DEVELOPMENT OF A CURVED LAYER CARBON FIBER REINFORCED PLASTIC 3D PRINTER

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ABSTRACT

Current desktop 3D printers use FDM (Fused Deposition Modeling) to build parts out of flat lay- ers of extruded thermoplastics. The printed parts have poor mechanical properties because of the low strength of thermoplastics and because the flat layer geometry limits inter-layer adhesion in thin areas. A curved-layer CFRP (Carbon Fiber Reinforced Polymer) 3D printer was developed to solve those two issues. With curved layers, the carbon fiber may be oriented to best suit the applied loading on any given part, and the layers may be designed for greater inter-layer adhesion. An FDM-compatible ABS-matrix CFRP filament was developed by dipping a carbon fiber tow in an ABS-Acetone solution and was shown to have promising mechanical properties, comparable to aluminum. A custom FDM extruder was de- signed and fabricated for mounting to an available FANUC LR Mate 200iC industrial robot arm, which provides the six degrees of freedom needed to print curved layers. Control electronics, in the form of the FANUC robot system and open-source Megatronics 3D printer microcontroller board, were implemented and programmed to generate a toolpath for a sample specimen and operate the extruder hardware during printing. Finally, a composite-specific finite element analysis predicted the strength of the printed CFRP sample part to be twice that of ABS with stiffness on the same order as and aluminum part of the same geometry.

INTRODUCTION

Intro text here.

NOMENCLATURE

ABS	Acrylonitrile Butadiene Styrene
PLA	Polylactic Acid
FDM	Fused Depostion Modeling
CFRP	Carbon Fiber Reinforced Plastic/Polymer
FEA	Finite Element Analysis
FEM	Finite Element Model

MATERIALS AND METHODS

Put materials and methods used here.

Carbon Fiber Filament

test text

Extruder Design

test text

Finite Element Analysis

test text. test citations [1, 2].

Print Controls

test text

FANUC Setup

test text

RESULTS

Put results here.

CFRP Analysis

test text

Finite Element Analysis

test text

Print Testing

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DISCUSSION

Put discussion here.

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REFERENCES

[1] Deuschle, H. M., 2010. “3d failure analysis of ud fibre reinforced composites: Puck’s theory within fea”. PhD thesis, Universität Stuttgart, September.

[2] Pinho, S. T., Davila, C. G., Camanho, P. P., Iannucci, L., and Robinson, P., 2005. Failure models and criteria for frp under in-plane or three dimensional stress states including shear non-linearity. Tech. rep., National Aeronautics and Space Administration Langley Research Center.