Internal Mobilization of *in vivo* Glucose Sensing System

Kathryn DiPippo[1,2], Sabbir Liakat[1], Phillip Heucke[1,3], Jessica Doyle[1,4], and Claire Gmachl[1]

[1] Princeton University Department of Electrical Engineering, Princeton, NJ, 08540, USA

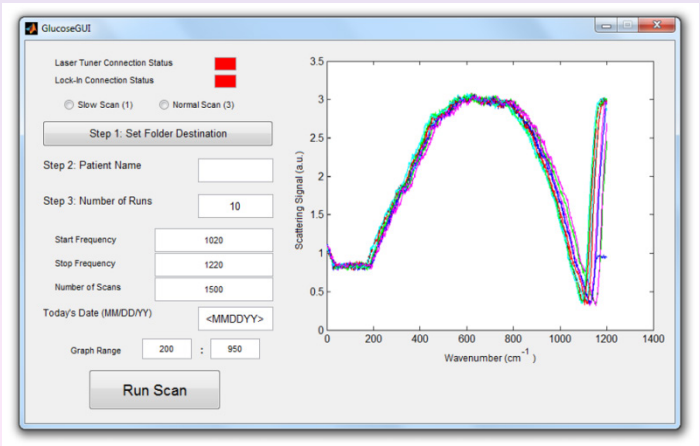
[2] Permanent Address: Rensselaer Polytechnic Institute, Troy, NY, 12180, USA

[3] Permanent Address: Bucknell University, Lewisberg, PA, 17837, USA

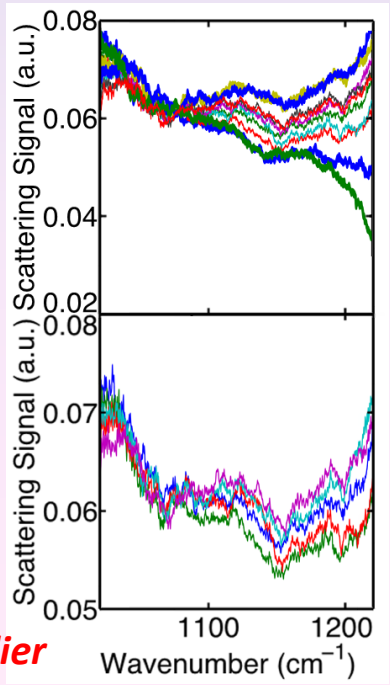
[4] Permanent Address: Hunterdon Central Regional High School, Flemington, NJ, 08822, USA

