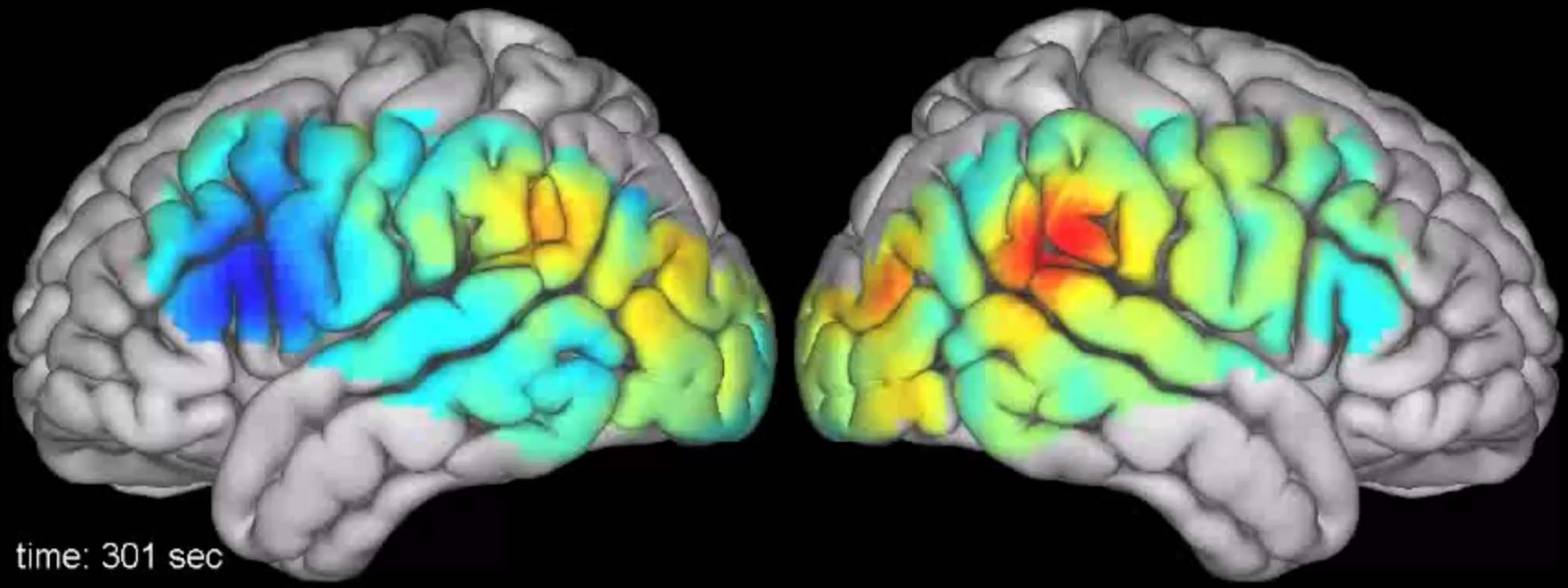
Wearable Optical Brain Imaging (WOBI)

Optics of Blushing Brains

Neurons fire →Stimulates local blood flow →Brain blushes

Red = blood oxygenation increasing

Blue = blood oxygenation decreasing



Towards an fMRI surrogate free of the scanner

fMRI

fDOT

Motivations for Optical Neuroimaging

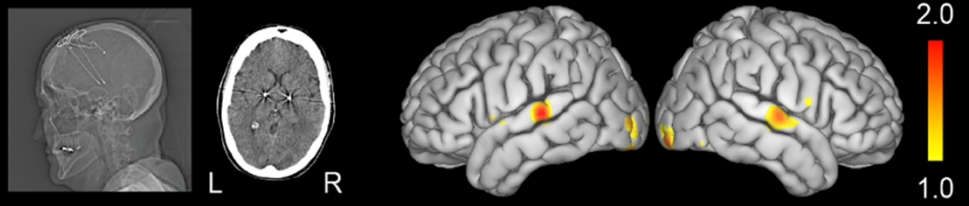
Can we detect ischemia?

Can we predict outcome of cooling therapy?

