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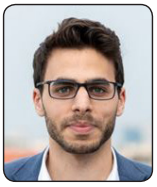
Abstract



A PRODUCTION METHOD FOR STANDARDIZED CONTINUOUS FIBER REINFORCED FFF FILAMENT

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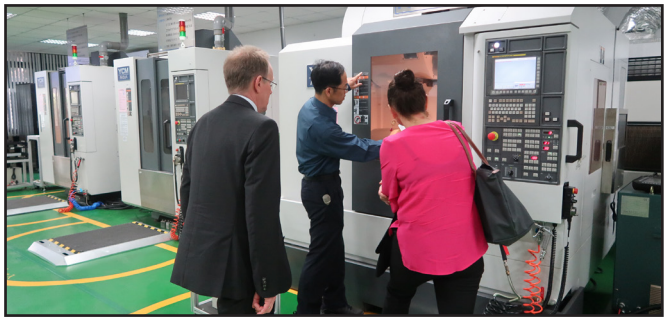
Abstract:

Consumer fused filament fabrication (FFF) desktop 3D printers are used for prototyping, spare parts and even small-scale production, but produce parts with lower tensile strength than traditional manufacturing methods. High tensile continuous fibers increase filament composite strength, but poor fiber adhesion and pull-out are common weaknesses. The few commercially available continuous fiber reinforced (CFR) filaments are costly and only compatible with their manufacturer's machines.

This work describes the development of a method and a prototype apparatus to produce standardized CFR filament, addressing the weaknesses of CFR thermoplastics while maintaining their compatibility with consumer 3D printers, and thereby achieving mechanical properties required for cost-effective small-scale productions.

A bundle of raw carbon fiber is impregnated with a solution of thermoplastic and compatible solvent, improving the adhesion of the fibers to the thermoplastic and reducing fiber pull-out. The pretreated fiber is then extrusion-coated with thermoplastic to achieve a standardized filament diameter. 1.75mm PLA filament reinforced with 12k continuous carbon fiber and pre-treated with an ABS-Acetone solution was produced.

Parts and products ranging from small consumer goods to meter-sized airplane wing sections were successfully printed using a standard FFF extruder. Tensile tests showed a yield stress increase of 535% compared to plain PLA, and a 70% increase compared to filament produced with raw, untreated fibers. Further work is needed to determine the ideal fiber content, its distribution within the filament and the concentration of the solution.



Biography:

Mohamed Aburaia is the Head of Competence Center Digital Manufacturing and Robotics at the University of Applied Sciences Technikum Wien. His research activities focus on generative manufacturing and using robots as manufacturing tools. He gives lectures on the design of robots and additive manufacturing.

Publication of speakers:

1. Mohamed Aburaia et al; Oriented to Multi-Branched Structure Unsupported 3D Printing Method Research, 2020 May; 13.
2. Mohamed Aburaia et al; Kinetic Uptake Studies of Powdered Materials in Solution, 2015 Jun 4.
3. Mohamed Aburaia et al; Safety and efficacy of photodynamic therapy using BCECF-AM compared to mitomycin C in controlling post-operative fibrosis in a rabbit model of subscleral trabeculectomy, 2016 Mar 18.
4. Mohamed Aburaia et al; Magnetic Resonance Imaging of Swallowing-Related Structures in Nasopharyngeal Carcinoma Patients Receiving IMRT: Longitudinal Dose-Response Characterization of Quantitative Signal Kinetics, 2016 Jan 28.
5. Mohamed Aburaia et al; Altered Micrornas in Bicuspid Aortic Valve: A Comparison between Stenotic and Insufficient Valves, 2010 Jul; 19

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