Optimized Methods of Cancer Detection via Optical Imaging with the Redox Scanner

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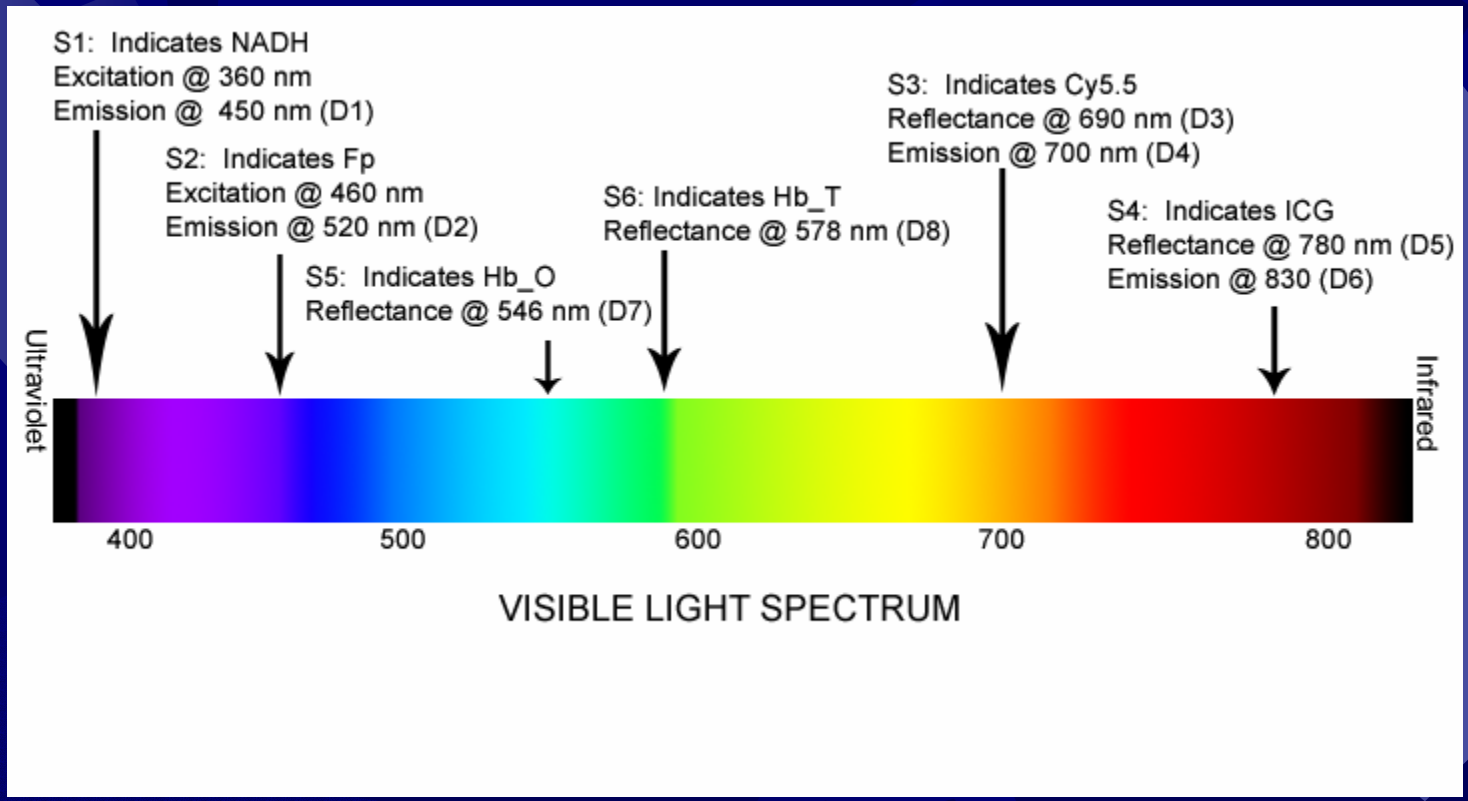
Goals