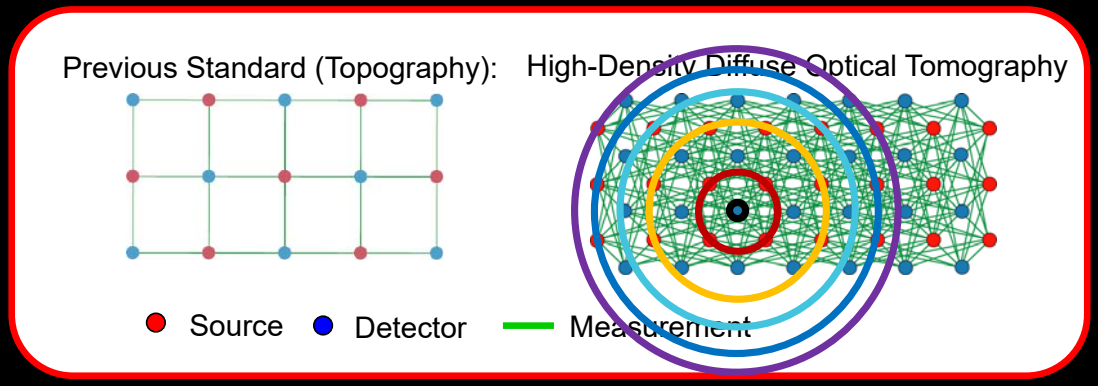
Can we quantify cognitive function?

Can we inform therapy of visual function disorders?

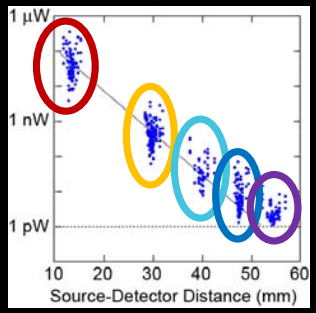
Can we monitor the effects of deep brain stimulation in Parkinson's?

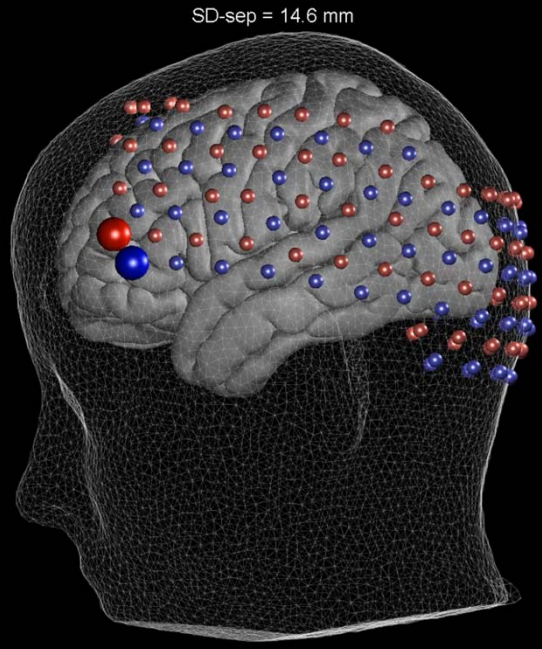


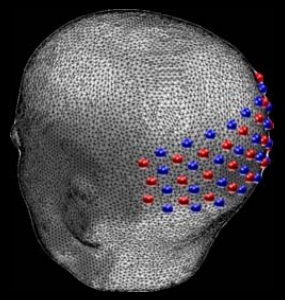
High-Density Diffuse Optical Tomography →
for optimizing lateral resolution with some depth profiling



