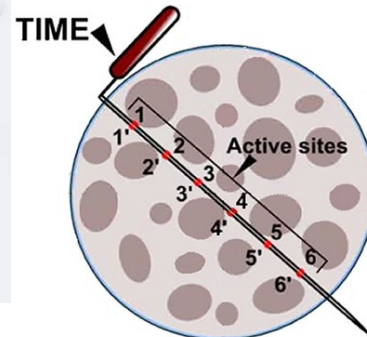
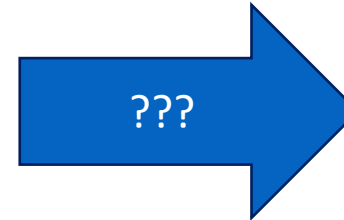
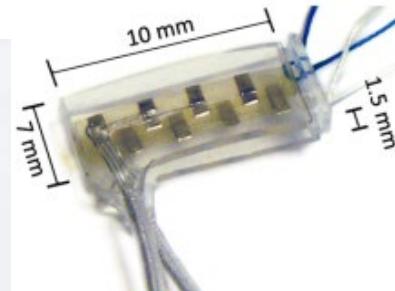
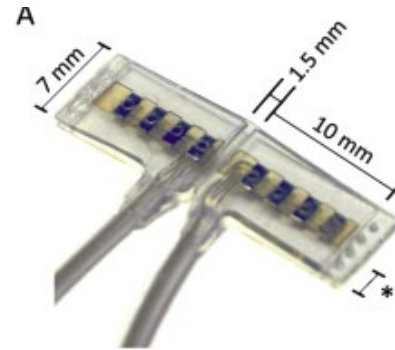
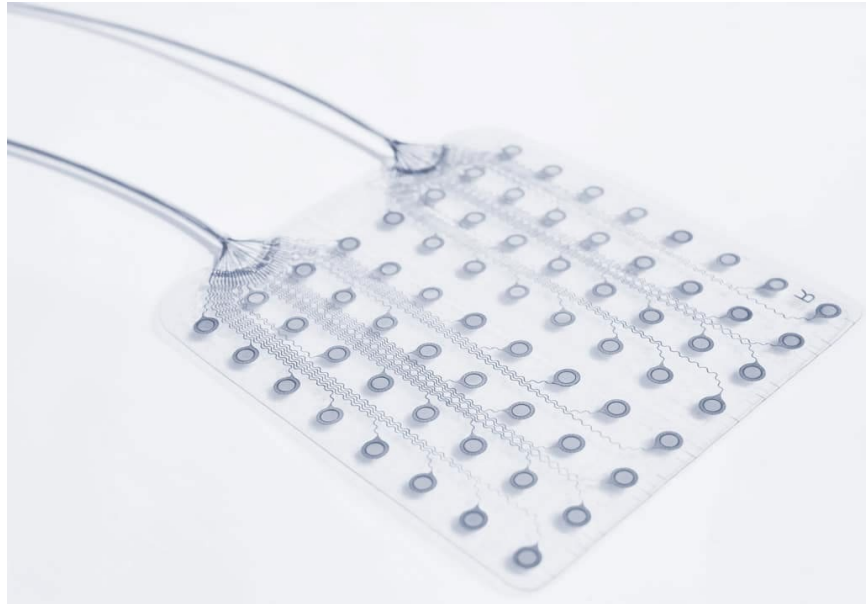
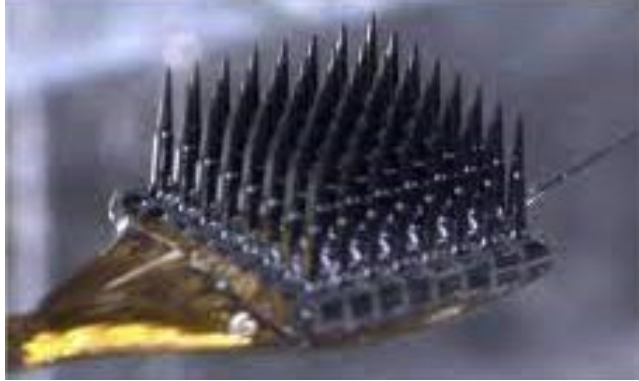


