UCLA Samueli School of Engineering

SUMMER UNDERGRADUATE RESEARCH PROGRAM

THz Sensors for Vital Sign Monitoring

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Introduction

- Terahertz (THz) technology enables non-contact, high-resolution vital sign monitoring by detecting sub-micrometer vibrations.
- This project uses a THz interferometry setup, which converts phase information from reflected beams into amplitude modulation for precise vibration sensing.
- Compared to RF and optical systems, THz offers superior resolution, lower power consumption, and penetration through optically opaque materials (e.g., clothing, plastic).
- The system incorporates a custom Continuous Wave (CW) THz radiator chip and is resilient to phase noise when beam correlation is maintained over short path differences [1].
- The approach aims to demonstrate the viability of THz interferometry for accurate, non-invasive health monitoring.

Materials & Methods

- THz waves from a Continuous Wave (CW) radiator chip were collimated using an Off-Axis Parabolic (OAP) mirror.
- A beam splitter divided the collimated beam into two paths:
- One directed to a stationary mirror (M1) as the reference arm
- The other to a vibrating mirror (M2), actuated mechanically
- Reflected beams were recombined and focused onto a VDI SAX receiver module.
- Interference between the beams converted phase modulation (from M2) into an amplitude-modulated signal.
- The intermediate frequency (IF) signal was amplified using low-noise baseband amplifiers.
- A power detector measured signal intensity, with output voltage captured by an oscilloscope.
- M2 was positioned in a “sensitive region” where small displacements produced maximal voltage response.

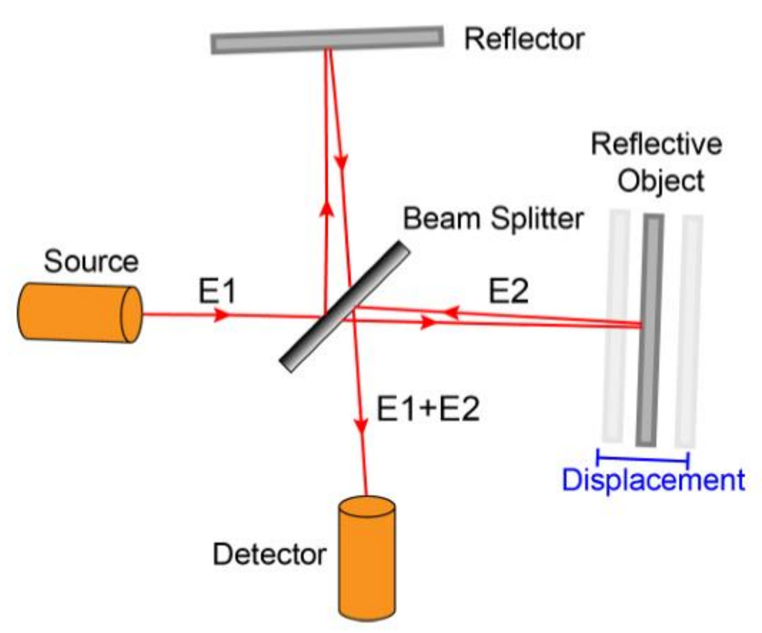

Fig. 1: Diagram of the basics of the interferometry setup

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