

Internal Optimization and Increase of Usability of *in vivo* Glucose Sensing System

Kathryn DiPippo^{1,2}, Alex Werthe¹, Michelle Zhang^{1,3}, Phillip Heucke^{1,4}, Jessica Doyle^{1,5}, and Claire Gmachl¹

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

² Permanent Address: Smith College, Northampton, MA, 01063, USA

³ Permanent Address: Rensselaer Polytechnic Institute, Troy, NY, 12180, USA

⁴ Permanent Address: Bucknell University, Lewisburg, PA, 17837, USA

⁵ Permanent Address: Hunterdon Central Regional High School, Flemington, NJ, 08822, USA

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

Diabetes afflicts nearly 9.3% of the entire United States population and “remains the 7th leading cause of death in the United States”, according to 2014 statistics [1]. Those who have the disease must monitor their blood glucose levels to ensure they stay healthy and administer insulin if needed. We seek to enhance our Quantum Cascade Laser (QCL) based noninvasive glucose sensor to provide an alternative to obtaining direct blood samples multiple times per day to measure glucose levels. This system has been proven effective to predict glucose concentrations in healthy human subjects [2], but further research using new test samples and data analysis algorithms will continue to improve it. While transforming the system to be more mobile in handheld cases, software enhancement of the mid-infrared (mid-IR) QCL-based non-invasive *in vivo* glucose sensor both promoted sensor mobility, improved prediction accuracy, and aided with ease of future use.

A new graphical user interface allows for non-specialized clinicians to be able to use the equipment without extensive knowledge of the program’s code and the requirement to run separate modules multiple times. The prior MatLab code existed for a few years and was used for other prior Lock-In devices. Rewriting the code in Python 1) forced us to understand what was going on 2) gave us the opportunity to comment everything again for future use. The GUI itself was designed to feature two different modes: one for use with clinical trials and one for use in the lab. The Clinical trials version was much more simplified and stored data for later analysis regarding the patient. The Solution version allowed for more variable manipulation, rather than needing to go into the code to alter values. Michelle Zhang designed and implemented a real-time analysis calculation code, which once completed was integrated into the GUI code as well. This work is supported in part by MIRTHE (NSF-ERC).

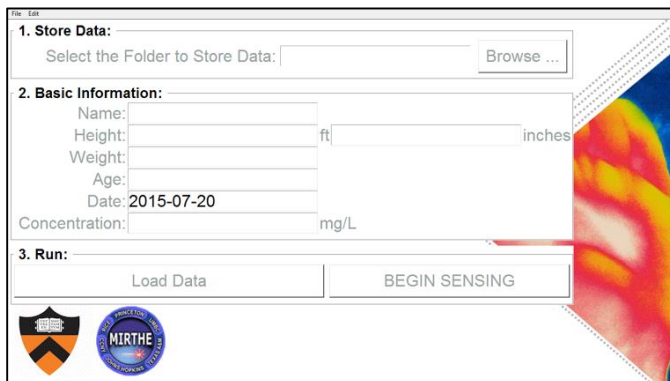


Figure a) Display of GUI when simplified for clinical trials.

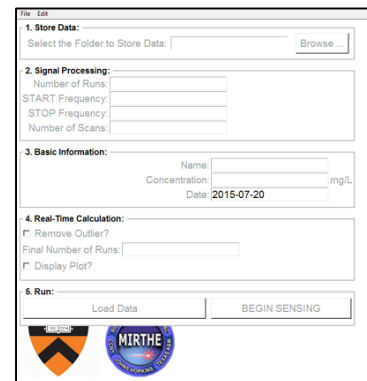


Figure b) More complex inputs allowed for solution testing in the lab.

[1] American Diabetes Association, www.diabetes.org/diabetes-basics/statistics/

[2] S. Liakat et al, “Mid-Infrared noninvasive *in vivo* glucose detection in healthy human subjects”, CLEO 2014, June 2014, San Jose, CA.