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Research Papers

Computation of Midsurface by Feature-Based Simplification–Abstraction–Decomposition

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Abstract

Computer-aided design (CAD) models of thin-walled solids such as sheet metal or plastic parts are often reduced dimensionally to their corresponding midsurfaces for quicker and fairly accurate results of computer-aided engineering (CAE) analysis. Computation of the midsurface is still a time-consuming and mostly, a manual task due to lack of robust and automated techniques. Most of the existing techniques work on the final shape (typically in the form of boundary representation, B-rep). Complex B-reps make it hard to detect subshapes for which the midsurface patches are computed and joined, forcing usage of hard-coded heuristic rules, developed on a case-by-case basis. Midsurface failures manifest in the form of gaps, overlaps, nonmimicking input model, etc., which can take hours or even days to correct. The research presented here proposes to address these problems by leveraging feature-information available in the modern CAD models, and by effectively using techniques like simplification, abstraction, and decomposition. In the proposed approach, first, the irrelevant features are identified and removed from the input FbCAD model to compute its simplified gross shape. Remaining features then undergo abstraction to transform into their corresponding generic Loft-equivalents, each having a profile and a guide curve. The model is then decomposed into cellular bodies and a graph is populated, with cellular bodies at the nodes and fully overlapping-surface-interfaces at the edges. The nodes are classified into midsurface-patch generating nodes (called "solid cells" or sCells) and interaction-resolving nodes ("interface cells" or iCells). In a sCell, a midsurface patch is generated either by offset or by sweeping the midcurve of the owner-Loft-feature's profile along with its guide curve. Midsurface patches are then connected in the iCells in a generic manner, thus resulting in a well-connected midsurface with minimum failures. Output midsurface is then validated topologically for correctness. At the end of this paper, real-life parts are used to demonstrate the efficacy of the proposed approach.

FIGURES IN THIS ARTICLE

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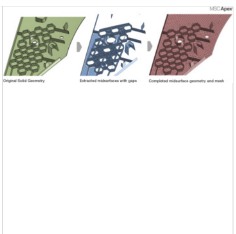

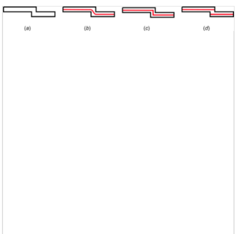

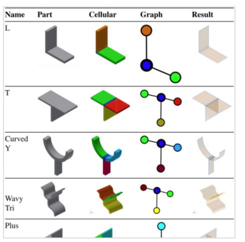

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Topics: Computation , Shapes , Sheet metal , Algorithms , Computer-aided design , Computer-aided engineering