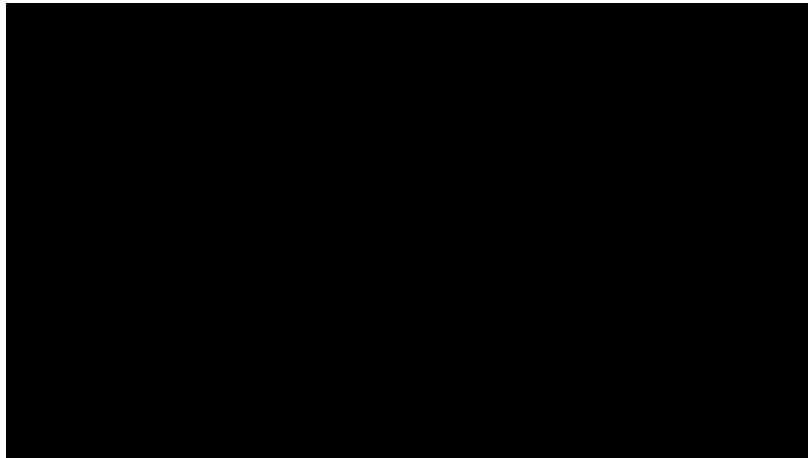


# Brain-machine Interfaces in Multi-species: A Neural Prosthesis for the Restoration of Hand Dexterity

Talas Conference 2019  
Dr. Kai Voges  
Research Fellow, SINAPSE, NUS  
27/06/2019

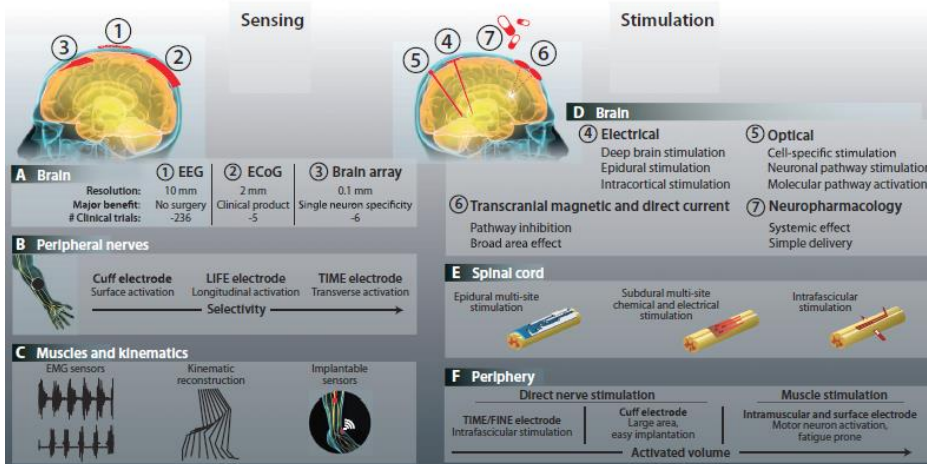
1

## State of the art neural prosthesis



2

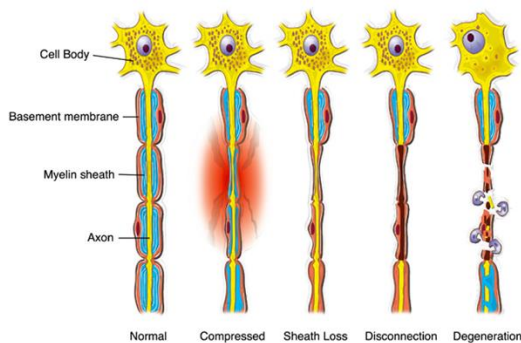
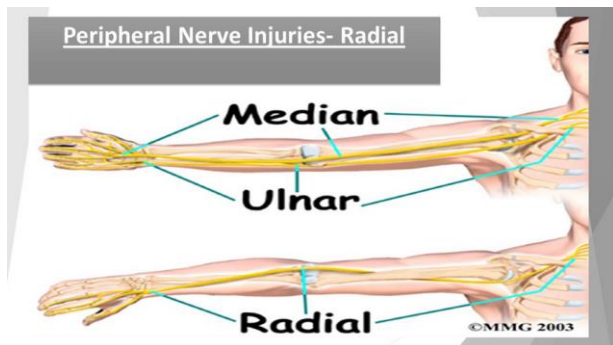
# Personalized neural prosthesis



