Project Requirements Document – Carbon Fiber Parameterization

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**Sponsor:** TangiTek, LLC

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| Document Modification History | |  |  |
| Version | **Date** | **Author** | **Description** |
| 1.0 | 02/01/2017 | Ha, Thanh, Jeffrey | Initial Version |
| 1.1 | 02/13/2017 |  | Added changes from advisor weekly meeting |

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# Project Description

A set up of measurements will be performed to extract the electromagnetic parameterization for Carbon Fiber composite microwave absorber.

## Problem/Need

Shielding materials are useful in protecting various products from electromagnetic interference (EMI) as well as satisfying FCC’s regulations and standards. The demand of these shielding and absorbing materials that are lightweight, thin, strong and durable are higher and higher to manage the growing wireless communication devices and automation. TangiTek has investigated and prototyped such an absorbing material which is called flocked CF composite absorber.

The initial tests show a significant improvement in shielding performance at a fraction of the weight of conventional absorbers. However, a full characterization test must be provided to extract the electromagnetic (EM) parameter and absorbing performance of the material in the desired frequency range in order to further test performance, modeling and optimization for the design of this flocked CF composite absorber. With the extraction of these EM parametrizations data which includes complex permittivity and complex permeability, the material behavior on an incident EM wave can be effectively modeled, characterized and simulated.

## Project Purpose

The purpose of this project is to develop a testing protocols for CF composite material characterization and to design a testing fixture prototype for extraction of the electromagnetic parametrization data of the measured materials. The obtained materials’ electromagnetic properties will be validated and modeled using an electromagnetic simulation.

## Project Background

This project is a Capstone project sponsored by TangiTek Company to develop and build a testing system for characterization of EM properties of the CF composite absorber. Firstly, in order to obtain the absorption coefficient of the absorber, we will follow the industrial standard in measuring the return loss of a material which is Naval Research Laboratory (NRL) Arch measurement system. Another test system that will be developed in order to compare the results with the NRL Arch setup is waveguide measurement setup. The complex permittivity and complex permeability will then be extracted from measured reflection and S-parameters obtained from NRL Arch and waveguide measurements respectively based on Nicholson Ross Weir algorithm. An EM simulation and modeling will also be performed to validate the extracted EM parameterization data of the absorber.

# Requirements

## Functional Requirement

1. Frequency range of operation must cover a frequency spectrum from 300MHz to 30 GHz.
2. The project must be capable of extracting dielectric constants, complex electric permittivity magnetic permeability, loss tangent and layer thinness of the absorbers.
3. EM parametrization data must be validated with simulation software.

## Hardware Requirements

1. The project takes advantages of available equipment and components that are accessible in PSU and sponsor: VNAs, waveguide, antenna, RF chamber.
2. The dimension for NRL arch
3. NRL Arch Reflectivity must be developed

## Software Requirements

1. Software can be used by both design team and the sponsor

## Policy Requirements

1. All students in the design team must sign for non-disclosure agreement.

# Project Constraints

Time constraints: The end of Spring term, 6/12/2017.

Cost constraints: Update after meeting with sponsor

# Communication Plan

Team meeting: Twice a week (about 2 hours each) at PSU

Advisor meeting: 9:00 am to 10:00 am, every Monday at PSU

Sponsor meeting: - After proposal and plan for major phases finished.

* Mid-term and End-term meeting to report the process.

# Documentation

All project documents are available at:

<https://github.com/trankhiemha/ECE412-413-Capstone-Project-N3>

#### Project schedule and progress

Project schedule: Gantt Chart for project time management (on Github)

Project progress: <https://trello.com/b/Ov0bqGiB/initial-cf-planning>

#### Research and Technical References

All research papers and technical documents are stored on Zotero group library.

<https://www.zotero.org/groups/957151/items/collectionKey/PUQ3V8GD>

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# References and Related Documents

* Electro-magnetic parameterization of composite microwave absorbers

<http://web.cecs.pdx.edu/~faustm/capstone/currentprojects.htm>