Sparkle ID

SP21C001235

Project Title

Continues Carbon Fiber 3d Printing.

Category

Sensors - Actuators for Automotive

Sub Category

Sensor Fusion

Abstract

FRP Composite part manufacturing is labour-intensive, costly, and needs to perform complex methods such as vacuum bagging. Also, the FRP parts are non-recyclable because of a thermoplastic matrix. Because of these composite applications are limited to only the high-end aerospace industries. This small percentage use of FRP is majorly affecting the environment. On the other hand, 3D printed thermoplastic parts are weak to be used as structural components. In addition to that because of the COVID-19, product industries are most affected compared to software industries. Virtual development of products becomes impossible because of the need for prototyping. This problem can be solved by continuous fibre 3d printing. By printing continuous carbon fibre embedded in nylon and using it in 3d printing. By achieving merely 17%-20% of fibre fraction printed parts could have specific strength comparable to steel.

Problem Statement

To reduce the manufacturing cost of composite parts, to reduce the environmental impact of non-recyclable FRP and to make remote composite product development possible, we are designing and manufacturing continuous fibre 3d printer with low-cost continuous fibre filament.

Solution

To solve the above problems we have developed a continuous fibre 3D printer that prints fibre-reinforced parts at a cost around plastic 3D printers. And pultrusion machine for raw material manufacturing. With an inhouse raw material manufacturing cost of parts to be manufactured is significantly reduced. Additionaly the use of thermoplastic, recycling is also easily possible.

Innovation

The system designed around a low-cost 3k carbon fibre which is 80% cheaper than 1k fibre. Fibre 3D printed parts have specific strength up to 1.4 times that of the steel. Because of cost and strength advantage, it can replace not only the CFRP parts but also the metal pars in different applications. Furthermore, replacing the metal parts with the continuos 3D printed parts can reduce weight in the automotive sector which results in an increase in the efficiency of the vehicle. In the end, concept remote product development can be achieved by using a digital CAD library. Using this consumer can print their on-site which reduces transportation cost and time delay.

Technical Description

The solution of continuous fibre 3D printing is divided into two parts: 1)Manufacturing of plastic embedded carbon fibre filament a) Nylon 6 has exceptionally low viscosity after melting and also good bonding strength, therefore it is selected as a matrix. b) If 1k fibre is selected for filament manufacturing then filament diameter can be less and the surface finish would be acceptable, but its price is around 18,000 INR/Kg. Instead, we have designed our solution by using 3K fibre which cost around 4220INR/Kg. By implementing this solution, we can reduce the manufacturing cost of up to 900Rs/kg of filament with 20% carbon fibre. 2) To solve surface finish problem duel nozzle design is implemented. In this first nozzle does the fibre printing which gives part its exceptional strength and second nozzle prints thermoplastic on the surface of the part which increases its surface finish and tolerance of +- 0.1mm. To dehydrate the filament dry box is implemented.

Keywords

3D Printing, CFRP, FRP, Composite, Carbone fibre, Nylon embedded 3D printing, Composite 3D printing.

Patent Status

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