Instrumentation challenges:
Dynamic Range, Sensitivity, Crosstalk

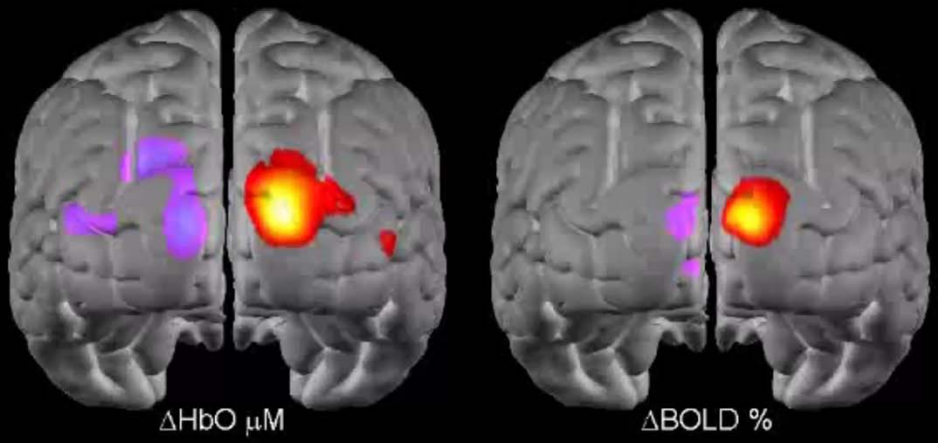






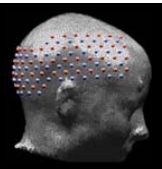
HD-DOT as a surrogate for fMRI

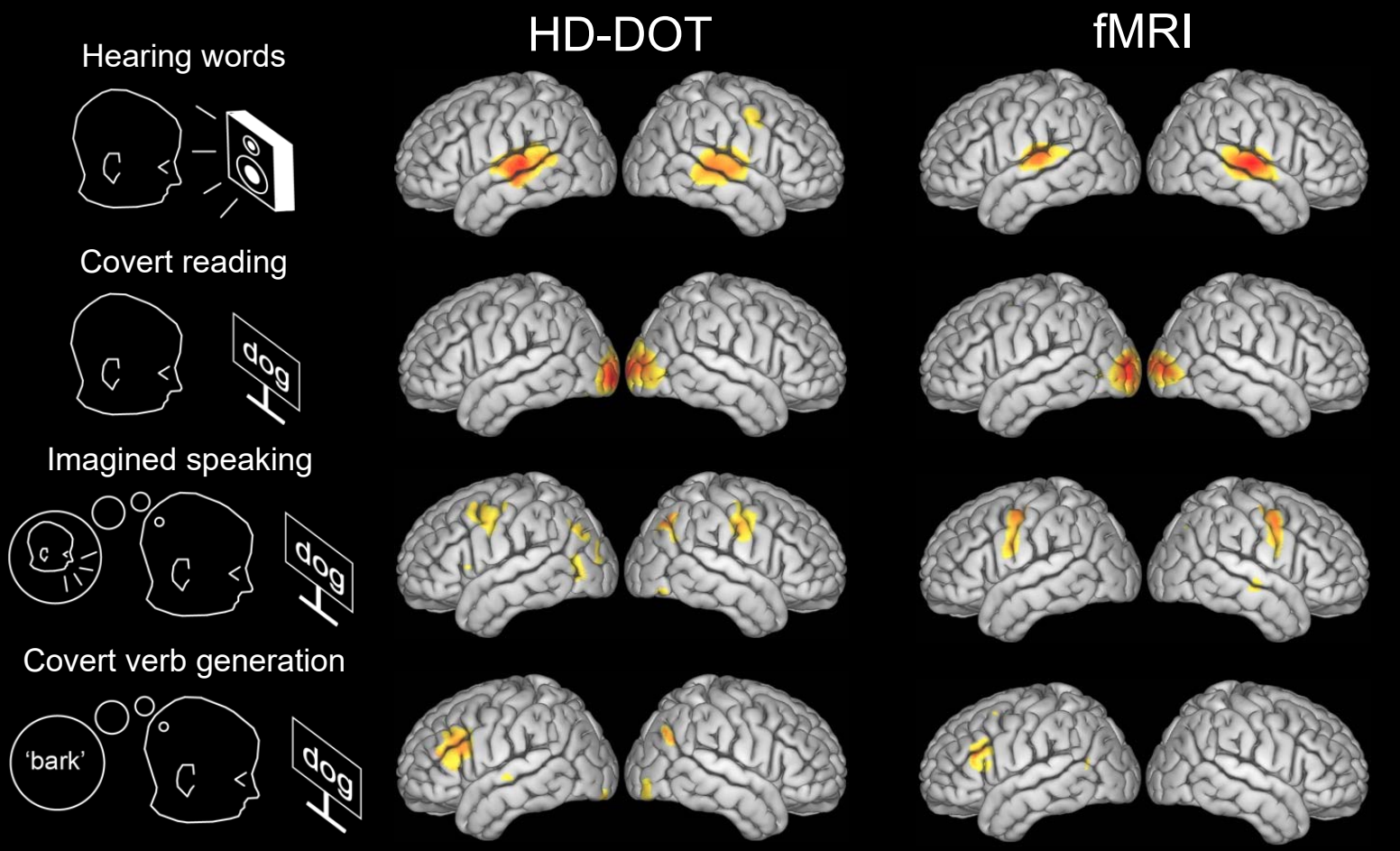
HD-DOT **fMRI**



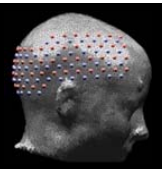
Resolution ~ 15 mm (White, et al. NeuroImage 2010)
Accuracy ~ 5 mm (Eggebrecht, et al. NeuroImage 2012)

