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Questions

- What is NeuroEngineering?
- Why engineers?
- Why now?
- Why us?
- What am I excited about?
What is NeuroEngineering?

- **Restore**
- **Reproduce**
- **Enhance**

**Outcome:** Understanding

**Challenges:** Soft, Wet, 3D, Distributed, Nonlinear
Why engineers?

- Understanding Network Architecture
- Decoding Signals
- Developing Hardware/Nanotechnology
Why now?

### New Technologies

#### Genetic Engineering
- Optical Write
- Optical Read

#### Nanotechnology
- Small & Dense
- Tune Material Properties

#### Data Sciences
- Looger, Svoboda, et al.

#### Microscopy
- Robinson, Park, et al.
- Tian, Lieber, et al.

### New Investment

#### Government
- $100M/yr BRAIN Initiative
- $65M DARPA NESD
- $70M IARPA MICrONS
- $100M NSF NeuroNex

#### Private Sector
- $715M Google + GSK
- $? Facebook B8
- $100M Kernel
- $25-100M Neuralink

### Timeline

- **2006 - 12**
- **2013 - 16**
Why us?

Get Data (Nanotechnology)

Szablowski  Xie  Luan  Robinson

Interpret and Use Data (Signal Processing)

Veeraraghavan  Kemere  Raphael

O’ Malley  Aazhang

Hardware  Algorithms
Why us?

Get Data (Nanotechnology)
- Szabolowski
- Xie
- Luan
- Robinson
- Veeraraghavan
- Kemere
- Raphael

Interpret and Use Data (Signal Processing)
- O'Malley
- Aazhang
- Baraniuk
- Allen

Hardware

Algorithms
Why us?

Get Data (Nanotechnology)

Szablowski  St. Pierre  Xie  Luan  Robinson  Seymour  Veeraraghavan  Kemere  Raphael

Interpret and Use Data (Signal Processing)

O’Malley  Pitkow  Aazhang  Patel  Baraniuk  Allen

Hardware  Algorithms
Interface

Get Data (Nanotechnology)

Hardware

Algorithms

Szablowski  St. Pierre  Xie  Luan  Robinson  Seymour  Veeraraghavan  Kemere  Raphael
Inference, learn, control

control → learn → read → action → control

Interpret and Use Data (Signal Processing)

O’Malley  Pitkow  Aazhang  Patel  Baraniuk  Allen

Hardware   Algorithms
What am I excited about?

• non-invasive deep brain stimulation
• wireless multisite modulation of the diseased heart
• real-time closed-loop modulation for depression
• learning and socialization in primates
• understanding olfactory circuit
• modulation of epileptic circuit