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Title: The Future of 3D Printing Script

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The Future of 3D Printing Script

Hi, I'm Bryan Carlton, and I ask is it possible to truly print in 3 dimensions simultaneously at a large scale with continuous embedded fiber?

In this presentation, I will discuss 5 axis printing, the tech used, and what was achieved by the team.

The team converted a 5 axis shopbot mill into a 3d printer in order to achieve all 5 axis and be able to print at a large scale.

To do this, the mill was removed and replaced with an anisoprint coextrusion print head.

The team was performing continuous fiber printing using basalt fiber and nylon filament.

To make sure that there is enough material in the printer at all times, I used a rotary encoder to make a filament counter.

Unlike traditional 3D printing, our print bread bead was a rotating indexer from shopbot. This gave us our 5th axis, and allows for continuous 3D printing.

In order to properly program all of the components, the team added and used a RepRap Rambo board.

The team used MATLAB to generate the g-code, since there is no slicing software available for 5 axis 3D printing. MATLAB allowed the team to compute values of distances and the required print speeds.

Soon after developing a script to generate g-code, we began printing on the rotating axis, as seen here. Printing on a cylindrical preform allowed the team to print with continuous embedded fibers. This helps keep the structure of the print intact. The team would print various cylindrical items in order to test different patterns for strength.

One of the first prints can be seen here. This is a 1 layer print. It is noticeable that the distance between each strand of fiber is significantly apart. This initial print proved to be strong, but the distance between each fiber allowed it to fall apart. That would change in the following prints.

The next set of prints would be multi-layer. The team noticed that with each layer the print became stronger, but the surface finish was rough and imperfect. We would continue to print multilayer prints, but with different patterns in order to improve the overall strength of the print.

To improve our prints, the team tested different patterns. This includes the patterns such as the one seen here and weaving patterns. Each pattern came with its own strengths, but each also had their own weaknesses as well.

One of the first patterns we attempted was to print each layer in different directions. 2 layers followed the curve, while the layer in between would be parallel to the preform. This print had great surface finish, and was incredibly strong, but the sudden change in direction would clog the print head. This would lead the team to move on from this pattern.

Next the team attempted a weave pattern. We called it a weave as we would print in alternate directions of rotation, and at an angle. This pattern provided similar strength as the previous pattern. Though this did not have the same surface finish. In this case the surface finish is secondary to the overall strength of the print.

The important thing achieved with printing in this way is the team is able to prevent delamination. This key in keeping the integrity of the prints and can only be achieved through true continuous fiber 3D printing.

Besides demonstrating that it is not only possible to print on a rotating axis, the goal was to design and print strong objects. The team found that multiple layers and weave-like patterns allowed us to achieve this goal.

The next step of this project would be to continue and venture into more complex shapes. This includes shapes, such as tapered cylinders. The work done already is merely scratching the surface.

In conclusion the team demonstrated that it is possible to print strong prints on a 5 axis 3D printer that uses a rotating print bed. Printing in this fashion is not only innovative, but it achieves the goal of retaining the integrity of the print by printing continuously and preventing delamination.

In the end, this project demonstrated that when you bring together a team with a diverse skill set, the boundaries of innovation can be pushed not only in 3D printing, but in everything that was brought together to assemble this printer.