Integrating Topology Optimization and AM: Post-Processing and Support Structure Design

Aaditya Chandrasekhar, Subodh Subedi, Chaman S. Verma†, Krishnan Suresh*

University of Wisconsin, Madison, ME 2059, 1415 Engineering Drive, Madison, WI 53706
e-mail: ksuress@wisc.edu, web page: http://www.ersl.wisc.edu
† Palo Alto Research Center (PARC), CA

ABSTRACT

This talk will address two challenges in the integration of topology optimization (TO) and additive manufacturing (AM).

The first part of the talk will focus on the post-processing of TO designs, specifically for down-stream finite-element analysis and AM; see Figure 1.

Current post-processing strategies will be classified based on their implicit dimension (1D, 2D and 3D), and they will evaluated against various metrics (see Figure 2). Following this, two new strategies will be presented: the first is a volume-based (3D) Boolean strategy that offers certain advantages for feature-based processing, and the second is a surface-based (2D) merging strategy that is relatively easy to implement. Results from both these strategies will be presented.

Figure 1: Post-processing of topology optimized designs.

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Figure 2: Proposed classification of post-processing strategies, and their merits.

The second part of the talk will be on the design of support structures for AM. A simple and efficient
physics-based approach will be presented where support structures are generated by solving a ‘AM-tuned’ thermal topology optimization problem. Specifically, artificial fibers are introduced to orient support structures along the build-direction, leading to a concurrent evolution of the support and fiber orientation. By penalizing the fiber orientation, we show that one can implicitly control the surface normal to satisfy overhang constraints. The generality of the algorithm is demonstrated in 2D and 3D (see Figure 3).

![Figure 3: Support structure design via AM-tuned thermal topology optimization.](image)