Design and Fabrication of Aerospace-Grade Digital Composite Materials

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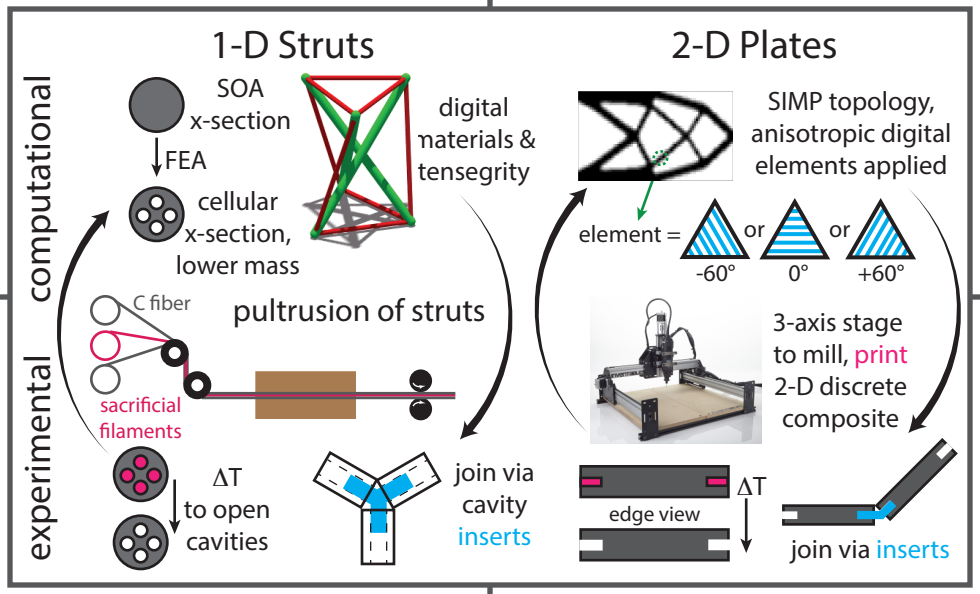
Research Objectives

- 1-D: specific tensile, compressive strut designs for optimum buckling in tensegrity structures
- 2-D: anisotropic plate designs and joining based on SIMP and FEA structural designs
- Innovative use of sacrificial materials to form internal joining
- Enter TRL 1 with paper designs, exit TRL 3 with 1-D, 2-D proof-of-concept built designs



Approach

- Computational: 1-D strut design use analytical, FEA for improved buckling resistance; 2-D anisotropic elements superimposed on SIMP topologies with rotation based on stress state
- Experimental: 1-D struts pultruded with sacrificial cores for mass savings, joined with core inserts, reversible adhesion via induction or electric heat; 2-D plates milled and 3-D printed, join via inserts

Potential Impact

- Up to 30-50% mass reduction for equivalent loads
- Design tools for novel, optimized structures
- Amortize structural launch cost over lifetime of subsequent structures using digital composites
- Mission flexibility via adaptable, modular designs
- Opportunity for discrete component testing and structural computation to avoid or minimize costly, lengthy subcomponent testing and certification