Summer Undergraduate Research Program

2025 Final Poster
Lab Consent to Publish Form

SURP Participant's Name (printed):_____Vishal Dandamudi__________

SURP Participant's signature: ______Vishal Dandamudi_____________Date: ___8/18/25_____

SURP Participant's Name (printed):____Kion Manesh__________

SURP Participant's signature: _______Kion Manesh______________Date: ___8/18/25_____

SURP students signed an acceptance contract agreeing to the following:

Both SURP and HSSEAS faculty view publication and dissemination of research as primary goals. However, I agree and understand I must get written permission from the faculty advisor before publishing the research in any form (on social media, submit as a writing sample to graduate school, scientific poster, undergraduate research conference, graduate school applications, or to research competitions).

In accordance with this policy students must show their Faculty Advisor or delegated Daily Lab Supervisor the Final Poster that will be published in the 2025 Summer Undergraduate Research Journal at the end of fall quarter 2025.

Please paste a copy of the Final Poster in the space provided below.

UCLA Samueli School of Engineering

SUMMER UNDERGRADUATE RESEARCH PROGRAM

Non-Contact Vital Sensing: Investigating Biomedical Capabilities of Silicon Terahertz Technologies

Vishal Dandamudi*, Kion Manesh*, Benyamin Fallahi Motlagh, Aydin Babakhani

Integrated Sensors Laboratory, Department of Electrical and Computer Engineering

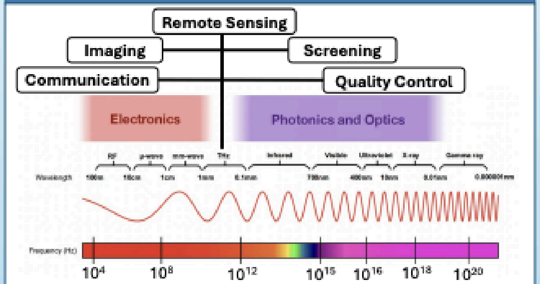
University of California, Los Angeles

* Equal-contributing SURP partners

FAST TRACK TO SUCCESS

UCLA Electrical and Computer Engineering

Introduction and Background



- Terahertz (THz) technology enables non-contact vital sign monitoring
- THz offers superior resolution & penetration through opaque materials compared to conventional methods
- Silicon THz is far cheaper & consumes less power because of extremely mature silicon technology
- **Objective:** Demonstrate the viability of the silicon THz technology for biomedical applications

Materials & Methods

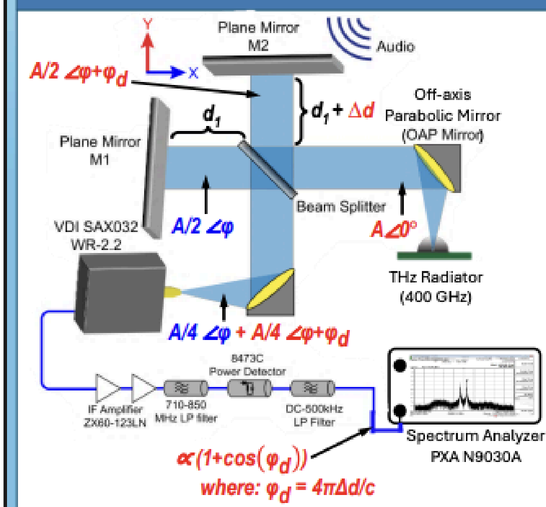


Fig. 1: Diagram of interferometry setup. THz signal is reflected off two plane mirrors and recombined to create the interference pattern, then filtered before being analyzed on the spectrum analyzer [1].

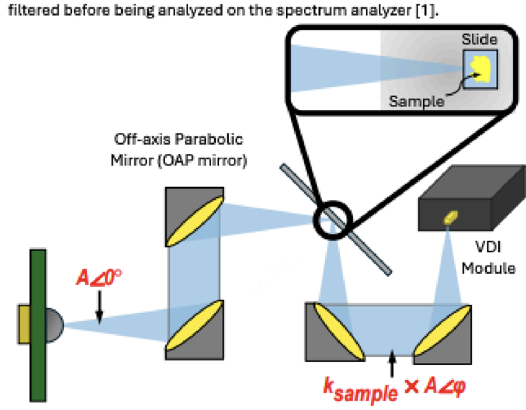


Fig. 2: Diagram of setup for biosample identification (reflectometry). A focused beam, operating at multiple frequencies around 400 GHz, illuminates the aqueous sample held within a stack of five slides. The reflected power is measured by the VDI module.

