Additive Manufacturing with Composites

Chad Duty
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CURRENT RESEARCH

A Manufacturing Revolution

Chad Duty, Associate Professor of Mechanical, Aerospace and Biomedical Engineering at the University of Tennessee, wants to create a world of stronger, lighter and cheaper products. From the moment he first saw a 3D printer in action in the mid 1990's, he set himself on the course to change the way products are designed and manufactured. Additive manufacturing (3D printing) puts new material only where it is needed, which allows manufacturers to create complex shapes and take full advantage of material properties with less waste.

Traditional manufacturing approaches for a typical Lockheed Martin F-22 Raptor result in a buy-to-fly ratio of 11:1. That means 11 times as much material must be purchased to create the plane than actually flies on the plane after construction. The traditional "subtractive manufacturing" approach starts with large chunks of raw materials, and cuts away any waste material that's not part of the final geometry that performs the function – similar to a sculptor chipping away at a big granite block. For the Raptor, that translates into buying over 110,000 lbs of raw stock titanium to produce 10,000 lbs of final components that go on the plane – resulting in over 100,000 lbs of waste with every plane. While material cost is only part of the F-22's $132 million price tag, that's still a massive amount of wasted raw material to make one aircraft.

3D printing technology has grown rapidly over the course of the last decade. Researchers and engineers have designed increasingly complex parts and more people have access to 3D printers than ever before. There are three F's in 3D printing; form, fit and function. Form is in reference to how the part feels, fit to how the part...

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AFFILIATION

The University of Tennessee, Knoxville

EDUCATION

- Ph.D. Mechanical Engineering, Georgia Tech

RESEARCH AREAS

Technology, Materials Science / Physics

FUNDING REQUEST

$120,000 will cover the tuition and stipend for a graduate student, salary expenses and standard laboratory expenses. Depending on the extent of the material development project, a single project could range from a few months to several years, so a wide range of contributions can be applied to this research effectively. For instance, identifying the appropriate print conditions for a specific material may only take a few months (~$40,000) whereas developing a new material for a specific application may take 2-3 years (~$300,000).