Borton et al. 2015

3

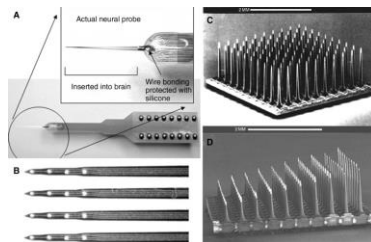
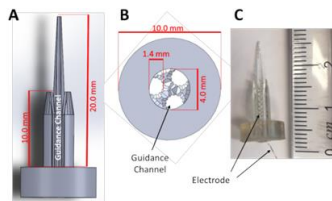
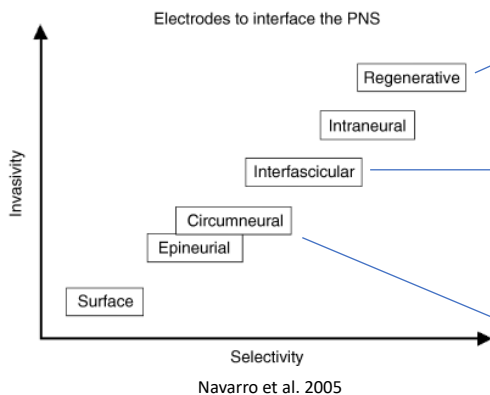
# We target the peripheral nervous system



www.medatrio.com

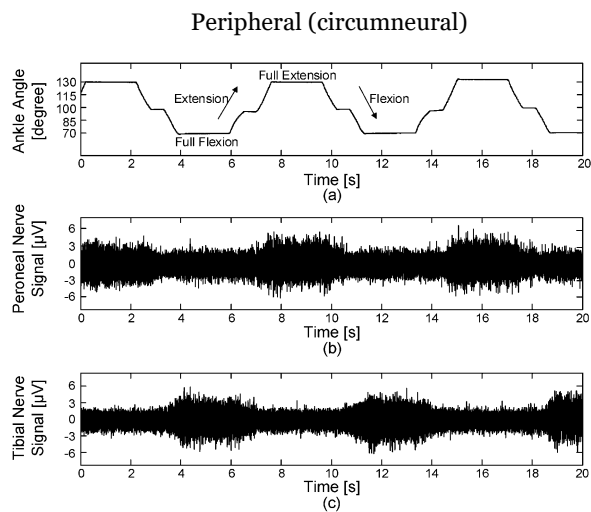
4

# Challenges – Neural interfaces



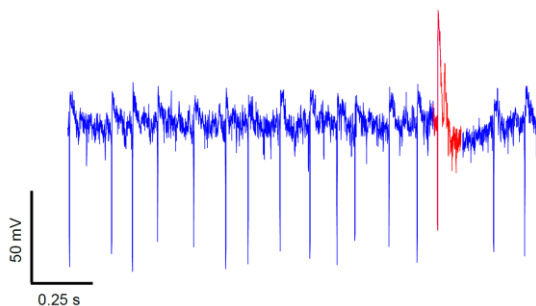
5

# Challenges – Signal quality



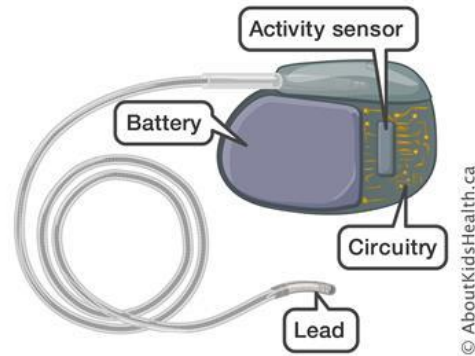
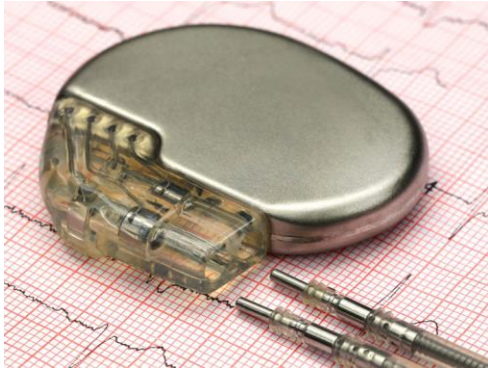
Shon et al. 2018

CNS (single cell)



