domain. Interpolation and extrapolation operations are defined to naturally extend the spatial domain of the original geometry to be valid for the entire reconstructed spline surface. We demonstrate the success of the method in reconstructing and analyzing CAD models of both aerospace and automotive interest.

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