- To provide 3-D high resolution images of six signals in tissue using NIR, near-UV, and visible light
- Will initially use the redox scanner to diagnose cancer in animal models, later as a biopsy tool for human patients

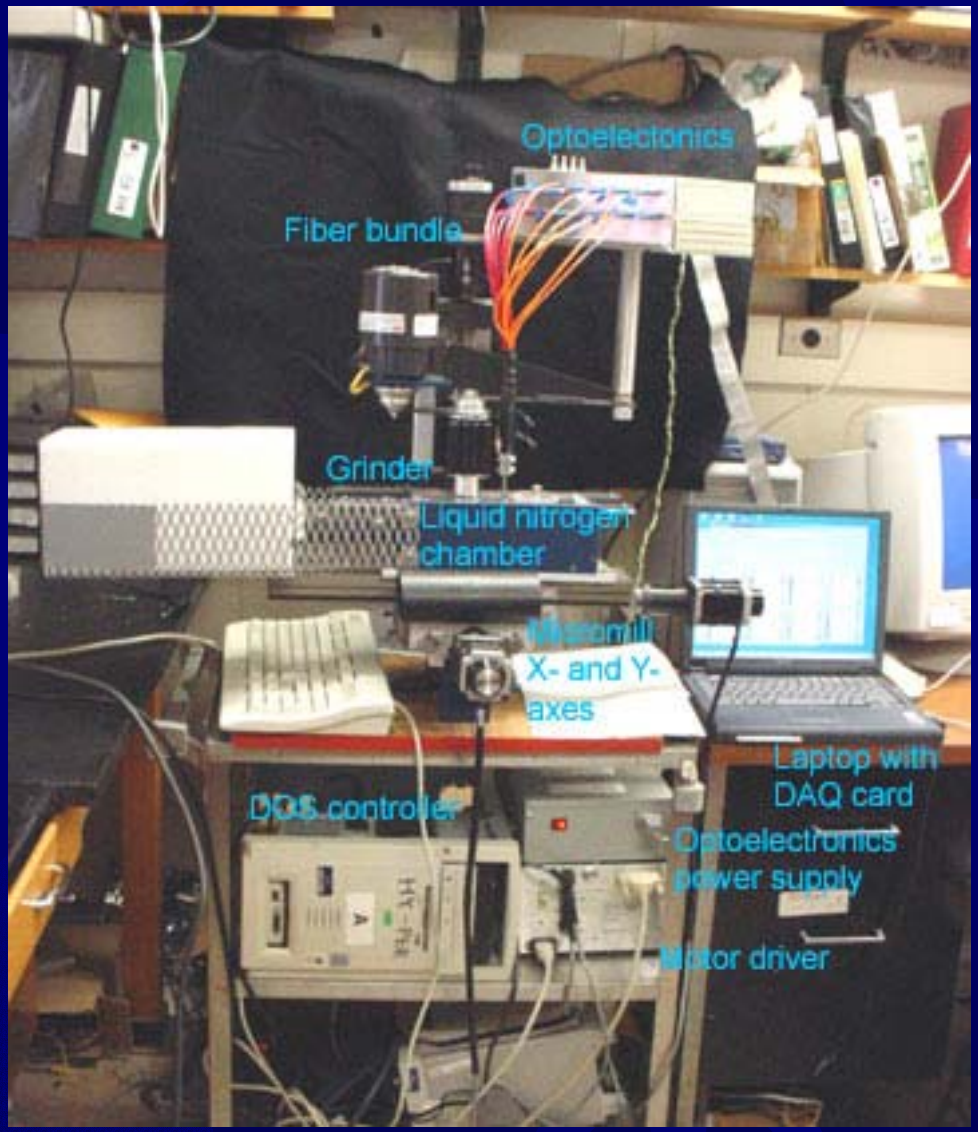
Is There a Need for a Redox Scanner?

- Current imaging techniques (MRI, ultrasound, x-ray) provide little information on the functionality of tissue
- 10% or 20,000 patients with breast cancer go undiagnosed per year
- NIRS, fluorescent spectroscopy can be combined with extant scanning methods
- Need a “gold standard” of chemicals that designate cancer
- Do we need a redox scanner?—Yes!