email: dipippo@princeton.edu / dipipk@rpi.edu

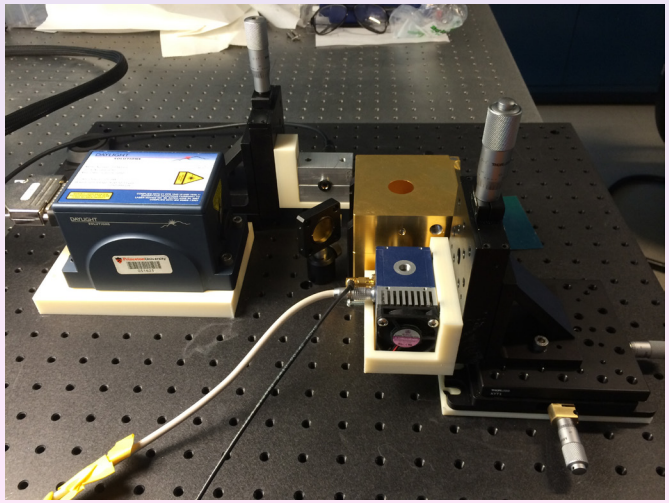
GOAL: Mobilize glucose sensor by…



1) Creating and Optimizing a MatLab GUI

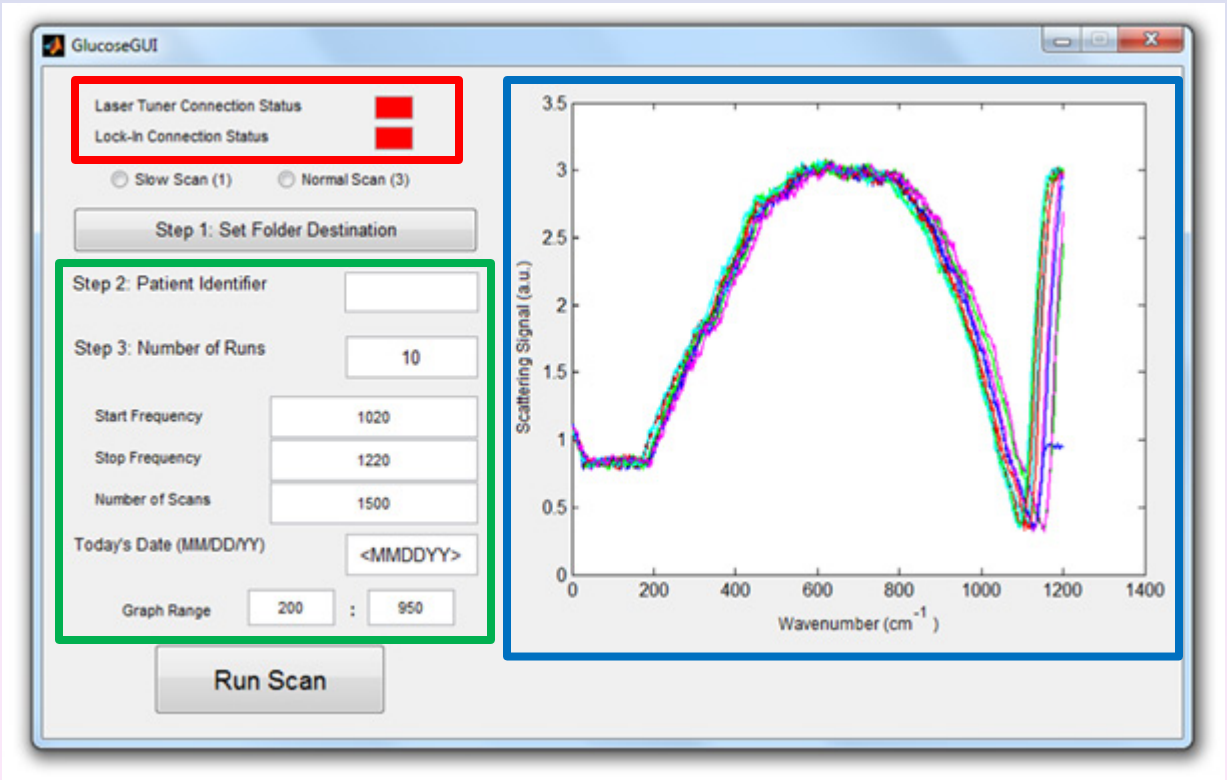


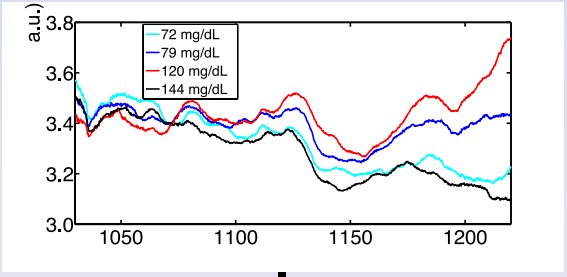
2) Optimizing outlier removal algorithm



1) Reducing the size of the Mid-Infrared Integrating Sphere (mIRIS)