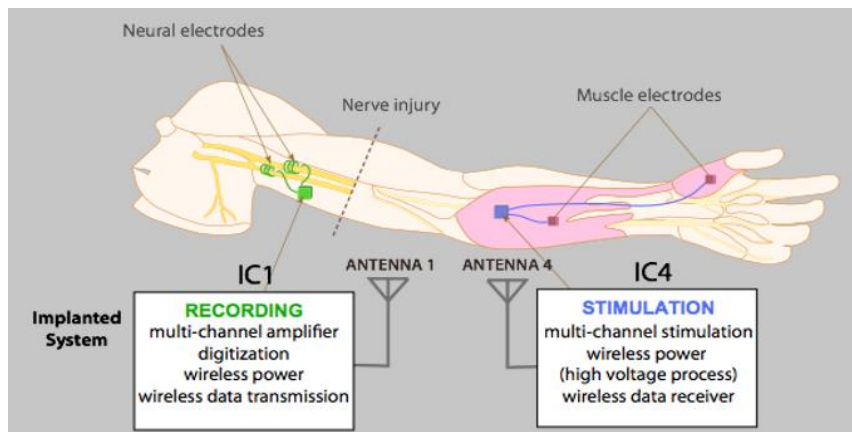
6

## Challenges – Power and data transfer



7

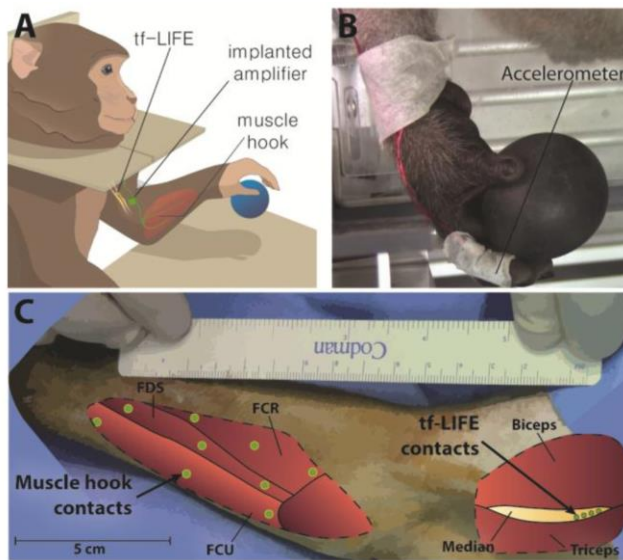
## Our approach – A fully implantable peripheral neural prosthesis



8

# Our approach

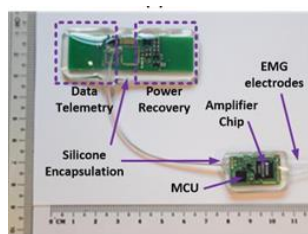
– A fully implantable peripheral neural prosthesis



