Conquering the Sensor-Tissue Contact
-- for A Breast Cancer Detector

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Distinguishing Two Projects

• His Project
  – Navigation
  – Improving the Circuit

• My Project
  – Stabilized detection
  – Mechanical Aspect

• Common Goal
  – Detect the cancerous tumors non-invasively
Big Picture

• Primary goal of the group
  – Use NIR light as a source to non-invasively monitor angiogenesis with diffuse spectroscopic techniques.

• Challenges addressed under this project
  – Optode-tissue coupling
  – Pressure equalization throughout the surface of interest
Alignment

• Foam
  – Tilt the detectors to fit the contours of the breast

• Rigid Plate
  – Equalization
Materials Used

• Foam
  – Poron Quick Recovery Polyurethane Foam
    • Instant recovery
    • Compliance: 1-5psi

• Force sensor (same as before)

• Backing Plate
  – Delrin

• Photodiode
  – 9.7mm * 9.7mm VS 2.3mm*2.3mm active area
  – Higher SN ratio than the previous
My Probe

- Backing Plate
- Force Sensor
- Foam
- Photodiode
Sensor Circuitry

- Differential Circuit

R_f = 1M Ohm
R_i = 40K Ohm
Gain ~ 20X
Diode Circuitry

Current → Voltage → Amplify

Diode Circuitry block diagram:
- U1 (OP37)
- C1 (8pF)
- R1 (1meg)
- D1
- R1
- C1
- 0

Connections:
- 0 to ground
- 1 to OUT of U1
- 2 to D1
- 3 to U1
- 4 to OUT of U1
- 5 to OS2
- 6 to OS1
Experimental Setup

- Labtop for display
- Control Box
- Probe
- Sand Bags
- Phantom
- Output voltage
- Circuit Board

[Image of the experimental setup with labeled components]
Experimental Results

Comparison of two force sensors

![Graph showing comparison of two force sensors with mass (g) on the x-axis and output (mV) on the y-axis. The graph includes data points for FS1 and FS2, with linear fits for each.](image-url)
More Results

Abdominal Test

- Voltage (mV) vs. Mass (g)
- Mass ranges from 0 to 600 g
- Voltage ranges from 0 to 2500 mV
- Trends for FS1 and FS2
- Different wavelengths: 730nm, 805nm, 850nm
- Linear relationships for FS1 and FS2
Closer Look at the Signal Output

![Graph showing signal output from a photodiode.]

- Signal From the photodiode
- Voltage Output (mV): 1200, 1250, 1300, 1350, 1400, 1450, 1500, 1550, 1600
- Points: 1 68 135 202 269 336 403 470 537 604 671 738 805 872 939 1006 1073 1140 1207
- Wavelengths: 805nm, 850nm, 730nm
- Markers: 100g at various points on the graph.
Improvements Made

• Change the point-contact from skin to plate
• Permit localized articulation
  – Elasticity of Foam
• Allow equalization with the aid of a rigid backing plate
In The Future...

• Future Work
  – Complete fabrication
  – Circuitries

• Recommendations
  – Minimize Friction
  – Use an improved differential amplifier
  – Packaging (more presentable to patients)