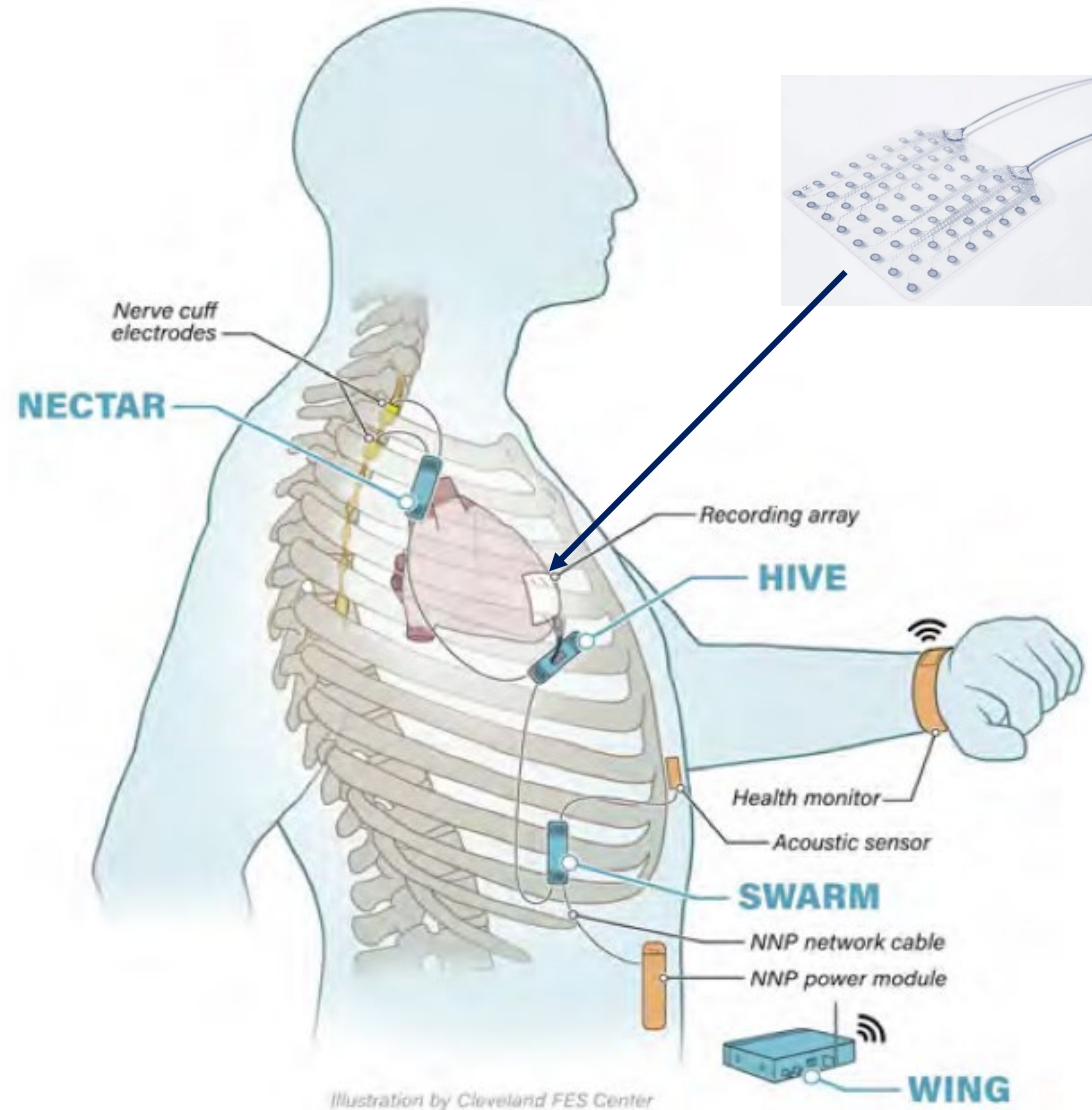


**HIVE (High-density
Interconnect with Variable
Electronics)**

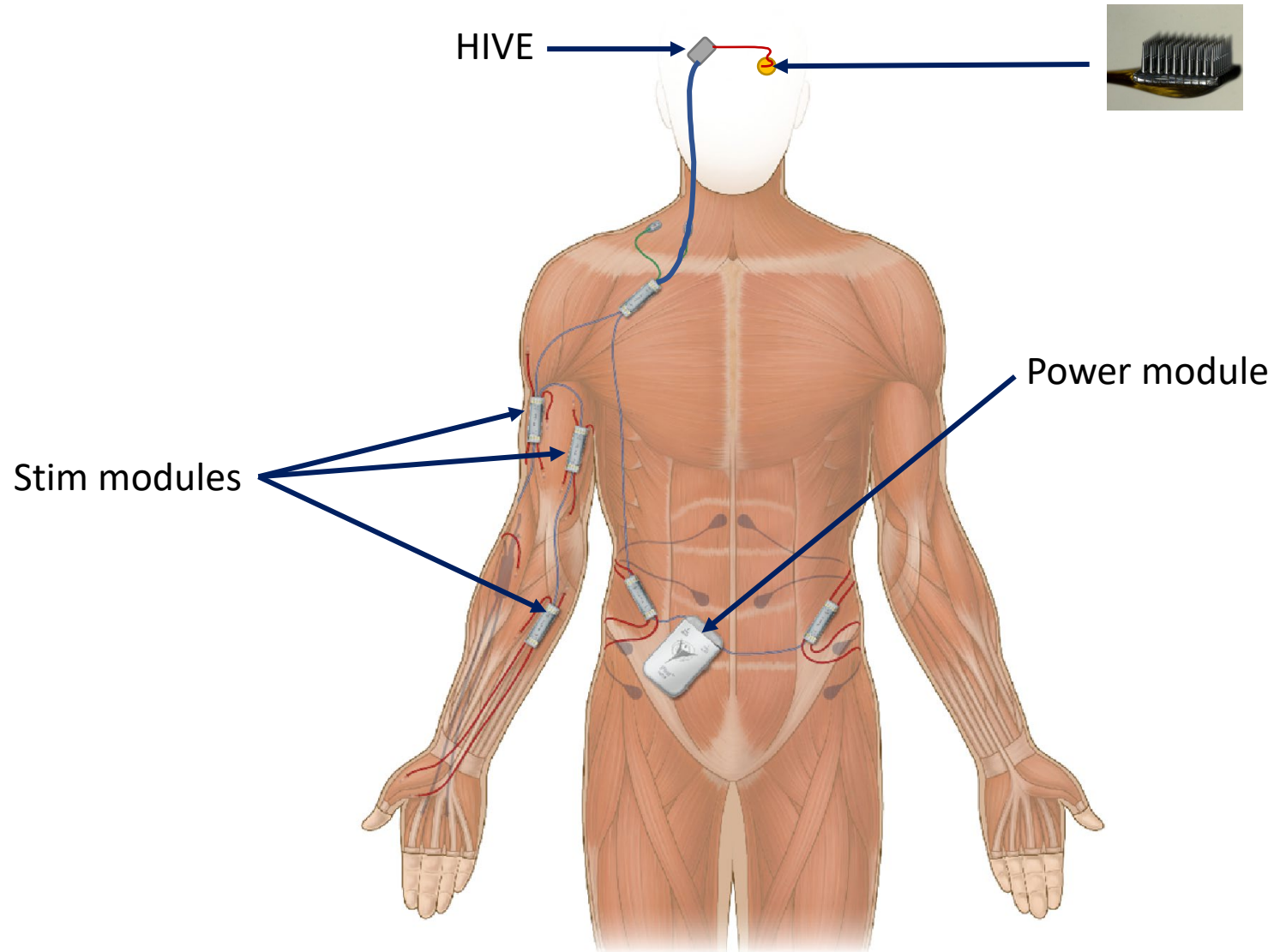
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- Aim 1) Create and validate an electronics module for 64 channel recording.
 - We will design and validate modular circuitry for 64-channel recording, based on our previous published NNP module (Bullard et al. 2019). We will have multiple modes of operation available, including for spiking data by using low bandwidth features, within the constraints of the existing NNP power system. This aim will include establishing a supply chain for all items, documenting all electrical safety tests, providing test hardware, and obtaining FDA feedback through a pre-submission inquiry.
- Aim 2) Create and validate a general purpose 64-channel package.
 - We will create a general purpose 64-channel package compatible with the NNP network, only slightly larger than existing modules. We will utilize a suite of leading-edge vendors from the medical device packaging industry to implement a hermetic feedthrough flange that will be laser-welded to a titanium enclosure, which in turn will be laser-sealed after installing the internal electronics of Aim 1. We will also optimize current high-density in-line connector designs for use with the 32/64-channel systems to enable attaching connectors during surgery. We will establish an open-source, academically accessible supply chain. By the end of the project we will provide data on hermeticity testing, electrical and mechanical testing of these modules.
- Aim 3) Create and validate a module for 32 channel stimulation and recording.
 - There are many applications that would benefit from higher channel count stimulation as well as simultaneous recording and stimulation on the same electrodes. Therefore, we will design and validate modular circuitry for a 32-channel bidirectional module. Again, we will establish a supply chain and complete safety data dossier for this design.



