Marshall Problem Statement/ Senior Design Topic

Problem Title: **3D printed Fiber Optics**

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Indicate which discipline/s is/are most appropriate to work on this problem, e.g., aerospace, mechanical, electrical, chemical, industrial, civil, computer, physics, materials, test, nuclear, earth science, other
Mechanical, electrical, and materials disciplines are most important for this work

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Marshall Problem Statement

Background: The big picture with references to previous work (Why would a senior design student be excited about this work?)

MSFC is a focus center for NASA development of advanced manufacturing technologies and processes. This includes advancing metal, plastic, and electronic additive manufacturing processes. Furthermore, a large effort is currently being put forth to advance multi-material fabrication (MMF) capabilities, with the ultimate goal of being able to integrate printed plastics, metals, and electronic circuits together to create complex, functional devices. Implementation of MMF manufactured devices could potentially reduce mass and volume of avionics, cabling, and structures on future NASA missions.

An area that has been identified as of importance is using MMF to reduce the mass and volume currently consumed by intricate cabling between avionics boxes. Fiber Optics are candidate replacements for these heavy, metal wire cables and the MMF team would like to investigate using 3D printed materials to create fiber optic communication channels.

Recent/on-going research on the problem (What resources, if any, are available to the senior design team, such as equipment, software, facility utilization)

Some early work has been done using splicers such as Mosaic system (https://www.mosaicmfg.com/) to use a single Fazed Deposition Modeling nozzle to created multi-material 3D parts. We believe that a similar method could be used to create structures with embedded fiber optic communication channels using plastics with ideal optical properties.

Additionally, the MMF team has a lot of experience in design and implementation of multi-material 3D printed systems and can act in an advisory role to the senior design team on the intricacies of designing for the proposed project.

Detai1s of the problem; design constraints, requirements (if any), outcome expected (one semester Senior Design course lasts 15 weeks; two semester course lasts 30 weeks.) (What do you expect the senior design team to accomplish?)

Work will need to be done by the team to identify the necessary materials, calculate and iterate through different printed geometries to get ideal transmission through the printed fiber optics,

demonstrate the viability of using printed plastics in this way, and finally implement such printed fiber optics as a part of a multi-material printed plastic structure. It is of interest to us both if such printed optics could be used for communication and in sensing applications where fiber optics are conventionally used (i.e. strain sensing).

For the deliverables of this project, simply demonstrating communication through printed fiber optics will be sufficient, however, the MMF team would like to see the senior design team demonstrate their implementation in a multi-material print as mentioned above or in a sensing application.

Any fiber optic communication protocol is acceptable to use (i.e. choice of communication band is up to the senior design team).

This work will likely need to be conducted as part of a two-semester design course as we desire a prototype or demonstration piece by the end of the course.

Senior Design Project Rules:

I. Weekly telecons will be scheduled to maintain proper progress and prevent dead-end ventures.

2. Deliverabl e/s required (e.g. one semester course - a written final report; two semester course - written final report and a prototype/model (if practical))