Team #2.5

3D Printing of Optical Fiber in Different Geometries

Corporate Sponsor: Purdue Innovates - Office of Technology Commercialization

Client Mentor: Dipak Narula **Academic Mentor:** Milton Aguirre

Project Members: Tyler Shuman, Audrey Petrow, Marcus Greenberg, Eric Schroeder

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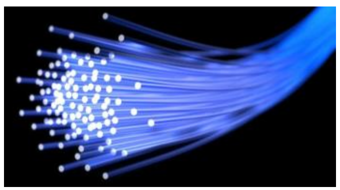
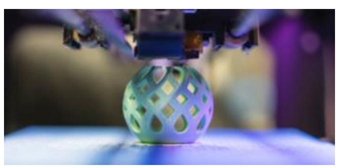
Project Background

Purdue's Office of Technology Commercialization [OTC] manages and licenses technology invented by faculty and graduate staff. This project was tasked with optimizing light collection through translucent filament using 3D printing, prototyping, and experimental testing methods. Given the commercial incentive of this project a portion of our research remains confidential.





Technical Requirements

Req. #	DESIGN REQUIREMENTS	DESIGN TARGETS	VALIDATION
	RATIONAL		
1	High translucent materials	Reduce amount of light that is escaping fiber optic holes to increase the amount of light that can be collected by the power meter. Also find proporties in the materials that reflect light well.	We will use a power meter to validate this.
2	Geometry of specimen to direct light to one point	Does 50% of intended light get directed to one point at the end of the fiber.	The size of the power meter input is limited by the size of the hole which is 0.195 inches
	Light meter has a small input whole to collect light.		
3	Keep filament strands in one direction during printing to increase amout of light transmitted over distances.	Improve the amount of light that can be transmitted over long distances.	Experimenting with filament strands and print specimens.
	Filement direction affect the way that light is transmision.		
4	Printer settings	Conduct expereiments to find the best way to print these speciments to direct light using layer heigh, tempertature, and infill.	Use power meter to validate the efficency of the specimens.
	Printer settings will affect the amout of light that will be transmited.		

Experimentation and Concepts

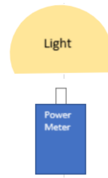


Figure 4 – Vertical Light Test

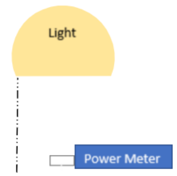


Figure 5 – Horizontal Light Test

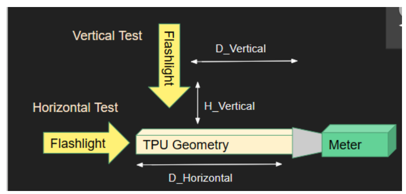


Figure 6 – Experimental Modeling

Figures 4 & 5 represent the setup for data collection. The sample is represented by a white rectangle. Figure 6 displays experimental modeling of different variables tested. Results were compared by their % efficiency.

Efficiency % = [Output ÷ Input] x 100

Design Evolution - Efficiency %

22 %

<1%

80%

150%

420%

Final Design Description

The final design is a 3D printed prism made from TPU. This geometry yielded the highest results transmitting approximate **700%** of the light input.

The 45-degree edges create an internal mirroring effect. The length of the sample contains waveguides that allow light to flow linearly through the material.

The figures display how a green laser interacts with the specimen from different angles.

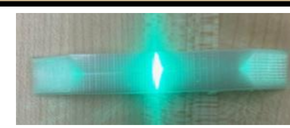


Figure 1 – Laser pointing from directly above sample

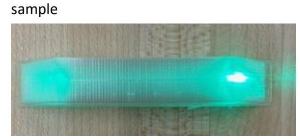


Figure 2 – Laser pointing towards right edge of sample

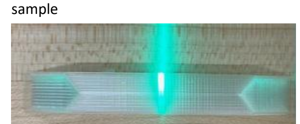


Figure 3 – Laser pointing perpendicular to the sample

Failure Modes

Failed Prints

Burnt Printer Nozzles due to the collection of moisture in TPU filament.

Solution: Store TPU in sealed bag in a dark, dry environment.

Melted Printer Nozzles because TPU slowly eats away at the nozzle causing small pieces of it to fall onto the printer bed, ruining the printed specimen.

Solution: Invest in high quality nozzles.

Figure 7 – Failed print specimens

Figure 8 – Burnt nozzle

Testing Flow Chart

Step	Description
1	Determine material - TPU, PETG, Optical Fiber, Nylon, or Silicon
2	Measure the efficiency of a non-printed specimen strand
3	Begin printing samples and optimizing printer settings for clearest performance
4	Compare printed to non-printed strands
5	Print different patterns and geometric configurations & compare to optimal non-printed geometries
6	Study the internal geometries & understand how light travels through them using the laser