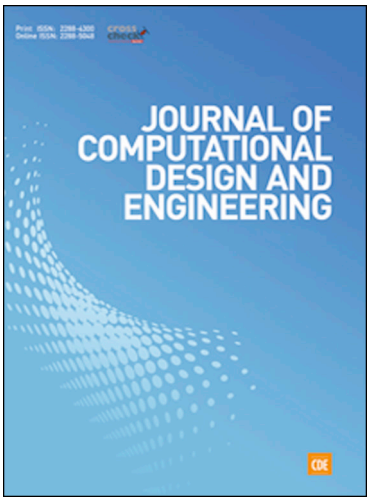

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Jacob Kresslein, Payam Haghighi, Jaejong Park, Satchit Ramnath, Alok Sutradhar, Jami J. Shah

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AUTOMATED CROSS-SECTIONAL SHAPE RECOVERY OF 3D BRANCHING STRUCTURES FROM POINT CLOUD

Jacob Kresslein, Payam Haghighi, Jaejong Park, Satchit Ramnath, Alok Sutradhar, Jami J. Shah

Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, OH 43210, USA

Corresponding Author: Jacob Kresslein, Kresslein.1@osu.edu

ABSTRACT

Many applications rely on scanned data, which can come from a variety of sources: optical scanners, coordinate measuring machines, or medical imaging. We assume that the data input to these applications is an unorganized point cloud or mesh of vertices. The objective may be to find particular features (medical diagnostics or reverse engineering) or comparison to some reference geometry (e.g. dimensional metrology). This paper focuses on the feature fitting of a segmented point cloud, specifically for branched, organic structures or structural frames, and targets non-monolithic geometries. In this paper, a methodology is presented for the automated recovery of cross-sectional shapes using centrally located curves. We assume a triangulated surface mesh is generated from the scanned point cloud. This surface mesh is the starting point for our methodology. We then find the curve skeleton of the part which abstractly describes the global geometry and topology. Next after segmenting the curve skeleton into non-branching segments, orthogonal planes to the curve skeleton segments, at preset or adaptive intervals, make slices through the surface mesh edges. The intersection points are extracted creating a 2D point cloud of the cross section. A number of application specific post-processing operations can be performed after obtaining the 2D point cloud cross sections and the curve skeleton paths including: calculations such as area or area moments of inertia, feature fitting or recognition, and digital shape reconstruction. Case studies are presented to demonstrate capabilities and limitations, and to provide insight into appropriate uses and adaptations for the presented methodology.

Keywords: Digital Shape Reconstruction; Shape Recovery; Metrology; CAD; Feature Recognition; Medical Imaging