Creation and Optimization of GUI





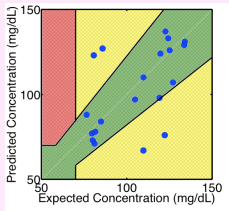
Outlier Removal

Cross-Correlate with Standard

Savitzky-Golay Filtering

Take First Derivative

PLSR



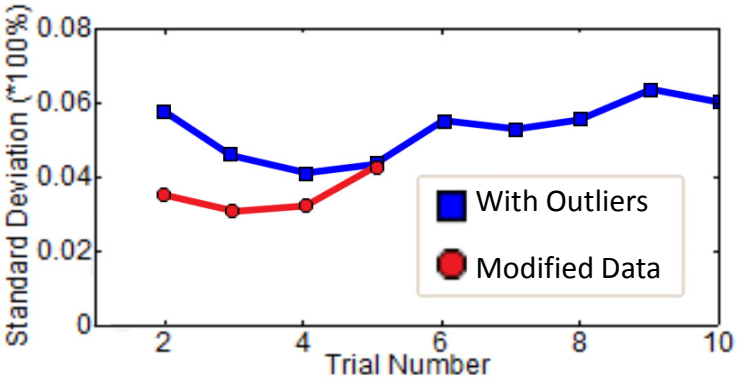
(1) Connection Status Indicators

(2) Easily input variables

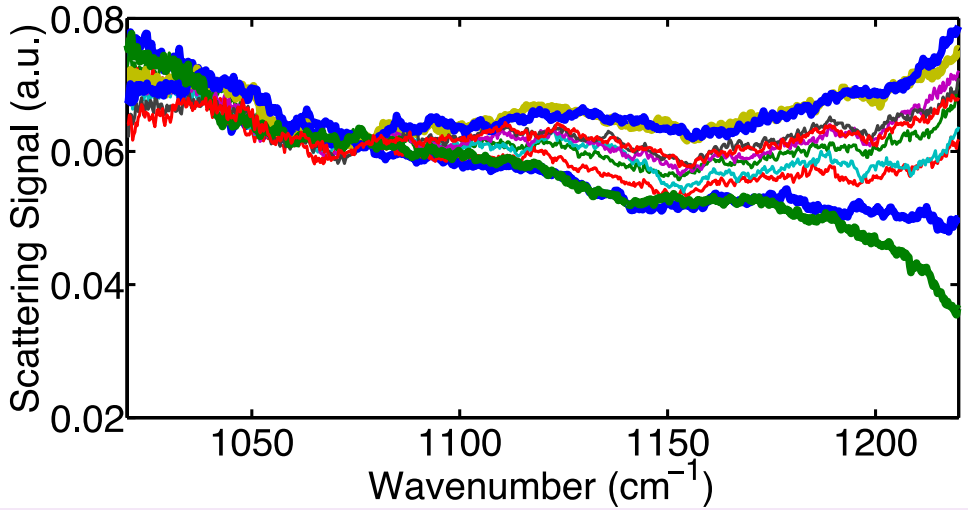
(3) Graphical Display

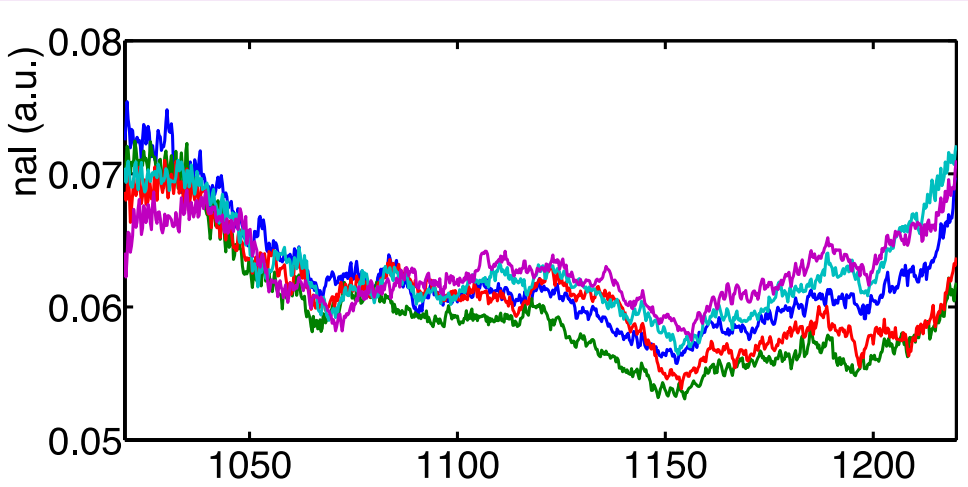
“Real-Time” Outlier Correction

- Previous method and problems
  - Cut-off after largest spike
  - Doesn’t account for early outliers
- Current method and advantages