Chemicals Reflect/Fluoresce Specific Wavelengths

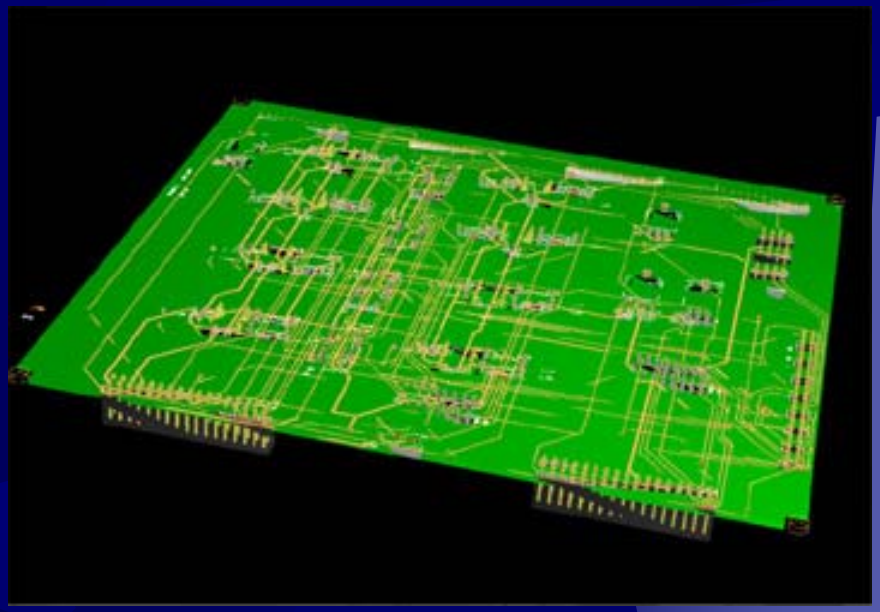


Scanner Components

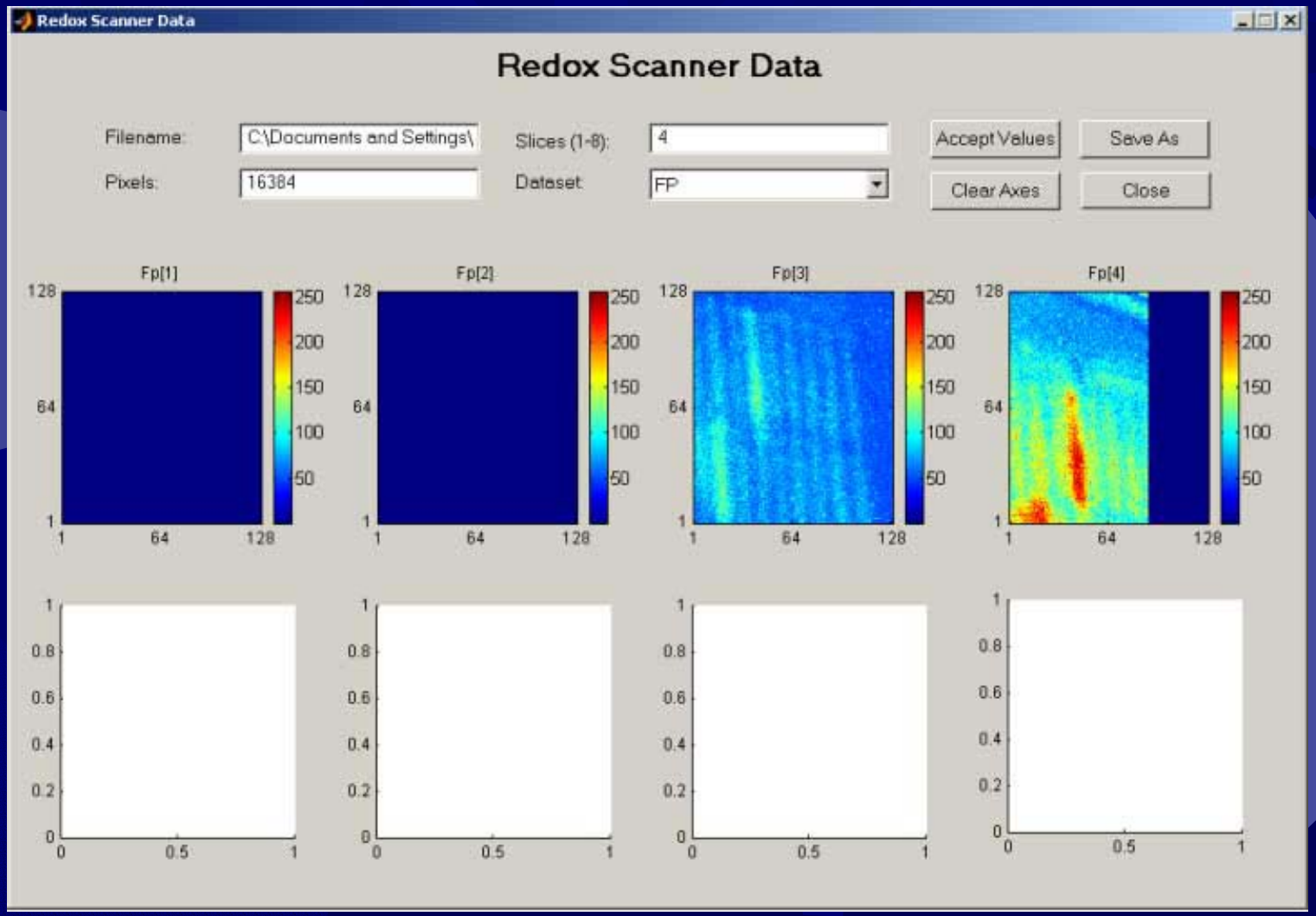


New PCB

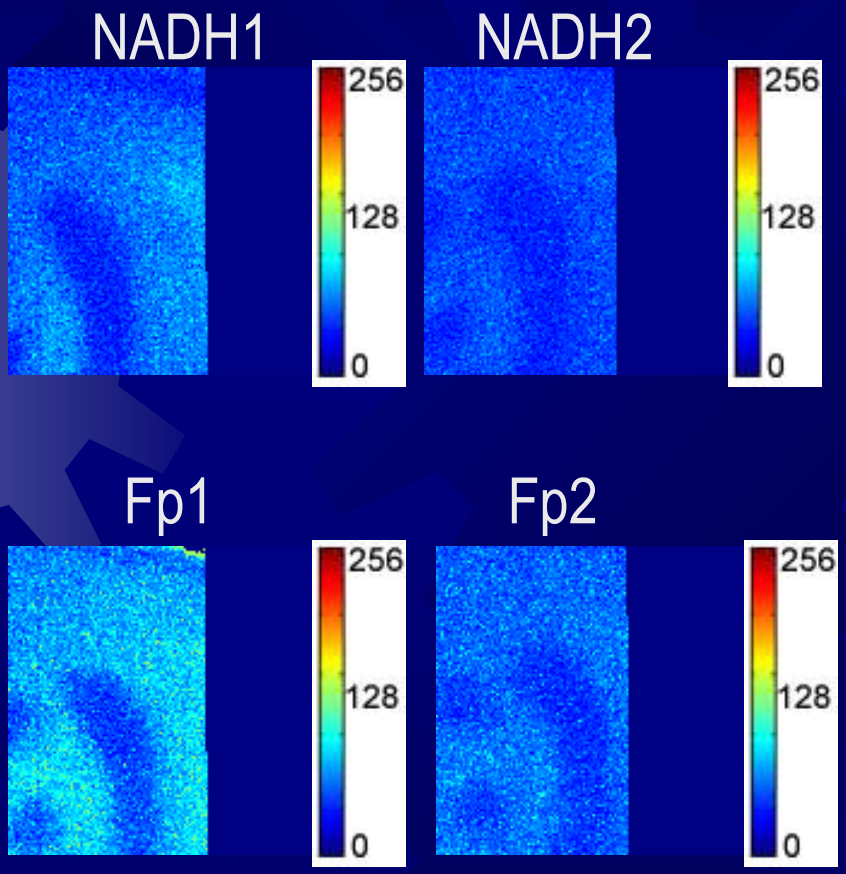
- Original PCB design copied from similar-not same-system architecture
- Extraneous sample and hold causes problems
- New design developed, manufactured, implemented