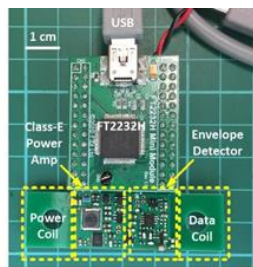
9

# Circuit design – these are our devices

## Recording device



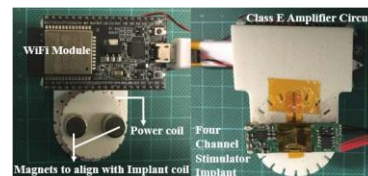
Implant



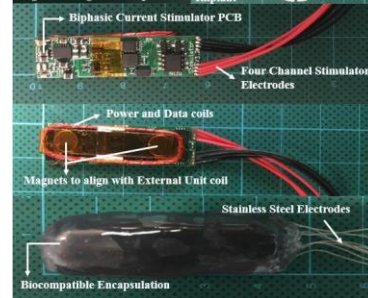
External

## Stimulation device

External

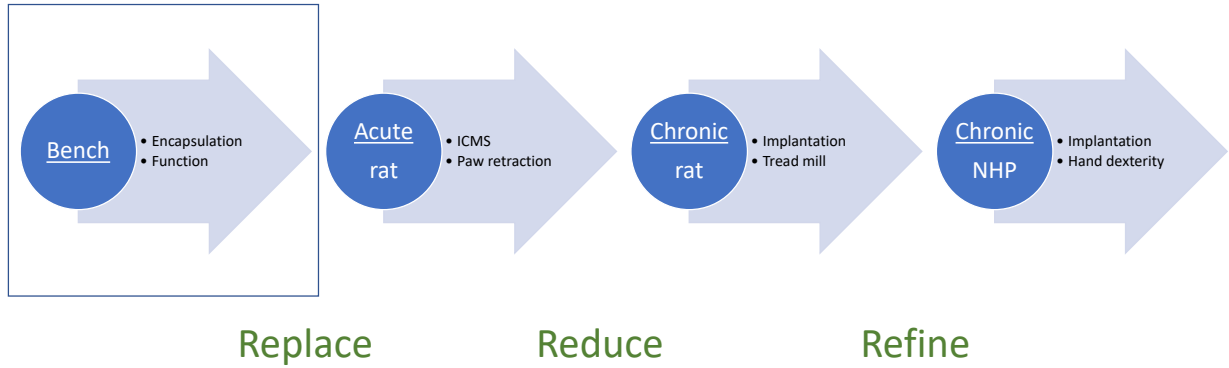


Implant



10

## The testing process

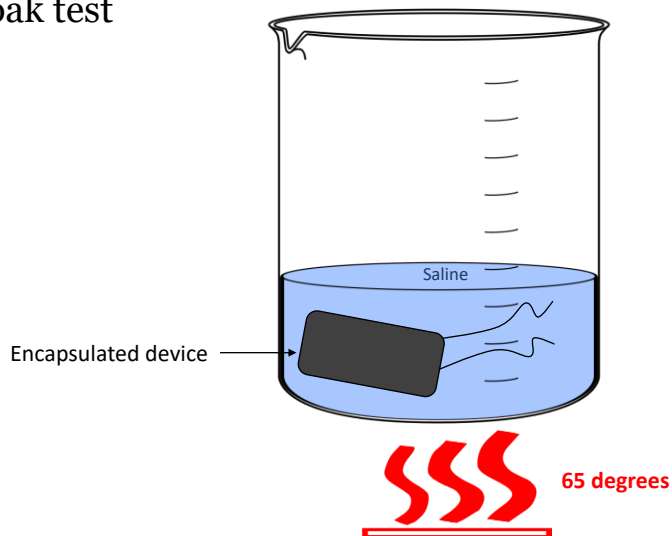


11

## Bench testing I - Encapsulation

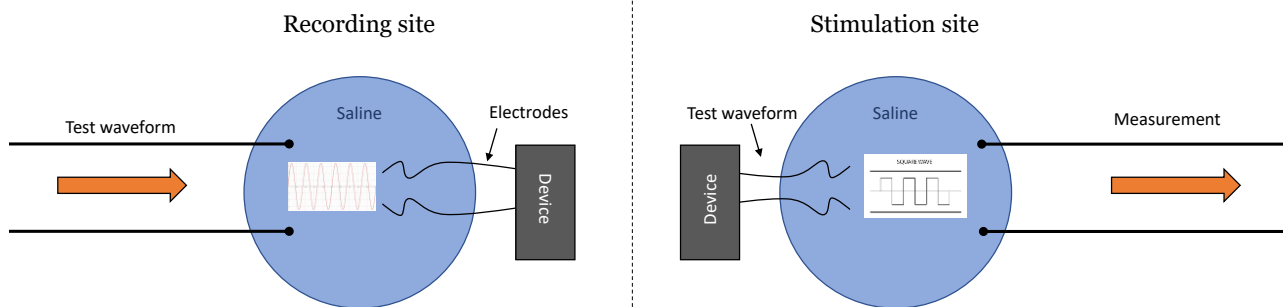
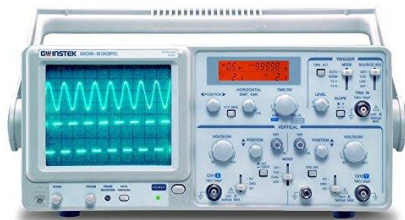
Soak test