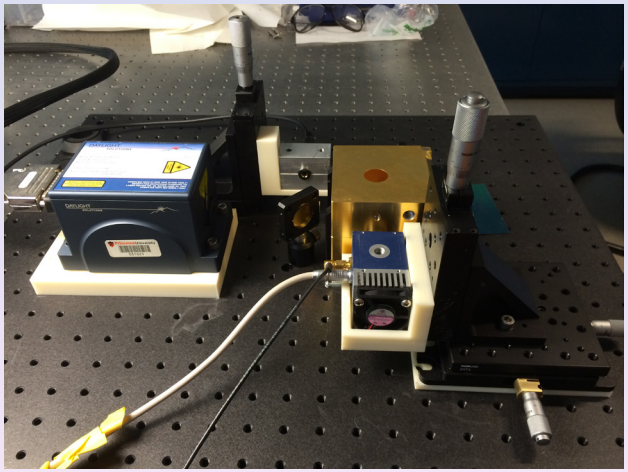


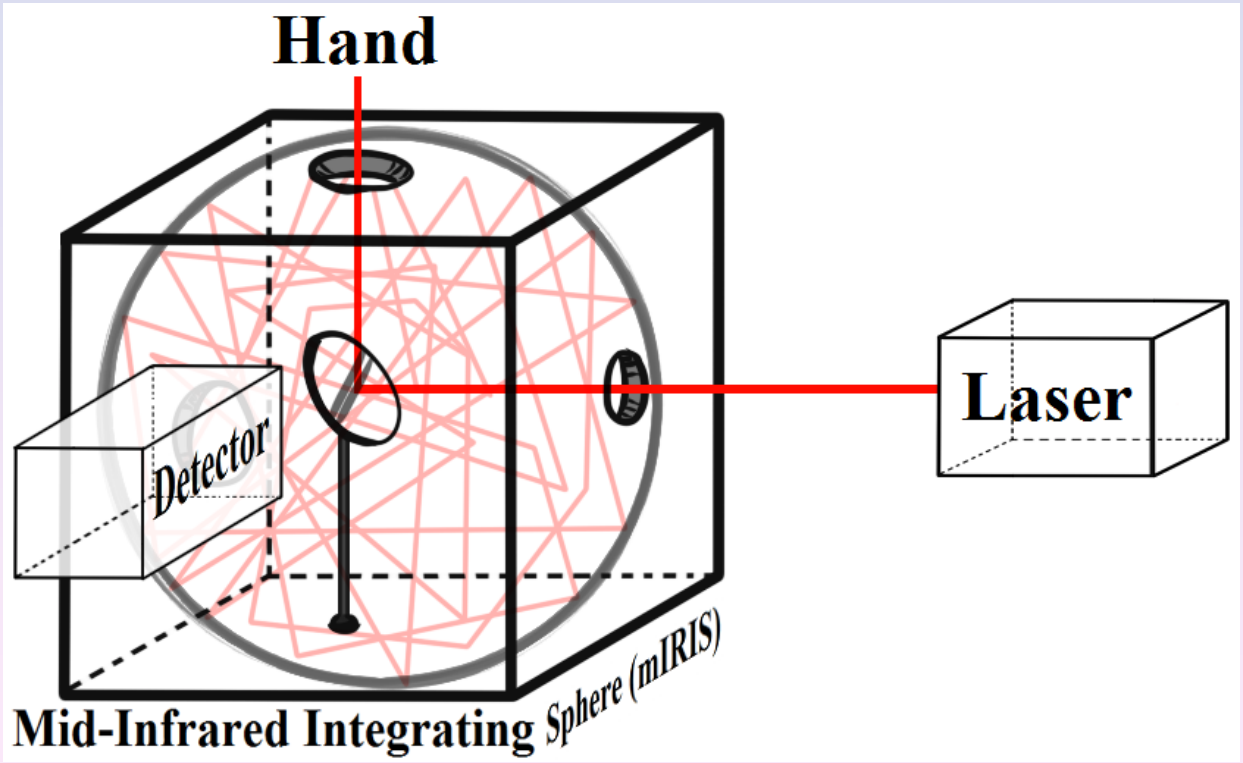
Glucose Absorption Spectra





Optimization of Mid-Infrared Integration Sphere (mIRIS)





Current size:
Cube: 3.27” x 3.27” x 3.25”
Sphere: 3” diameter
Holes: 2.0 cm diameter

Device Aperture Sizes:
Hand: 1.0mm diameter
Laser: 1.2mm diameter
Detector: 0.50mm x 0.50mm

