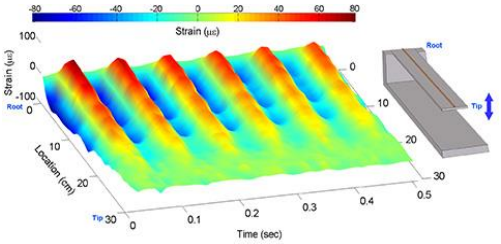
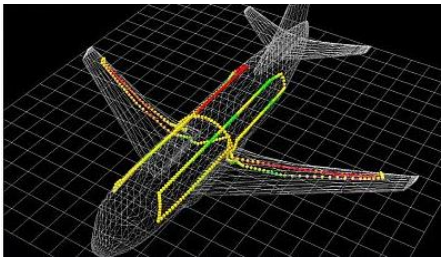
Distributed Fiber-Optic Sensing System

Contact: Prof. Tao Wei

Overview:

What is Distributed Fiber-Optic Sensing?





A sensing solution that enables a continuous distributed measurement (strain or temperature) along the length of an optical fiber. Imagine that tens of meters of optical fiber. With distributed fiber sensing, you can measure the strain or temperature at not just a few key locations, but at hundreds of locations along a single fiber. The equivalent gage length (a small section of fiber) can be as short as a few millimeters. Instead of needing two to three wires per sensing point for the traditional thermistor or strain gauge, only one optical connection gives you access to hundreds of sensing points.

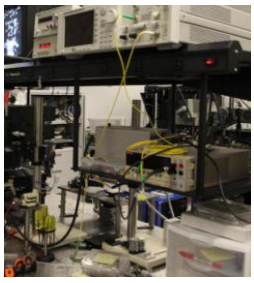
NEXT Lab at URI

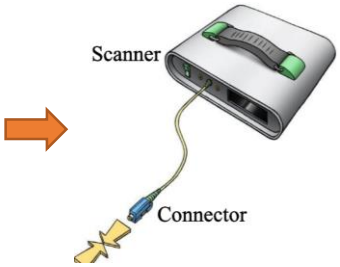
NEXT Lab, or next generation sensing technology lab at URI, is aiming at incorporating cutting-edge advances in wave optics, microwave photonics, and related areas into novel sensor technologies that address critical problems in science and industry. Particular focus is paid to solving difficult engineering challenges beyond the reach of existing sensing platforms. One of our research thrusts focuses on research, developing, and improving various types of distributed fiber-optic sensing technologies.

A video clip was made in NEXT Lab demonstrates the real-time temperature mapping concept of distributed fiber-optic sensing system by using a hot air gun to create “hot spots” along the surface [Demo].

Scope of the Project

Prototyping the above-demonstrated system - transferring a novel lab-technology to a product; simply speaking, putting a big lab mess into a box.





Team Description

- Two electrical engineers and one computer engineer.
- Strong self-motivation, and independence are a must.
- Knowledge of basic electronic design (transimpedance amplifiers, filters, etc.) is a big plus.
- Knowledge in electromagnetics, and fiber optics is a big plus.
- Experience in embedded system design (DSP, MCU, FPGA) is a big plus.
- PCB layout experience is a plus.

Deliverables:

- Functional distributed fiber-optic sensing prototype in an instrument box
- Functional test and measurement software (GUI)
- Final report including block diagrams, theory of operation, material cost & results of early test runs.

Team Division of Labor:

Electrical Engineer 1 (electronics design):

This engineer's primary responsibility will be the design of all the electronic components of the system. He/She will be responsible for the selection or design of circuits, including driving circuit for high-speed (>10 MHz) photodiode, transimpedance amplifier, analog filters (ex. aliasing filter), and analog-to-Digital triggering circuits. We would like this engineer to have experience with some or all of the above mentioned circuits. Once the components have been chosen and circuits designed, this engineer will work with the group's second electrical engineer to integrate his or her electronics into the overall design.

Electrical Engineer 2 (optics design):

This engineer's primary responsibility will be the design of all the optical components of the system. He/She is also responsible in understanding and deriving all the mathematical equations for the whole system, which will provide critical guidance for the team. He/She will be responsible for the selection or design of lasers, photodiodes, interferometer, etc. Once the components have been chosen and put together, this engineer will work with the group's first electrical engineer to integrate his or her electronics into the overall design.

Computer Engineer 1 (Test platform control software and UI):

This engineer will design the embedded system, and the graphical unit interface (GUI) to facilitate fast signal acquisition, processing, displaying, and storage. We would like this engineer to have some familiarity with FPGAs and/or DSPs. This engineer will begin the process of automating the test procedures and creating the platform's UI. Along the way this engineer will also work with the rest of the team to interface the measurement platform with the data acquisition system on the embedded system. Finally, this engineer will work with the rest of the team to test the prototype platform and verify its functionality.

If you have any questions about the project, its objectives, or any of the roles described before our presentation, please do not hesitate to contact Prof. Tao Wei (Kelley Annex A220): tao_wei@uri.edu