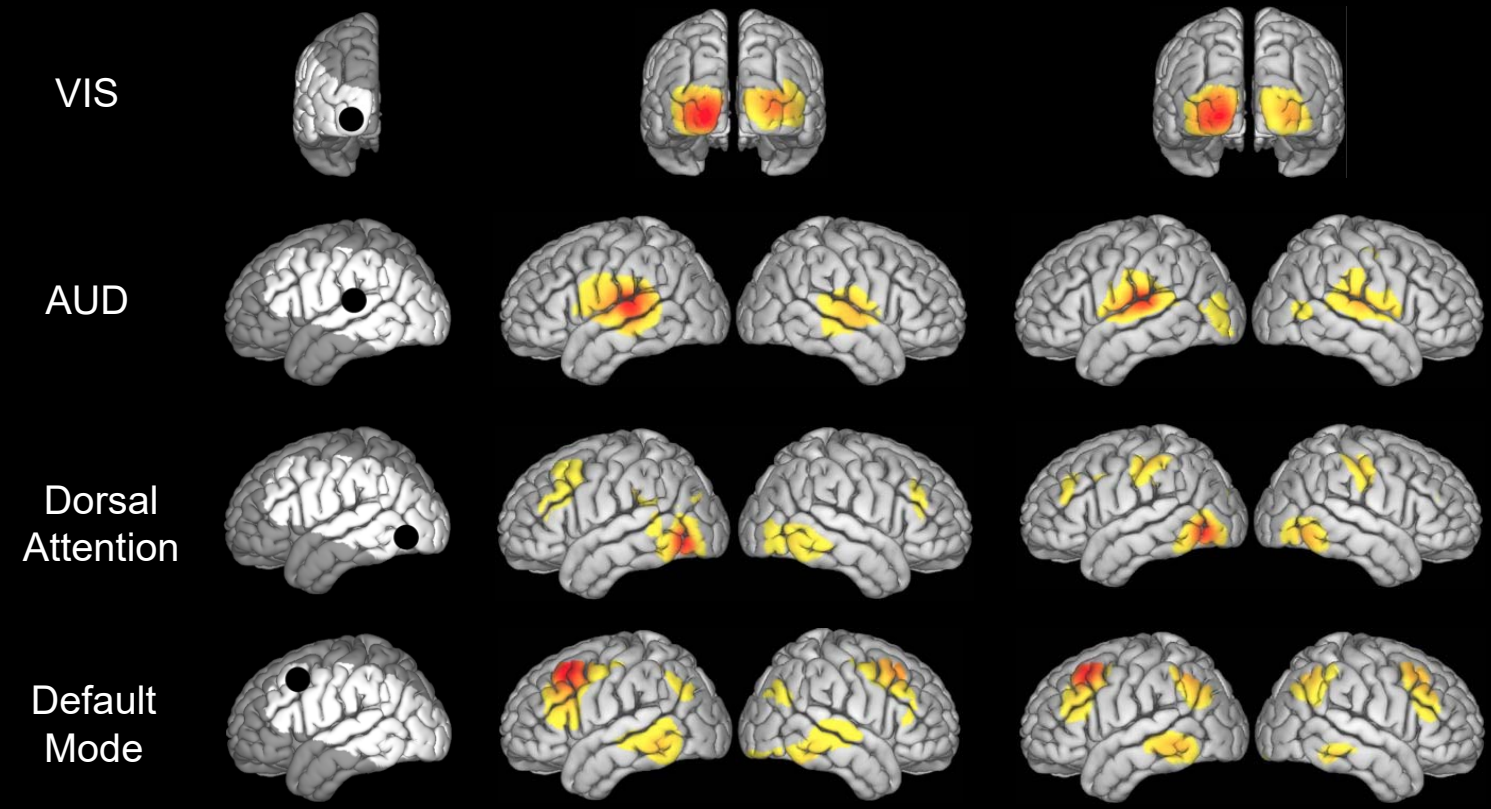
Mapping Language Processing





Mapping Resting State Networks with fcDOT

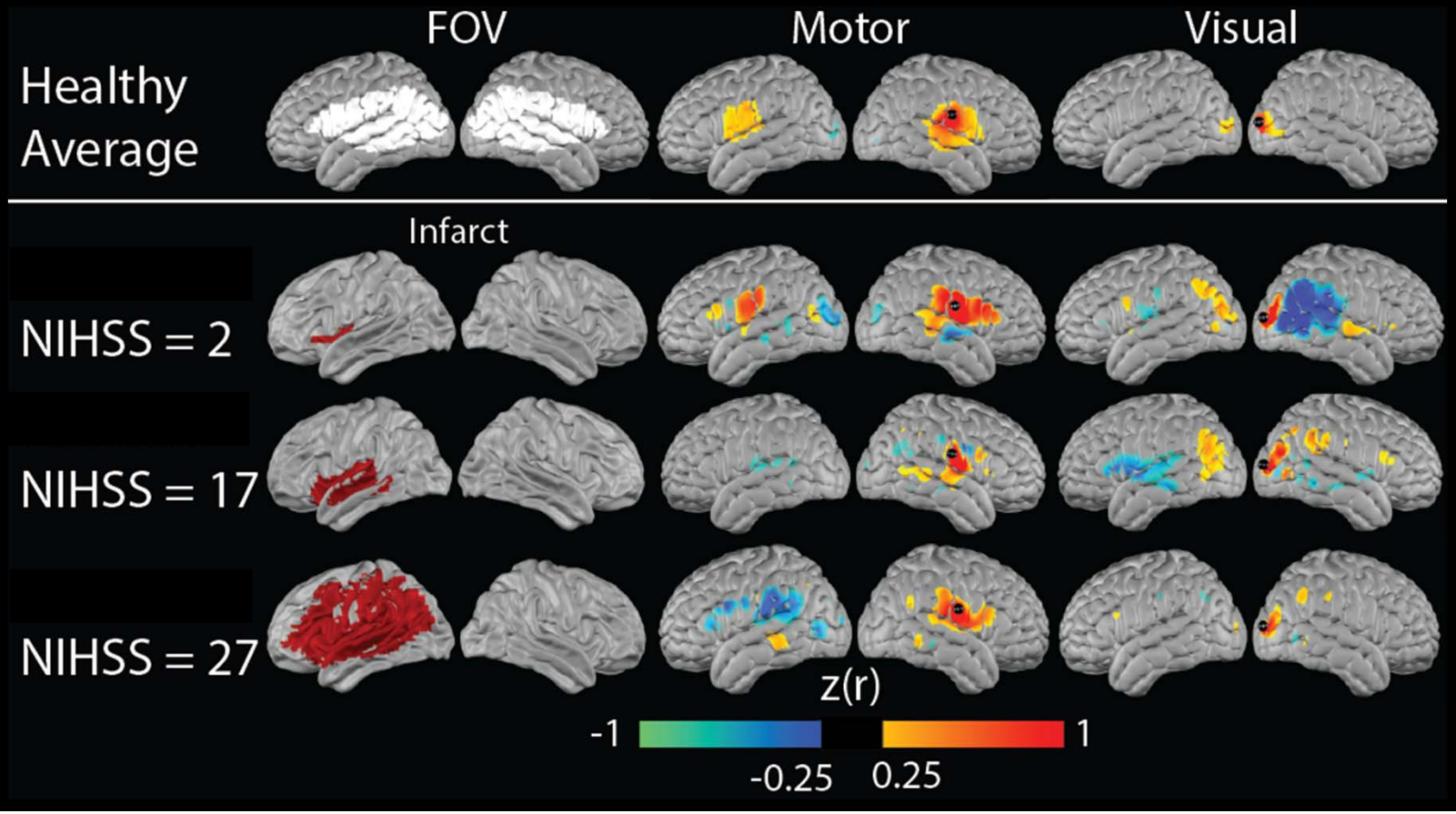




