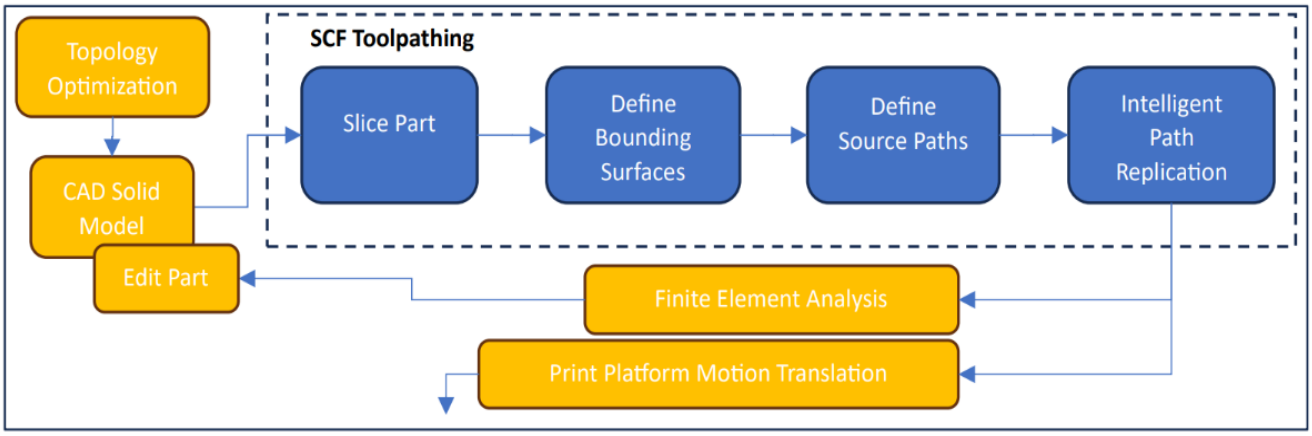
PROJECT SUMMARY 5555

Innovations in Robotic Additive Manufacturing Process Planning



Steered continuous fiber toolpathing involves part slicing, defining anchor/source toolpaths, and intelligent toolpath replication.

PROBLEM

In the continuous fiber 3D printing industry, there is a gap in printability between the part geometries that can be designed and those currently produced by state-of-the-art continuous fiber printers. Specifically, steered continuous fiber (SCF) toolpath planning software lags physical SCF printing capability. To date, there is no slicing or toolpathing software available that enables a designer to efficiently specify SCF within complex and highly-curved 3D geometries to achieve fiber orientation parity with finite element analysis (FEA) load simulation guidance.

OBJECTIVE

The objective of this project is to develop a user interface and toolpathing approach that is fully 3D-centric. This will include a variable slicing perspective and a library of intelligent toolpath replication algorithms. The end result will be a collection of functional building blocks that designers can use to efficiently define fiber pathways. Additionally, the project will establish downstream interoperability with industry finite element analysis software.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

DESIGN

ASTM PROCESS CATEGORY
Material Extrusion

EQUIPMENT
3D Steered Continuous Composite Fiber Manufacturing Printers

MATERIAL
Polymer and Ceramic Composites

TECHNICAL APPROACH

Continuous Composites, Inc. (CCI) CF3D® Toolpathing Studio software will be leveraged to provide an application codebase and 3D slicing surface computer-aided design (CAD) models imported by the designer. CCI engineers will develop new SCF toolpathing algorithms and then test the functionality of each algorithm through a sample part. Toolpathed parts will be exported to a CF3D printing platform digital twin on the Siemens Run My Virtual Machine simulator for confirmation. Once the functionality is confirmed, C++ programming language algorithms and capability demonstrating visuals and files will be delivered. To achieve downstream interoperability of SCF software and FEA, CCI will work with two FEA vendors to develop a standard for multi-fiber, multi-material SCF toolpath data. This standard will be free of motion data and include a translation utility to import data into the vendors' standards. The downstream interoperability of FEA will be improved by developing a toolpath data standard and a post-trim model reconciliation algorithm to account for expected post-machining of the print.

PROJECT START DATE

August 2023

EXPECTED END DATE

July 2024

EXPECTED DELIVERABLES

- Data management plan
- Transition and commercialization plan
- Slicing, regioning, replication, wrapping, and toolpath algorithms
- Presentation at two public forums
- Final project report

FUNDING

$1,527,415 total project budget
($794,284 public funding/$561,116 private funding)

PROJECT PARTICIPANTS

Project Principal:
Continuous Composites, LLC

Other Project Participants:
Air Force Research Laboratory

Public Participants:
U.S. Department of Defense