- 1 week



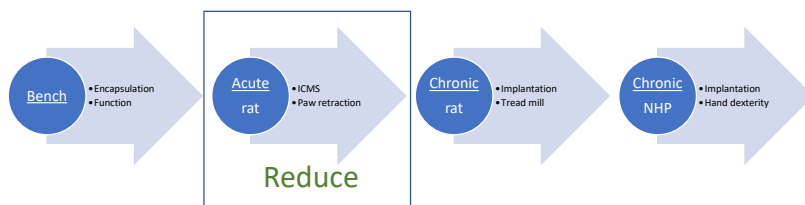
12

# Bench testing II - Functionality



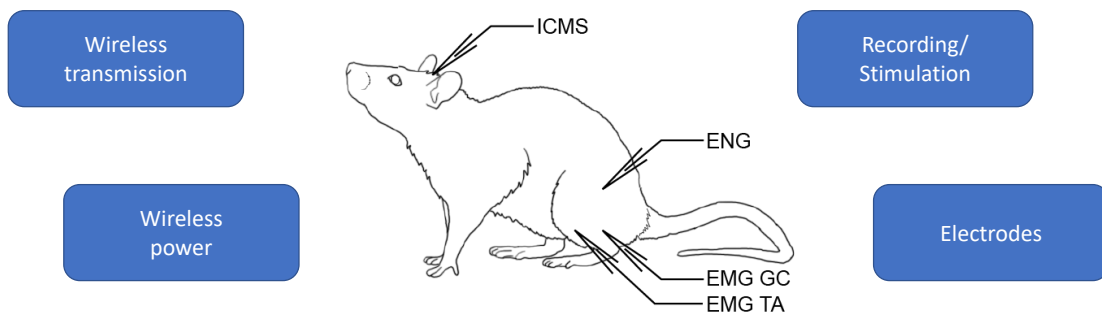
13

# Acute testing - Rat



ICMS = Intracortical microstimulation

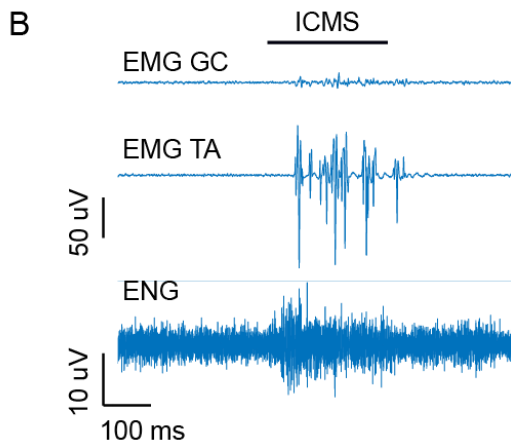
A



Voges et al., in preparation

14

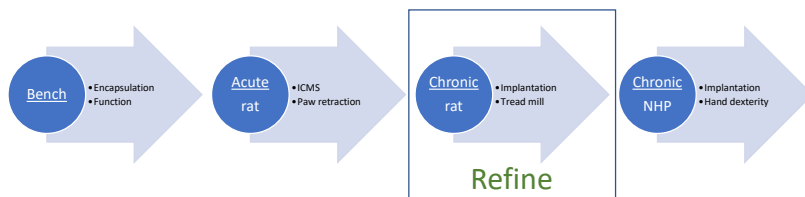
# Acute testing – Rat model



Voges et al., in preparation

15

# Chronic testing - Rat



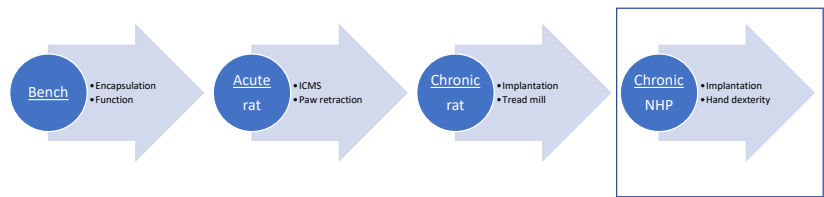
EMG recording



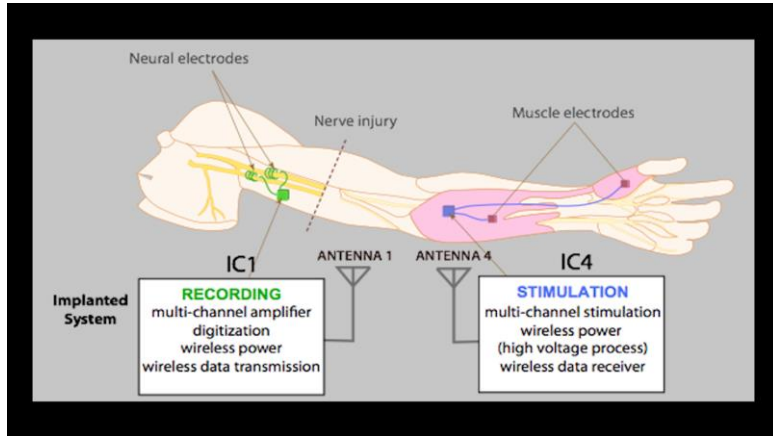
16



# Chronic testing - NHP

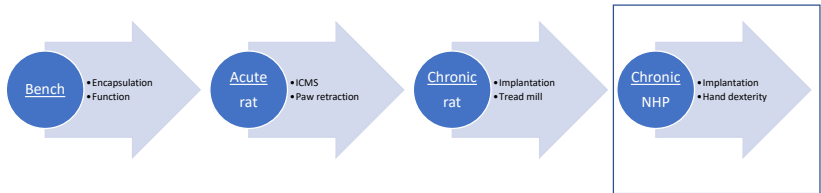


## Muscle stimulation

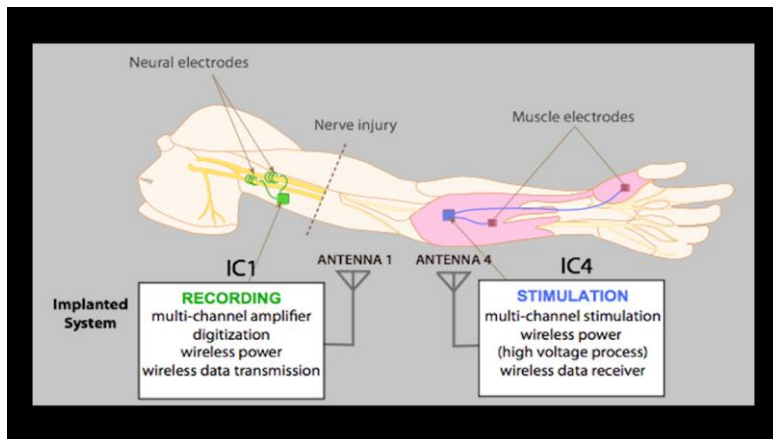


17

# Chronic testing - NHP

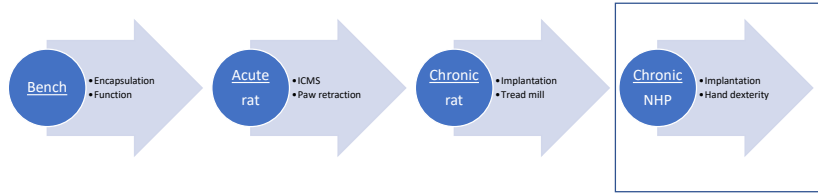


