Team May 15-29
Client: Prof. Meng Lu, ECpE
Advisor: Dr. Meng Lu
Member: Chenyin Liu; Xuan Zhang; Wenbing Ma; Zhikai Cui; Jingxiang Zhang;

Ultrasonic Detector Using Plasmonics

Project Plan 2nd

Problem Statement

High-amplitude focused ultrasound can provide localized perturbation in liquids and tissues by inducing shock, cavitation, and heat deposition. Such mechanical and thermal disturbances have been widely used to deliver targeted impacts to cells and tissues for biomedical therapy: for example, transmembrane drug delivery, neural activity modulation in brain, and thrombolysis. The purpose of our project is to develop a 2D array of optoacoustic detectors based on the property of high-amplitude focused ultrasound. Our contribution consists of three main parts: Optical plasmonic sensor and fiber tip sensor, labview program for Tektronix scope and motorized stage, optical setup.

SYSTEM DESCRIPTION

This senior design project aims to develop a 2D array of optoacoustic detectors. The optoacoustic detector consists of a planar plasmonic crystal sturecure, which exhibits enhanced optical transmission at a particular resonant wavelength. Acoustic displacement of the plasmonic sensor results in a measurable change of the resonant wavelength. We will build a near infrared imaging system using a CCD camera, a moduled laser diode, and a delay generator, to interrogate the ultrasound field. In order to obtain high sensitivity and high frequency detection, the team will explore the nanoscale interface between photonics and acoustics.

Deliverables:

1. First semester:
   - We will finish Sample holder design and fabrication.
   - We will finish coding for the motorized stage and DAQ.
   - We will finish Sensor fabrication (Plasmatic sensor and fiber tip sensor
   - We will finish part of Design Document and Webpage

2. Second semester:
   - Optical setup will be finished
   - We will do test and adjustment to the Sample holder and Sensor
   - Assess performance from first semester and make any required adjustments.
   - Test the equipment to check the equipment is eligible to work or not.
   - Prepare to the final presentation and Design report.

Specifications:

I/O specification:

Input: Light and acoustic wave
Output: The image of movement of ion.
/software specifications:
Software used to be used:

- Labview.

Software that will be used:

- Universal libraries (C++, C, C#, vb, etc)
- Microsoft Visual Studio

Hardware
Hardware that will be used to control motorized stage and oscilloscope

- DAQ (Data acquisition) made by Measurement Computing
- Here is what the DAQ might seem like and its basic data standard.

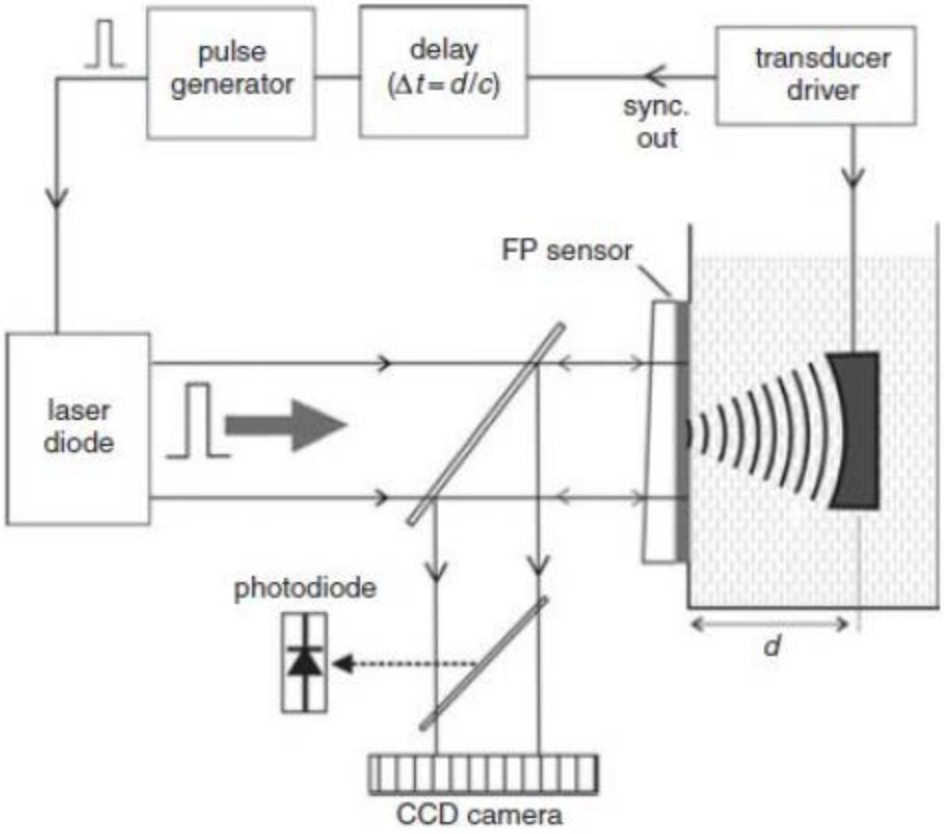
Sample preparation

1. samoke setup
2. water container sent into lab table
3. Photonic equipment used to measure the result.