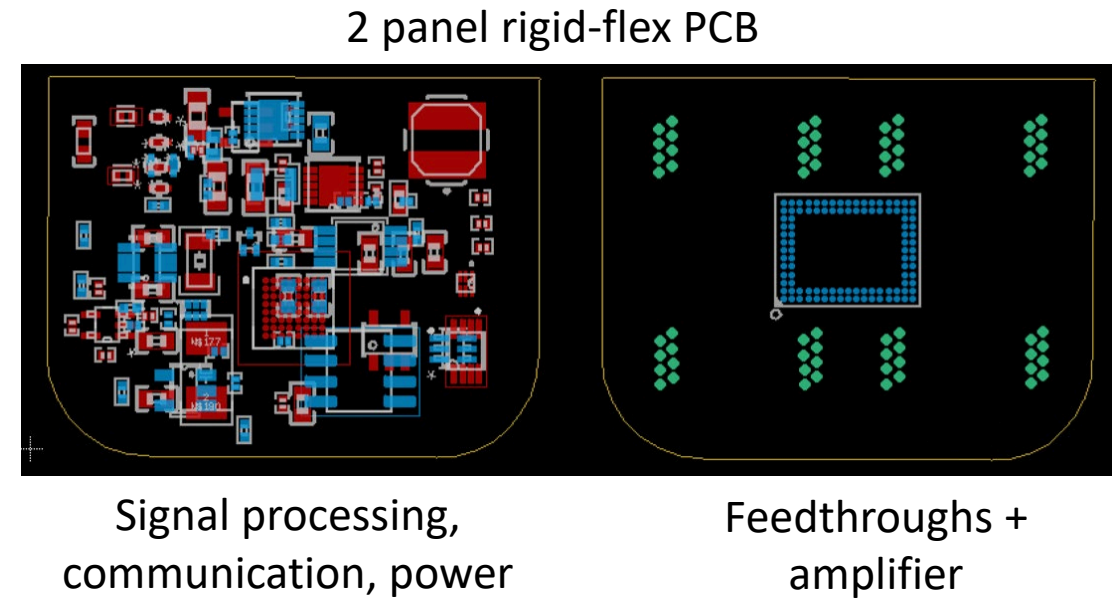
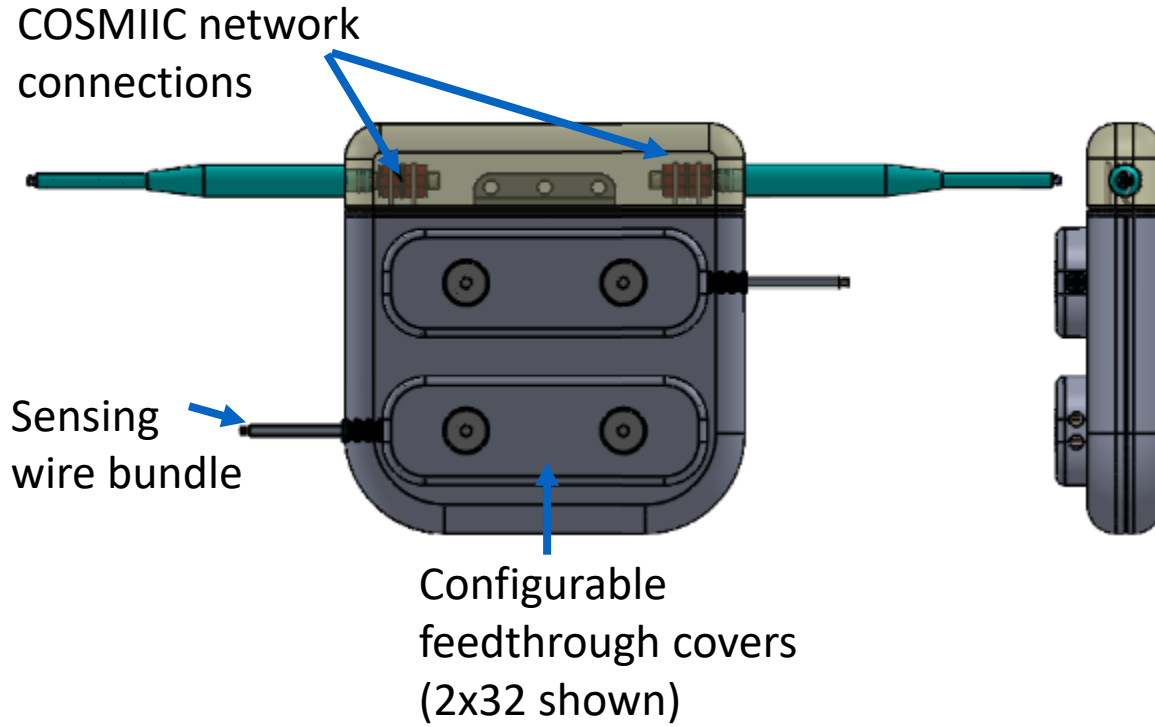


- High density electrode grid for cardiac monitoring



- Intracortical array for high fidelity Functional Electrical Stimulation

64 Channel Recording Module



Specifications

Package Dimensions	35.8 x 36.6 x 9.4 mm
Package material	Titanium
Electrode connection methods	Hard-wired or in-line connector
Bioamplifier	Intan RHD2164
	Sampling rates up to 30KSps
	Lower cutoff frequency 0.1-500Hz
	Upper cutoff frequency 100-20KHz
Microcontroller	STM32L433RCI6
Power and communication	FESCAN

Performance Goals

Input referred noise	$2.4\mu\text{V}_{\text{rms}}$
Power consumption	30mW sampling at 2KSps

Features

Package	Similar to 64 channel recording module
Electrode connection methods	Hard-wired or in-line connector
Bioamplifier+stimulator	2x Intan RHS2116
	Programmable current controlled stim
	10nA to 2.55mA over 14V range per contact
	Amplifier fast settle feature
	Sampling rates up to 40KSps
	Lower cutoff frequency 0.1Hz-1KHz
	Upper cutoff frequency 100Hz-20KHz
Microcontroller	STM32 same or similar to 64 channel recording module
Power and communication	FESCAN