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Computationally Efficient Stacking Sequence Blending for Composite Structures with a Large Number of Design Regions Using Cellular Automata

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Abstract : This article introduces a computationally efficient method for stacking sequence blending of composite structures. The computational efficiency makes the presented method especially interesting for composite structures with a large number of design regions. Optimization of composite structures with an unequal load distribution may lead to locally optimized thicknesses and ply orientations that are incompatible with one another. Blending constraints can be enforced to achieve structural continuity. In literature, many methods can be found to implement structural continuity by means of stacking sequence blending in one way or another. The complexity of the problem makes the blending of a structure with a large number of adjacent design regions, and thus stacking sequences, prohibitive. In this work the local stacking sequence optimization is preconditioned using a method found in the literature that couples the mechanical behavior of the laminate, in the form of lamination parameters, to blending constraints, yielding near-optimal easy-to-blend designs. The preconditioned design is then fed to the scheme using cellular automata that have been developed by the authors. The method is applied to the benchmark 18-panel horseshoe blending problem to demonstrate its performance. The computational efficiency of the proposed method makes it especially suited for composite structures with a large number of design regions.

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