Contribution ID: **107** Type: **Apresentação regular**

Efficient nesting via Fast Fourier Transforms to solve the production scheduling problem in Additive Manufacturing

The interdependence of nesting and production scheduling problems in Additive Manufacturing (AM) systems poses a significant computational challenge when considering traditional optimization methods. This work addresses the AM scheduling problem (AMSP), with a particular focus on the nesting component, which remains the major computational bottleneck in existing approaches. Current nesting methods frequently rely on complex and computationally intensive preprocessing and struggle to scale efficiently or handle multiple part rotations. Building on an in-depth review of geometric tools for handling part geometry and no-overlap constraints, we propose a nesting framework that builds on raster-based representations and exploits the Convolution Theorem by employing Fast Fourier Transforms on modern computing hardware to quickly identify feasible part placements. Contrary to the expectations, results show that finer raster resolutions and a predefined number of rotations do not significantly impact run time, highlighting the scalability and efficiency of the method. This nesting framework is integrated into a Biased Random-Key Genetic Algorithm (BRKGA) to address the AMSP in a unified manner. Initial experiments on benchmark datasets showcase the competitiveness of our approach compared to state-of-the-art methods, offering a promising path toward scalable and efficient AM scheduling.

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Session Classification: Session 2.3 –Scheduling

Track Classification: Session 2.3 –Scheduling