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De-homogenization of Stiffness Optimal Infill for Additive Manufacturing

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Additive manufacturing will play an impotent role in Industry 4.0 to help produce more advanced, affordable, and greener products. The manufacturing technique is already used in many industries today. Products often have to be designed with the manufacturing technique in mind. With additive manufacturing, one issue is often how to design as a porous structure, *i.e.* designing with infill. The choice of infill for additive manufacturing designs is often determined after the product's design and not as a part of the product design itself. Furthermore, the infill often has a regular uniform structure; popular ones are orthogonal grid, honeycomb, or gyroid -structures. This results in a sub-optimal design.

Wu *et al.*[3] showed how density-based topology optimizing could be used for infill stiffness optimizing for additive manufacturing. However, density-based topology optimization often requires large computational resources to get good designs. Groen *et al.*[1] proposed using de-homogenization to get near-optimal large-scale designs at a fraction of the cost of large-scale density-based topology optimization. However, this was based on a structured grid for a single load case. The de-homogenization methods map composite layers as a periodic structure, representing a porous medium well. Groen *et al.*[2] hence used the de-homogenization method to generate orthotropic infill material for 2D coated designs.

The purpose of this work is thus to use the de-homogenization method to generate large-scale stiffness optimal infill for 3D irregular structures subjected to multiple loading cases at a low computational cost.

References

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