Temporally Multiplexed Raman-based Laser System for Spectral Reflectivity Measurements

Group 3

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Sponsors:
United States Air Force Research Laboratory (AFRL) - Munitions Directorate

(UCF & Professors)

2. **Project Description:**

Motivation: Conventional laser detection and ranging (LADAR) devices have significantly improved detection in many areas. However, most LADAR systems operate at a single wavelength because their main purpose is to detect based on distance. This drawback can be resolved by implementing a cascaded Raman laser source, detection can be further improved by spectral reflectivity measurements of objects and scenes.

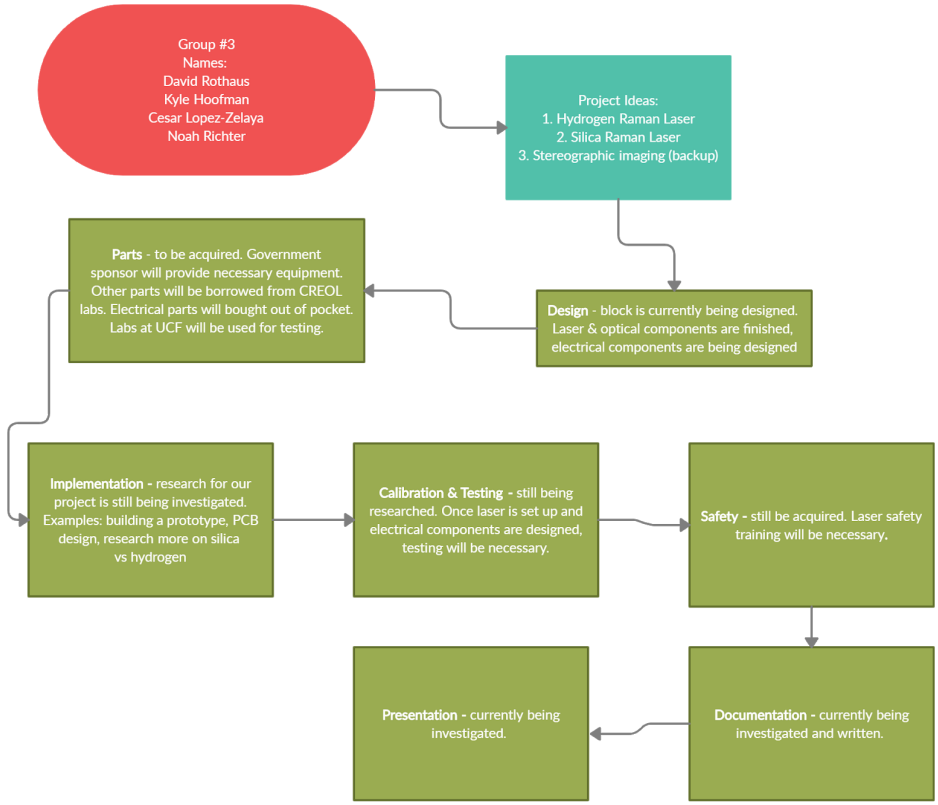
Goals & Objectives: Build a low cost, size, weight, and power (C-SWAP) fiber-based laser system that can operate close to the quantum defect of stimulated Raman scattering (SRS) and can provide spectral reflectivity measurements with the added benefit of measuring range (optional).

3. **List of Requirements:**

Keep it low C-SWAP.

Make it as small as possible, preferably it must fit in an optical breadboard (depending on the breadboard's size).