New Prospective Size:
Cube: 8.3mm^3
Sphere: 7.6mm diameter
Holes: 2.0mm diameter

Internal Mobilization of *in vivo* Glucose Sensing System

K.R. DiPippo[1,2], S. [illegible][1] P. Kleunker[1] J. Dowell[1] and C.M. Gmachl[1]

1 – Princeton University Department of Electrical Engineering, Princeton, NJ, 08544, USA
2 – Permanent Address: Rensselaer Polytechnic Institute, Hartford, Lewisberry, PA, 17339, USA
Industry / Practitioner Collaborators: Daylight Solutions, Inc. | Central Regional High School, Flemington, NJ, 08822, USA
email: dipppo@princeton.edu / dipppo@rpi.edu

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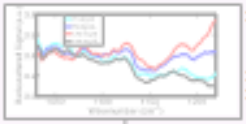
Introduction

- Nearly 10% of the US population is forced to monitor their blood glucose
- Current method is to painfully finger prick several times a day
- Goal is to provide [illegible] non-invasive laser de[illegible]
- Future goal is to [illegible] of a smartphone

System Setu[illegible]



- Current procedure: laser enters mIRIS, bounces off hand on top hole, and reflects outward against main detector
- Calculation takes ~3 min
- Main detector reads in Glucose Absorption Spectra (see figure to left)

Outlier Removal

6) Cross-Correlate with Standard

- Following statistical analyses on data (listed left) to produce glucose level reading (below)

Mid-Infrared Integrating Sphere (mIRIS)

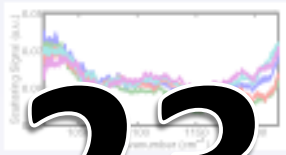
Current size:
Cube: 3.27" x 3.27" x 3.25"
Sphere: 3" diameter
Holes: 2.0 cm diameter

Device Aperture Sizes:
Laser: [illegible]mm diameter
Detector: 0.50mm x 0.50mm

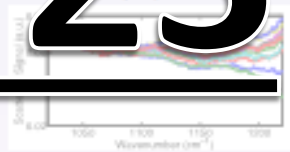
New Prospective Size:
Cube: 8.3mm³
Sphere: 1.6mm diameter
Holes: 2.0mm diameter

- around until the detector reads absorption spectra.
- The holes in the provided mIRIS are bigger than needed
- The larger top hole interferes with the reading since some of the laser gets reabsorbed by the hand rather than bounce against the walls
- By reducing the size of the sphere until the holes are the minimum size they can be, the sphere will become 10% of its original size.

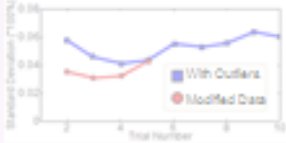
Outlier Removal Algorithm



- Original spectra [illegible] scans with[illegible] (bold) before [illegible]m



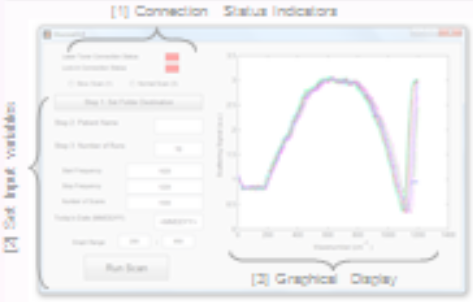
- Depiction of 5 most consistent spectra after algorithm



- Standard deviations of the data per each trial with and without outliers

Flowchart for the new shifting algorithm that removes outliers by leaving only the five most consistent spectra are left in order to make the average std. dev. decrease from 0.090 to 0.032, a <7% increase in accuracy

Graphical User Interface (GUI)



- [1] The red dialog boxes change to green once the GUI detects that they are connected via USB
- [2] Top radio buttons determine whether reference scan or normal scans are being recorded
- Edit buttons allow for easy manipulation of data ranges and iterations
- [3] Current display depicts raw graphical output prior to cropping and statistical analyses

Future Work

- Incorporate statistical analyses into GUI algorithm
- Produce a physical version of the modified mIRIS
- Reduce the sizes of the laser and detectors along with the mIRIS

We w[illegible]e to acknowledge the Wendy [illegible] Eric Schmidt Foundation for financial support.

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