Approaching Ready to Print Designs with the Discrete Sequential Element Rejection and Admission (SERA) Method.

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ABSTRACT

The development of the Additive Manufacturing technologies has been a serious boost for structural optimization methods. Before the appearance of these revolutionary manufacturing processes, design possibilities were strongly delimited by the capacities of the classical manufacturing technologies, but along with Additive Manufacturing these boundaries were broken and free design came into play [1]. Topology optimization has become a perfect tool to maximize the design potential that these revolutionary manufacturing technologies offer, allowing to conceive designs that utilize available resources optimally. However, there are still many theoretical and practical issues regarding automatic integration of both technologies [2], and generally, manufacturers are forced to resort to scaffold structures. This investigation aims to advance in this line of research, where algorithms that provide the ability to control overhang inclinations and minimize support structures will be developed. The proposed procedure is based on the evolutionary topology optimization method known as Sequential Element Rejection and Admission (SERA) method. The optimization problem stands then as a multiple constraint evolutionary formulation with an additional overhang constraint. That constraint, rather than referring to supported elements, it refers to the number of supported contours and stands as the ratio between the value good supported contours to the total value of contours present in the structure. Additionally, the proposed constraint is versatile and not only allows to define different overhang angle values, but it also permits to choose whether to eliminate or control the presence of scaffold structures. Contours are analyzed by means of the Smallest Univalue Segment Assimilating Nucleus (SUSAN) method, an edge detection algorithm initially developed for Digital Image Processing and which in this work has been adjusted so that it allows classifying contours according to their inclinations. Different benchmark examples are solved to demonstrate the effectiveness of the method.

REFERENCES

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