MATLAB “Redox.m”



High Signal Attenuation/Noise

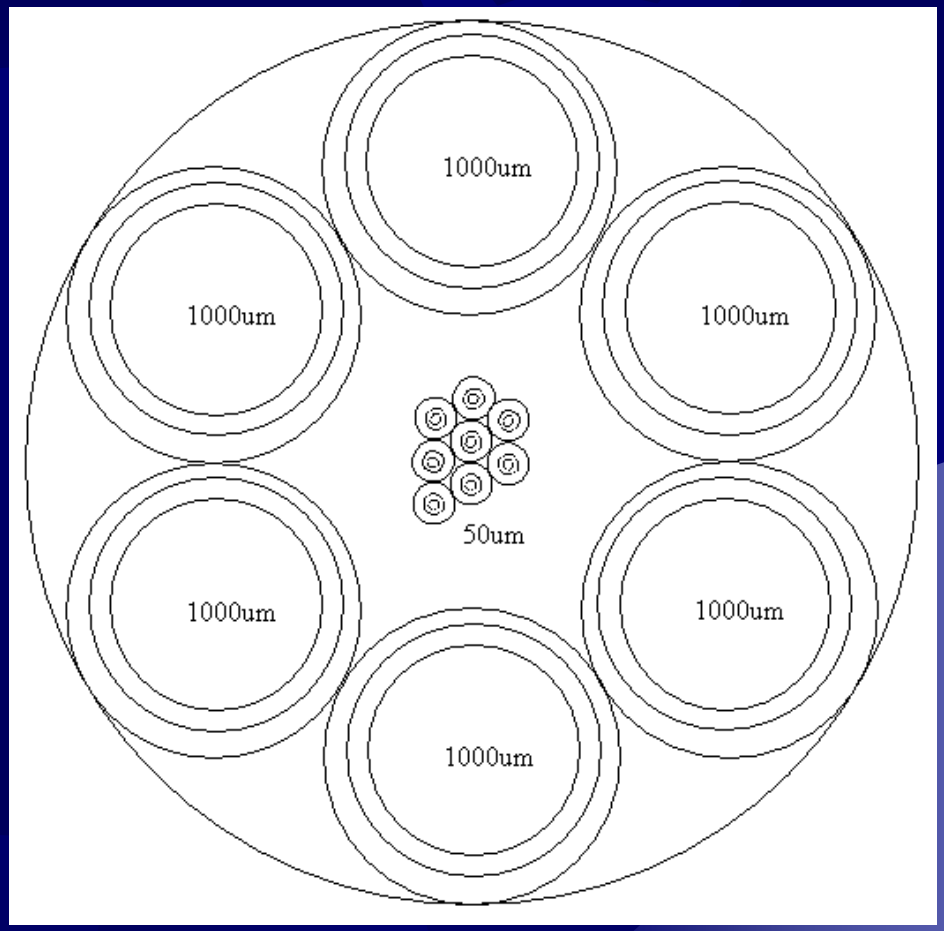


- Standard-smiley face drawn on bright white paper with black marker
- Obseved pixellation and low signal to noise ratio (white paper should show reflectance signal in red)
- Hypothesis wrong: S2 better than S1--probably not correct
- More calibration needed before able to compare different sources
- Source / detector optics not optimal

