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A Manufacturability-based Method of Topological Shape Optimization for Structures under Multiple Loading Cases

Hao Li[1*], Liang Gao[2], Li Zhang[3], Tao Wu[4]

[1] School of Mechanical Science & Engineering, Huazhong University of Science and Technology, China, 430074, helloleehao@gmail.com
[2] School of Mechanical Science & Engineering, Huazhong University of Science and Technology, China, 430074, gaoliang@mail.hust.edu.cn
[3] School of Mechanical Science & Engineering, Huazhong University of Science and Technology, China, 430074, zlmse@mail.hust.edu.cn
[4] School of Software Engineering, Huazhong University of Science and Technology, China, 430074, wutaooptal@126.com

Considering the manufacturability during the design phase, this paper proposes a level set-based method for the optimal design of extrudable structures under multiple loading cases. Firstly, the level set model is used to describe the moving structural boundary as the embedded zero level set. To avoid the mathematically solving of the difficult Hamilton-Jacobi equation, the compactly supported radial basis function (CSRBF) [1]as well as the discrete wavelet transform (DWT) [2]are introduced to transform the standard level set method into a parametric one, to which several well-established gradient-based algorithms can be applied [3, 4]. Besides, the linear system for the interpolation is extremely sparse in our study, which will guarantee the computational efficiency. Secondly, the multi-objective optimization considering different loading cases is formulated by a normalized exponential weighted criterion (NEWC) method. The NEWC is used to depict the entire Pareto set on both convex and non-convex Pareto frontier. Thirdly, a cross section projection strategy is utilized to satisfy the extrusion constraint and reduce the computational cost. Several numerical examples in 3D are provided to show the efficiency of the proposed method. The results verify this method can achieve a manufacturable design using lower computer effort.

Key Words: *Topological Shape Optimization, Manufacturability, Extrusion, Level Set, Discrete Wavelet Transform.*

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