Vibration/Heartbeat Sensing (Vibrometry)

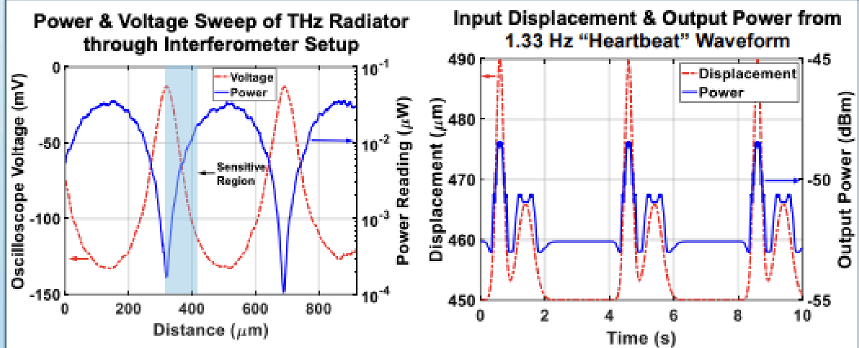


Fig. 3: (left) Behavior of measured power & voltage due to mirror displacement. (right) Time-domain power waveform of 1.33 Hz pulsed heartbeat signal recovered compared to input signal; the mirror to be vibrated was placed in the sensitive region.

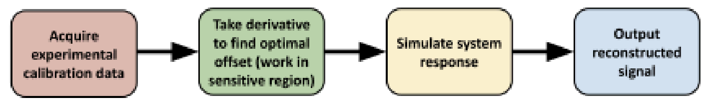


Fig. 4: Workflow of Simulation Using Experimental Calibration Curve Data

Material/Concentration Determination (Reflectometry)

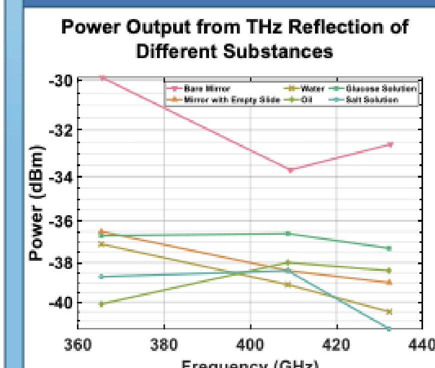


Fig. 5: Reflected power measurements from various substances measured at three frequencies. The system detects differences in power level allowing clear differentiation between some substances (especially at 432 GHz).

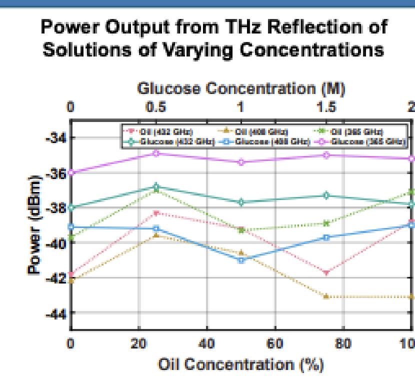


Fig. 6: Reflected power measurements for oil and glucose solutions. The system detects changes in oil concentration with a highly correlated pattern of peaks and troughs. For glucose, it identifies a unique absorption dip at 1M.

Conclusions & Future Work

- Demonstrated viability of THz band for vibration sensing at micrometer scale
- Successfully isolated concentrations of 1M glucose in solution
- Data for consistent concentration detection was inconclusive but spectral footprints seem promising
- **Challenges:** Beam alignment required high precision, weak signal, phase noise of free-running systems
- **Suggestions:** increase chip power, use of coherent (phase-locked) sources
- **Future Work:** in vitro and in vivo testing of vibration sensing and biosample identification

Acknowledgements

We would like to thank Professor Babakhani and the Integrated Sensors Laboratory for their support. Special thanks to Benyamin Fallahi Motlagh for his extensive guidance and mentorship. We also acknowledge the SURP team and NSF for making this research possible.

References

[1] S. Razavian, S. Thomas, M. Hosseini and A. Babakhani, "Micro-Doppler Detection and Vibration Sensing Using Silicon-Based THz Radiators," in IEEE Sensors Journal, vol. 22, no. 14, pp. 14091-14101, 15 July15, 2022, doi: 10.1109/JSEN.2022.3183002.

For Faculty or Designated Daily Lab Supervisor

I have read and approved the above named Final Poster to be published in the 2025 Summer Undergraduate Research Journal. I understand this 2025 Summer Undergraduate Research Journal will also be published on the public facing SURP website.

Keep a copy of this consent form and poster for your lab records. SURP students must upload the completed

consent form with their Final Poster by the designated deadline. DEADLINE is Monday, August 18, 2025 by 6pm.

~~Faculty Advisor's name (printed):~~ ______________________________

~~Faculty Department:~~ ______________________________

~~Faculty Advisor's signature:~~ ______________________________ ~~Date:~~ ____________

Faculty Advisor delegates the Daily Lab Supervisor to approve and authorize the publishing of the final Poster.

Daily Lab Supervisor's name (printed): _**Benyamin Fallahi Motlagh**_______

Daily Lab Supervisor's signature: BENYAMIN FALLAHI MOTLAGH Date: __8/18/25_____

Student Instructions:

1. Upload the signed version of this form to the SURP website by August 18th at 6pm

2. Bring the hard copy of the signed version of this form to Poster Workshop #4 on 8/18 to turn into your facilitator