Initial test results of S1 & S2 indicate low signal-to-noise ratio

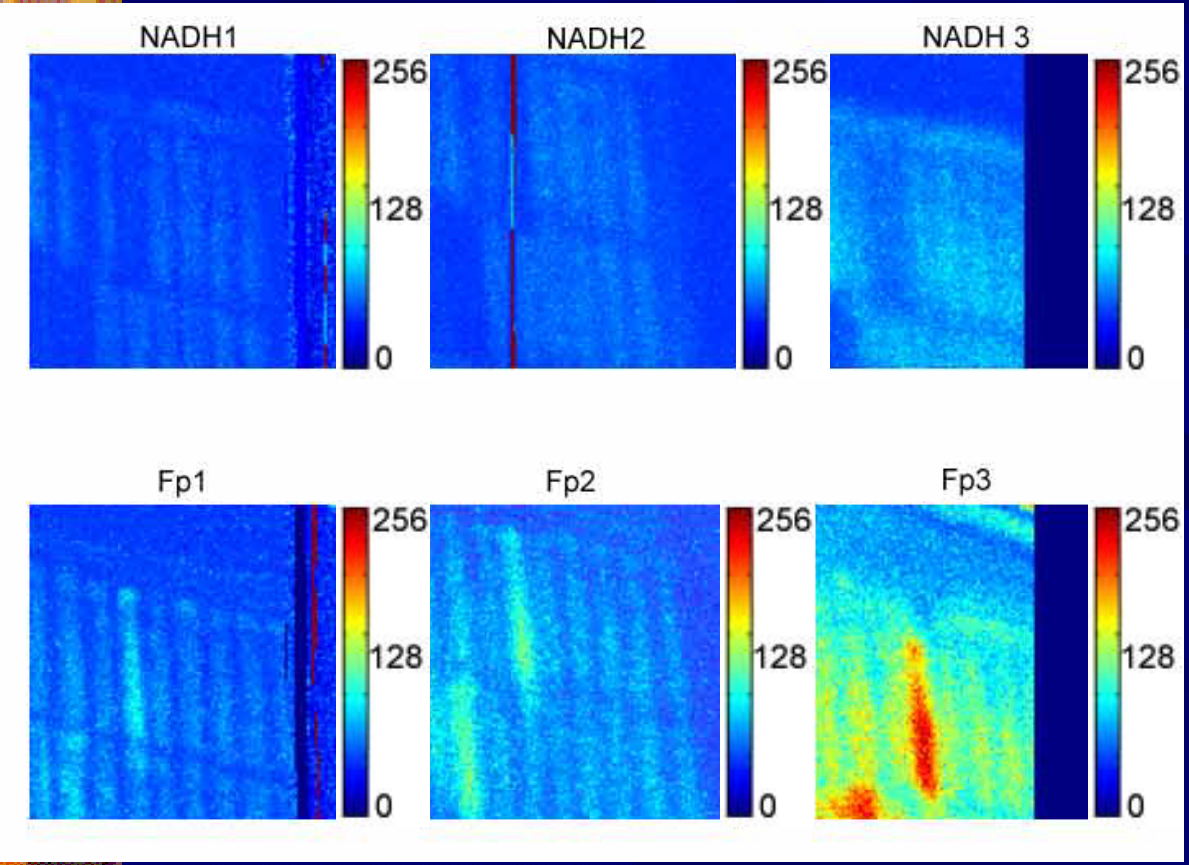
System Optics

- Source/detector pairs must be close
- Fiber tip must be close to sample surface
- Actual geometry not optimal
- Two sources transmit well, two poorly
- Scanned areas overlap but not same



Ideal fiber coupling design shown above would allow maximum transmission of light

Windows Timing Delay



- Standard-grid in black ink on white paper with yellow highlighter
- Data shifted down during each scan to right

Test results indicate the images are displayed incorrectly, caused by Windows timing inconsistencies

Recommendations

- Optics recoupled/tips ground
  - Increase signal-to-noise
- Picture quality increased
  - More samples/pixel
- Visual C++ debugged
  - Sample grind 80 um
  - Unipolar/Bipolar issue
- Calibration of light and fiber tip

Conclusions

- Project has progressed from low functionality to near completion
- System still requires work
- Critical Windows timing error fixed
- End of development phase in sight