Measurement Setup/Control software:
Installing software for DAQ(InstaCal & Universal Library, TracerDAQ, Universal Library Extensions for Labview)

Experiment Design:
We designed a water container in order to hold water. The acoustic generator will generate a high frequency of wave. We will put the generator into water to prevent any harm to people.

Concept Sketch/Mockup



Hardware Block Diagram:

The hardware is a block that can be made by machine, or manually. In our lab, the hardware is the equipment we need to use to check the result. Currently, we have sensor, kab-equipment, sample holder and some other equipment that we use to check the wave. We will use oscilloscope at last to check the wave.

Measurement Equipment:

- transducer driver:
- function generation
- laser diode
- FP sensor
- Photodiode
- CCD camera
- DAQ
- Motorized stage
- Sample Holder

Software & Controls

Software used to be used:

- Labview.

Software that will be used:

- Universal libraries (C++, C, C#, vb, etc)
- Microsoft Visual Studio

User Interface Description:

Hardware
DAQ -USB 3103 (Measurement Computing)
Motorized Stage
Oscilloscope

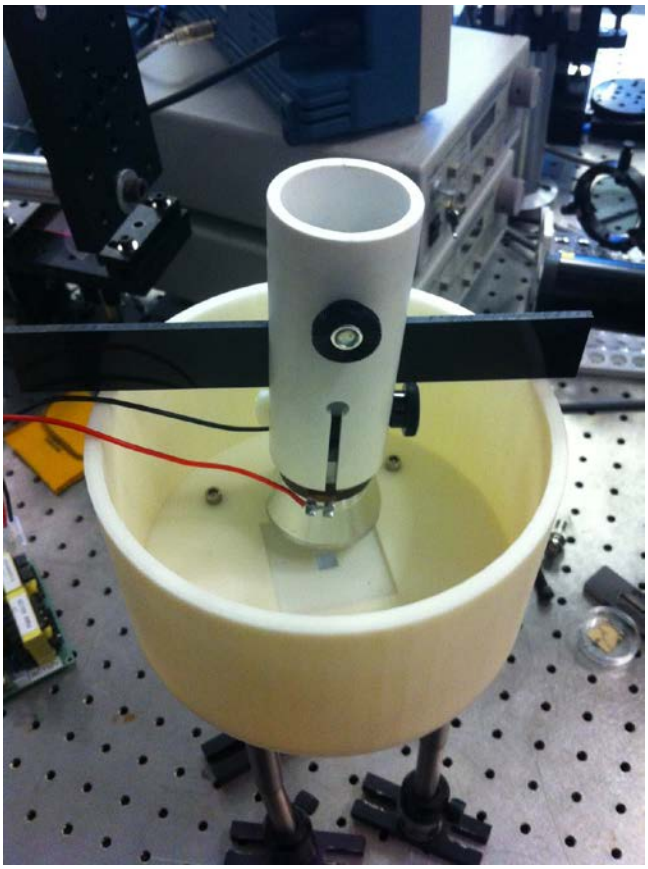
Software
Labview (Detailed functions)
Universal Libraries(stage control and data processing)
Solid Work(For design)

Functional Requirements:

Hardware

DAQ -USB 3103 (Measurement Computing)
Motorized Stage
Oscilloscope
Sample holder

Control & Automation:



Non-functional Requirements

Work Breakdown Structure

We have some methods to prevent the breakdown. In the lab, there are many ways to cause errors. We can make some method to prevent the error happen. For example, we use the exterior voltage adjustment machine to keep the voltage around some range. We also make some equipment to protect us. So far from now. we have known there is a breakdown happen in our project, which is the sensor part. We fixed this part and we debug it. We also develop in this project to make the error not happen any more.