Can we quantify cognitive function in acute stroke?

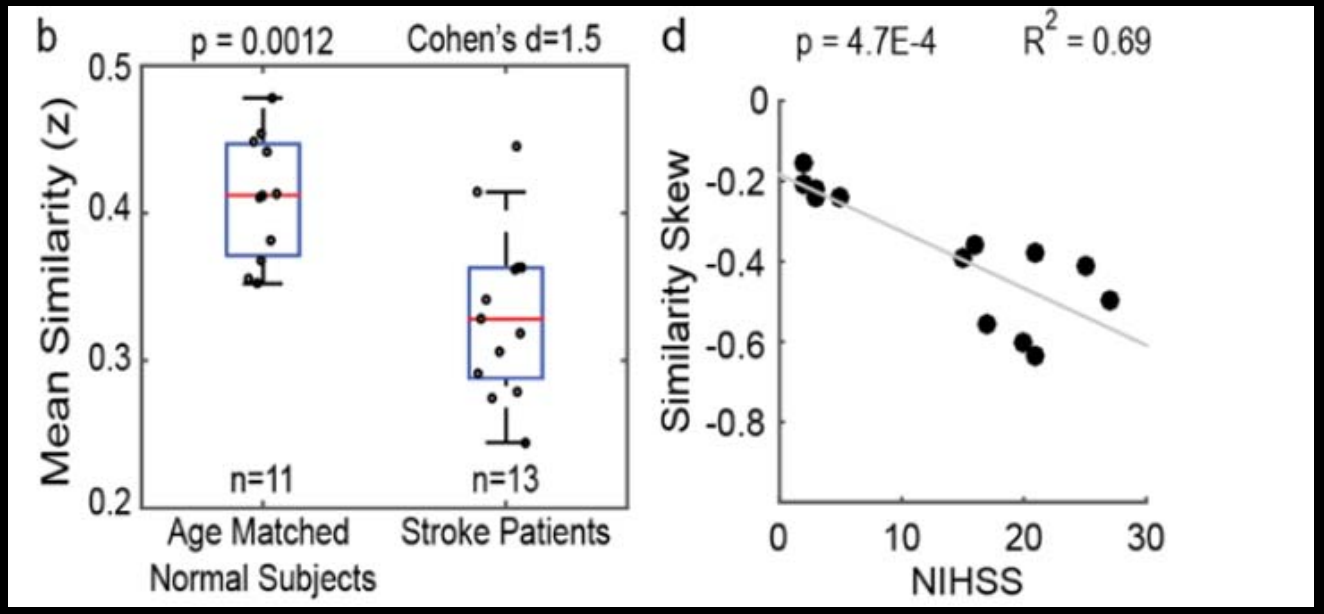

Jin-moo Lee MD, PhD


Karla Bergonzi PhD



National Institute of Neurological Disorders and Stroke

Value Proposition:
Detect & Characterize Stroke

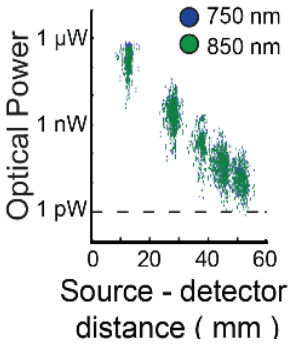


Not quite wearable or portable any more….

