Node based shape optimization for higher productivity in additive manufacturing

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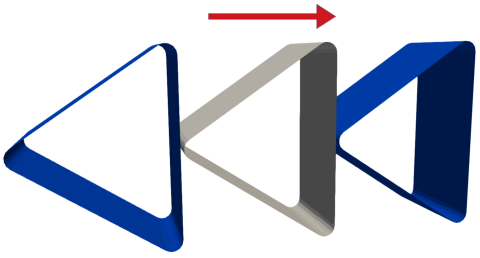
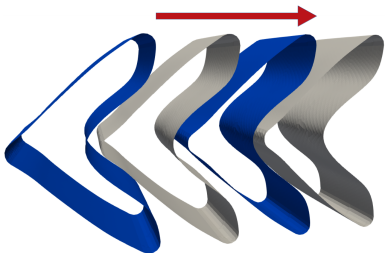
ABSTRACT

The emerging and established techniques in the field of additive manufacturing and 3D printing in general has the requirement of being more productive for the components being printed. This is more pronounced when using powder bed based techniques. One of the important factors influencing productivity is stackability of the component, that is ability to print of more components per unit area. In geometric terms, this transforms into the requirement of placing two consecutive components as close as possible to each other in a given direction. This contribution discusses two different approaches of performing shape optimization of the components to achieve higher stackability and thus higher productivity, subjected to constraints quantities like strain energy and mass.

The first approach is to formulate a geometrical no penetration constraint between the adjacent geometries and explicitly move them closer. As the no penetration constraint is applied and satisfied every optimization step, the shape of the component evolves to be more stackable. The second approach formulates an objective based on the volume between the constitutive components and its sensitivities, which then are used in the shape optimization process. The exemplary application presented here consists of a triangular component which is subjected to pseudo load conditions. As shown in the Figure 1a the initial component is less stackable in the given direction. Figure 1b shows the optimized component after shape optimization.



(a) Less Stackable Geometry



(b) More Stackable Geometry

REFERENCES

[1] Stackabilization, Honghua Li and Ibraheem Alhashim and Hao Zhang and Ariel Shamir and Daniel Cohen-Or *ACM Transactions on Graphics, (Proc. of SIGGRAPH Asia 2012)* **31(6)**.

[2] A consistent formulation for imposing packaging constraints in shape optimization using Vertex Morphing parametrization, Asl, Reza Najian and Shayegan, Shahrokh and Geiser, Armin and Hojjat, Majid and Bletzinger, Kai-uwe *Structural and Multidisciplinary Optimization, 2017*