Remote Cognosensors: Developing an NIR Imaging Model to Map Brain Function

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Introduction

Goal: Develop an untethered system for detection of oxygenation and blood volume levels in the pre-frontal cortex.

- Use oxygenation and blood volume information to tell us about subject behavior
- Why untethered? Eliminates nervousness and misleading signals
Experimental Setup

- Basic Principle: Convert photons from laser into an electrical signal
- Processing of signal is based on TCSPC (Time Correlated Single Photon Counting)
- Develop processing system to determine absorption coefficient ($\mu_a$)
Standard Single Photon Counting System

- One source / One detector model at the moment
- Solved problem of trigger signal not being accepted by SPC board
- Some concern with grounding issues with the Hamamatsu R5600U PMT
SPC Experimental Setup

- Laser Frequency varied from 15 MHz to 40 MHz
- Attenuators used are identical (anywhere from 1 dB to over 40 dB attenuation)
- Amplifiers used not identical
SPC Experimental Results 1

- Trials done with PMT/Subject distance at 60 cm
- Trial 3 done with subject position altered to increase reflection
Remote Trial Demonstrating Separation of Specular and Photon Migration

- Possible separation of reflection and diffuse photon signals?
- Possible artifact from PMT.

SPC Experimental Results 2
Initial Box Car Results

- Response from 1-gated integrator and pulse generator.
- Voltage decreased as frequency of input increased.
- Pulse stretching increased as frequency of input increased.
What’s Next?

• Continue development of Box Car system – make sure data can be acquired
• Continue testing at longer distances to collect more data for SPC method
• Move system to new laser source/detector location to verify results
Conclusions

• Important that subject is completely untethered
• Use $\mu_a$ to give information about subject behavior (via oxygenation and blood volume)
• Eventually want to develop multi-channel source/detector system