## EMG recording

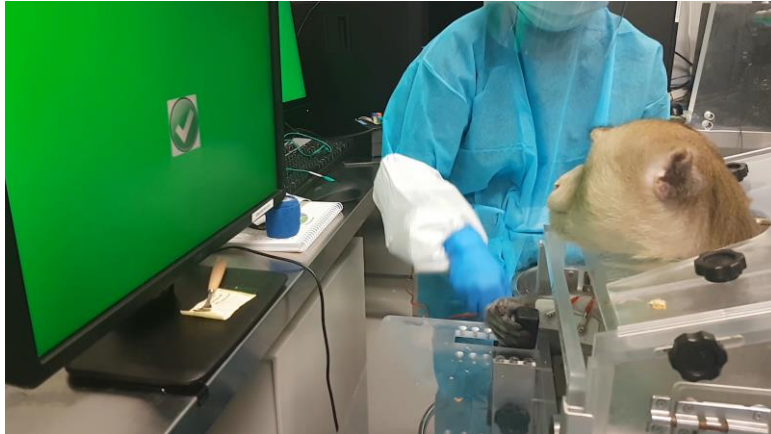


18

## Behavior - NHP



Grasping



19

## Next steps - Full implementation

- implant the complete system in a trained animal
- conduct temporal nerve block
- conduct chronic nerve block
- implement precise decoding algorithms



- demonstrate the full system

20

# Thank you for your attention

## The current team

### PI:

Dr. Nitish Thakor  
Dr. Shih Cheng Yen  
Dr. Camilo Libedinsky

### RA:

Thow Xin Juan  
Marshall Wong  
Lijing Ong  
Chne-Wuen Tsai  
Shih Chiang Liu

### Animal Care:

Gil Gammad  
Priscilla Oh Dan Qi  
Lim Wee Chiek  
Seow Yan Ting

### RF:

Dr. Taf Sibindhi  
Dr. Kian Ann Ng  
Dr. Agatha Blasiak  
Dr. Kai Voges  
Dr. Amit Lahiri

21

# Supplemental research

22