An Effective Level Set-based Method for the Design of Extrudable Structures

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Extrusion is a manufacturing technique that creates products with constant cross sections. The extrusion process is widely employed to reduce cost. The conventional structure optimization approaches are typically failed to deal with this particular manufacture constraint. Therefore, this paper presents an effective level set method for the optimal design of structures with extrusion constraint. The free boundary of the structure is embedded into a higher-dimensional level set function, which can be used to implement the structural shape and topology optimization simultaneously. The compactly supported radial basis functions (CS-RBFs) are introduced to convert the conventional level set method to an easier parameterization form. Discrete wavelets transform (DWT) approximation is utilized to produce a sparser linear system to accelerate the fitting and evaluation operations arise from the parametric formulation. Furthermore, a cross section projection strategy is applied to reduce the design variables and satisfy the extrusion constraint. Several numerical examples are provided.

Keywords: Level set method, Radial basis functions, Parameterization, Discrete wavelets transform, Extrusion constraint