Resource Requirement 3d printer and the specific printing material

1. electric wire and cable
2. plastic model
3. a set of tool for making electric model
4. a lab table which for making experiment for Photonics

Project Schedule

1st semester:

Risks

The only risk for us is we would focus a single problem for too long, then we would miss some other detail in the project. We are the people who like study very much. In fact, we could finish the project in 2 month. However, when we found some errors happened, we would spent a long time on studying it. Thus, we really enjoy the process of doing the project. We plan to finish the project at the early of February.

Risk to the project timeline

We might not get enough time to have a raw test on everything during the end of the semester. Hopefully, we will write appropriate code for data import and saving using universal Library.

Physical dangers

The first risk we are able to notice is that we will work in laboratory. The lab safety plays a key role for the success of your projects, as well as other students' experiments. We think about the potential hazard aspects before we start our experiment. We list some basic requirements to follow:

1. Wear gloves to protect ourselves , optical components, and our devices.

2. Wear lab coat. If we just stop by the lab to take our samples or tools, we don't need the lab coat. Otherwise, we need to put on the lab coat during our experiment.

3. Place all the solvents and hazard items in the chemical hood. The squeeze bottles of solvents should be kept in the chemical hood. Acetone is a volatile organic compound, which may damage kidney and liver.

4. Keep the workbench clean. Clean the glasswares when experiment is over. Don't leave them in the sink. Turn off the instruments when we are done. In particularly, the lasers should be shut off because we don't want to blind a curious student who may peek inside the laser.

5. Don't block airway of any ventilation system: chemical hood, power supply, etc..
6. the damage from acoustic generator. The 1K frequency of generator can hurt the feeling of ear.

Market/Literature Survey

The team plan to make Market survey through email on Feb,15. Members will make questionair and collect feedback to improve the product and fix bugs. There are two survey that we will do to know the product.

Time Line:

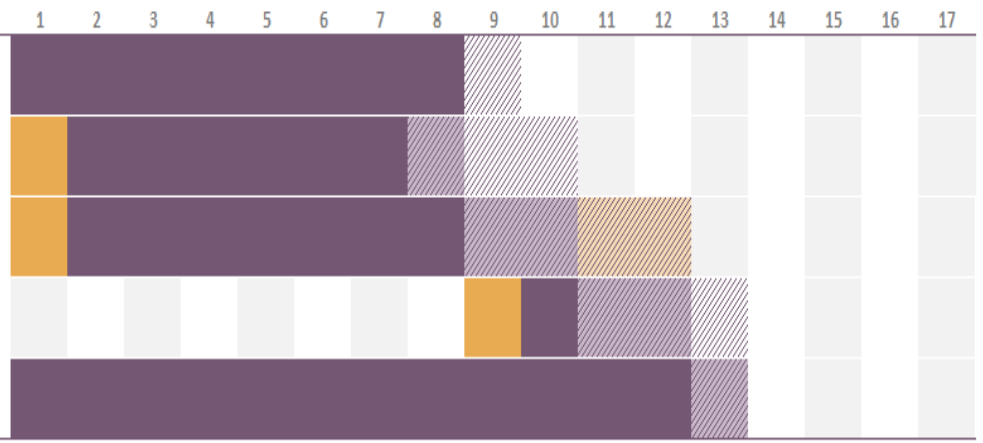
Month	Assignment/Goal
Nov,14	Finish the rest of testing and fix some bug for the result of project
Dec,14	Show the product for the first stage; make presentation and prepare for the questions that would be asked from committee
Jan,15	Start the second stage of project; make plan for the project and make new assignment for each members
Feb,15	Make survey about selling the product and make a documentation to analysis the marketing potential
Mar,15	Accumulate the response from people who have any idea about the product. The team will analyse how to improve the product to make more people like it
Apr,15	Second survey hand out to people. Members will accumulate all information got from people and do the last round of fixing
May,15	finish the improvement of product and prepare for the committee's questions and make post and presentation

Project Planner

Period Highlight: 0

Plan | Actual | % Complete
Actual (beyond plan) | % Complete (beyond plan)

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Sample holder	1	9	1	8	100%
Sensor fabrication	2	9	1	8	90%
Automatic Control	2	9	1	12	70%
Optical setup	10	4	9	4	50%
Web and Document	1	13	1	13	12/13



LABOR

Wenbing Ma

-Labview program for Tektronix Scope and motorized stage - Optical setup

Jiangxiang Zhang

- Sensor fabrication (Plasmonic sensor and fiber tip sensor) - Sensor fabrication

Xuan Zhang

- Documentation and webpage - Sample holder

Zhikai Cui

- Labview program for Tektronix Scope and motorized stage - Optical setup

Chenyin Liu

- Documentation and webpage - Sample holder

CONTACT INFORMATION

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