4. **Project Block Diagram**



5. Project Diagram

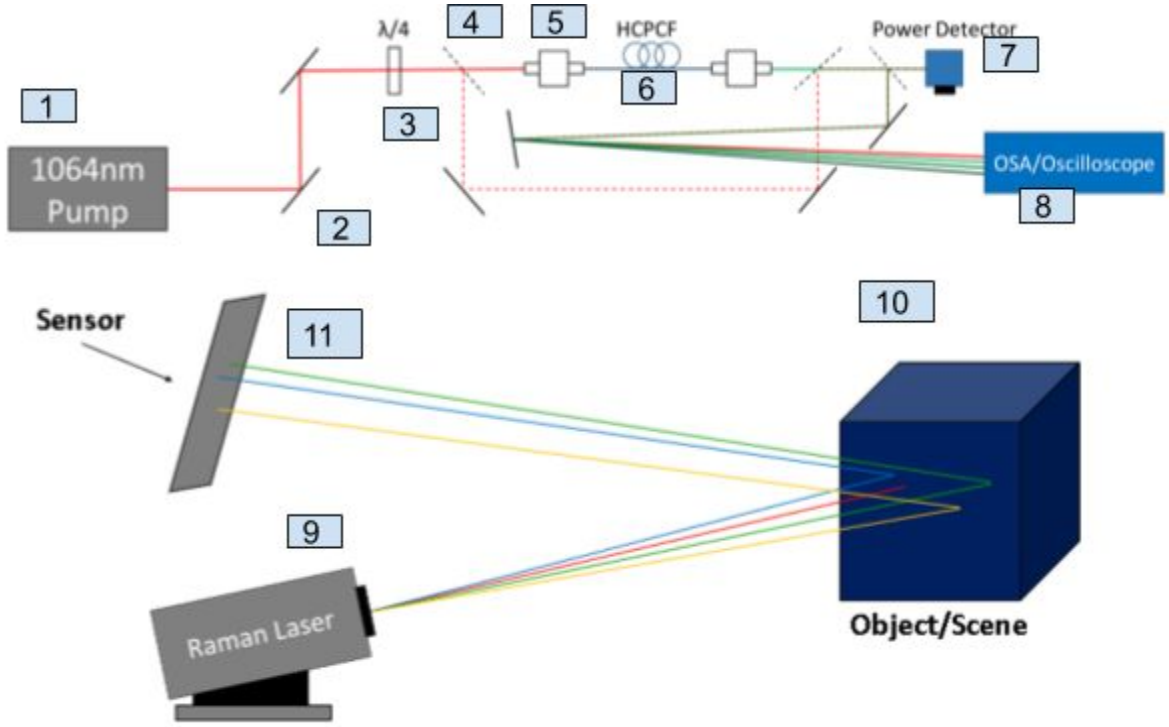


Figure 1-Laser Diagram

1. LM Telesto (with controller)
2. Mirrors
3. Quarter-wave plate & polarizer
4. Beam Splitter
5. Gas cell
6. Hollow-core photonic crystal fiber
7. Power Detector
8. Oscilloscope/Detector

   Note: Silica-based Raman fiber-laser will use regular step-index fiber and will not need gas cells

Figure 2-Big picture device

9. Raman Laser (**figure 1** inside)
10. Object, surface, or scene being scanned
11. Detector/Oscilloscope

5. **Project Budget and financing**

Total Estimated Cost: ≈ $40,000

Cost Breakdown:

Name	Model #	Obtained Via	Cost ($)
LM Telesto		(AFRL)	30,000
Wave-plate and Polarizer		(UCF/AFRL?)	
Grating		(UCF/AFRL?)	
Optical Box		(AFRL?)	
Fast Detectors		(AFRL)	
Fast Oscilloscope		(UCF?)	
Power Detector		(UCF/AFRL?)	
Optical Breadboard		(UCF)	
Electrical Breadboard		(UCF/Personal)	
Optical Mounts and Holders		(UCF?)	
Microscope Objective		(UCF/AFRL?)	
Collimating Lenses		(UCF/AFRL?)	
Mirrors		(UCF?)	
Optical Fiber		(AFRL)	5,000
Windows		(AFRL)	
Gaskets		(AFRL)	
Gas Cells		(AFRL)	
Swagelok Connectors		(AFRL)	
Plumbing		(AFRL)	

Regulator		(AFRL)	
H2		(AFRL)	5,000
Electrical Components		(Personal)	40
Laser Controller		(AFRL/Personal)	15

*All prices are estimates based on standard market prices and are subject to change
** (?) indicates currently searching

6. **Initial Project Milestones**

Fall

1. Idea Finalization
2. Design
3. Project Documentation
4. Acquire parts and Lab space

Spring

1. Build and prototype
2. Test and calibrate
3. Complete documentation
4. Finalize and present project

7. Decision Matrix

Project Idea	Cost	Difficulty	Usefulness	Group Interest
Hydrogen Raman Laser	5	5	5	5

Silica Raman Laser	4	4.5	5	2.5
Stereographic Imaging	1	2.5	3.5	1

Note: 5 best/highest , 1 worst/lowest

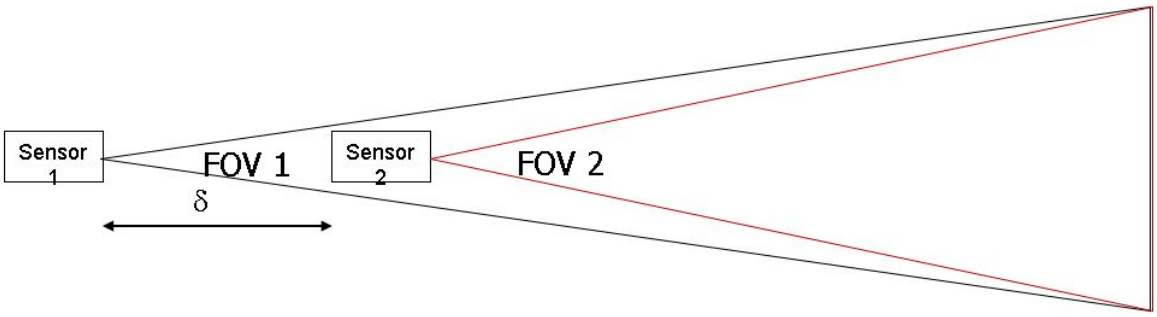
Plan B Project:

3-D Imager Enabled By Range Dependent Natural Processes

Motivation: We propose a simple, low cost 3-D imaging architecture. This takes advantage of the natural ranged dependent processes associated with solar illumination to and from a target and the resulting measured signal recorded at the sensor receiver. We propose to place two active sensors such that they image the same field of view but are displaced by a distance δ. Using a common wavelength in each sensor, the ratio of measured intensities can be used to estimate range for each pixel in the scene.

Cost Estimation: No more than $5000. Most of the cost will be from the cameras.
Sponsor: United States Air Force Research Laboratory (AFRL) - Munitions Directorate

Goals and Objectives: Build a low cost imaging system that will give us an increased knowledge of what is in view of the system's sensors.


Sensor 1
FOV 1
δ
Sensor 2
FOV 2