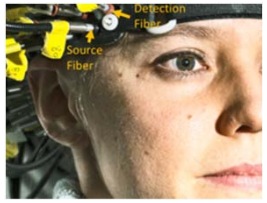
Replace the fibers with smart optodes

What do we keep from HD-DOT?

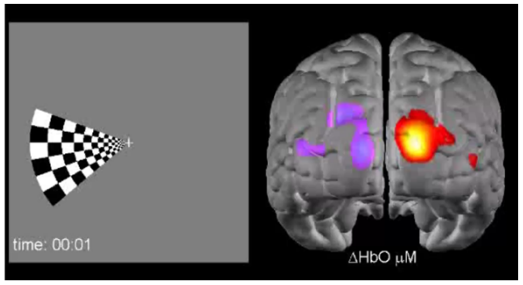
- Detectivity
- Dynamic Range
- Crosstalk



- Cap fit, and combing through the hair

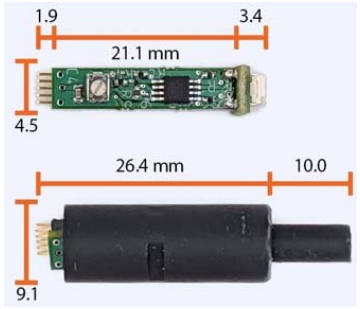


- Image quality

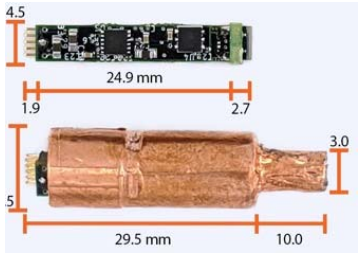


New smart optode modules

LED Source



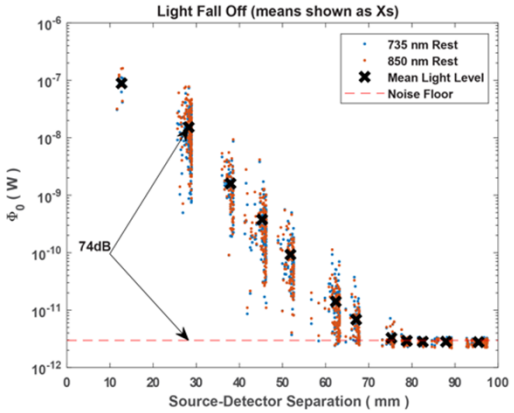
Photodiode Detector



32 source 32 detector Wifi, battery system

Performance with our first wearable prototype

Detectivity, DNR, Cross talk



WHD-DOT Specifications	
NEP	94 fW/√Hz
Detectivity	12.3 fW/√(Hz)/mm^2
Dynamic Range	134 dB
Crosstalk	-108 dB
Frame Rate	10 Hz

Retinotopy

Summary

New wearable prototype pass both benchtop and initial in vivo performance milestones.

Customer Segments

- Research
  - Cognitive Neuroscience
  - Child development and Developmental Disorders
  - Mental Health
  - Addiction
  - Stroke: acute and recovery
  - Traumatic Brain Injury
  - Aging, Alzheimer's
  - Parkinson’s
  - Anesthesiology
- Clinical
  - Spaces:
    - Critical Care
    - Emergence Care
    - Intensive Care units
    - Operating Room
  - Injuries
    - Stroke
    - Traumatic Brain Injury
    - Subarachnoid hemorrhage

Market Size

- Clinical only:
  - Cerebral Oximetery (non-imaging) Market Capitalization was $130 million. (2018)

- research only: fNIRS -
  - “The global fNIRS Brain Imaging System market size is expected to gain market growth in the forecast period of 2020 to 2025, with a CAGR of 10.0% in the forecast period of 2020 to 2025 and will be expected to reach 201.2 million by 2025, from 137.2 million in 2019.”

Consumer Market? Facebook is interested.

Potential Team

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Sherwood Moore Professor of Radiology

Ed Richter, MS.
Professor of Practice, Electrical Systems Engineering

Adam Eggebrecht, PhD
Assistant Professor
Radiology

Jason Trobaugh, PhD,
Professor of Practice,
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