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## WIRELESS NEURAL IMPLANTS 1 5

### MOTIVATION

- 17,000 new cases of Spinal Cord Injury every year
- Restore use of limb after spinal cord Injury

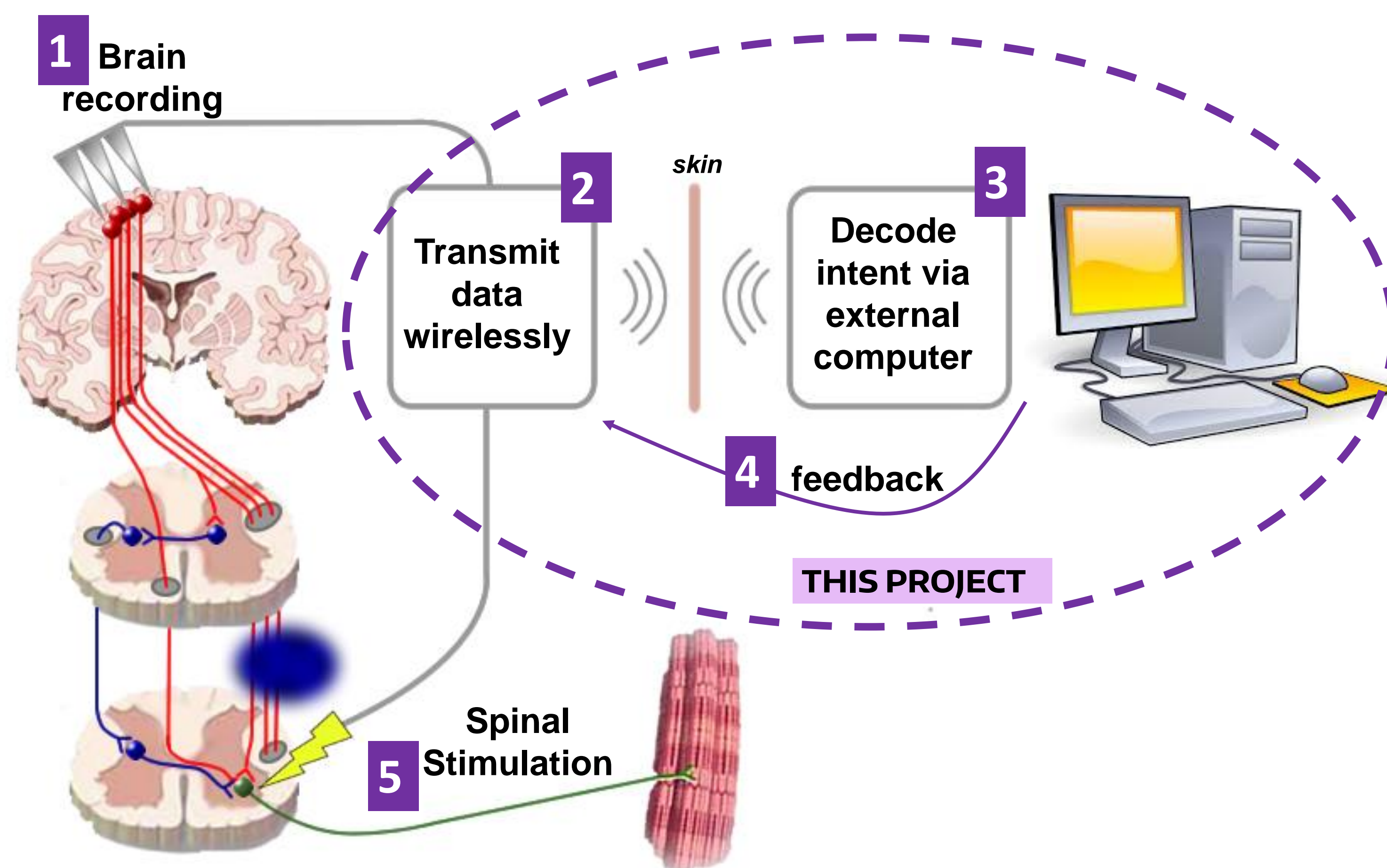
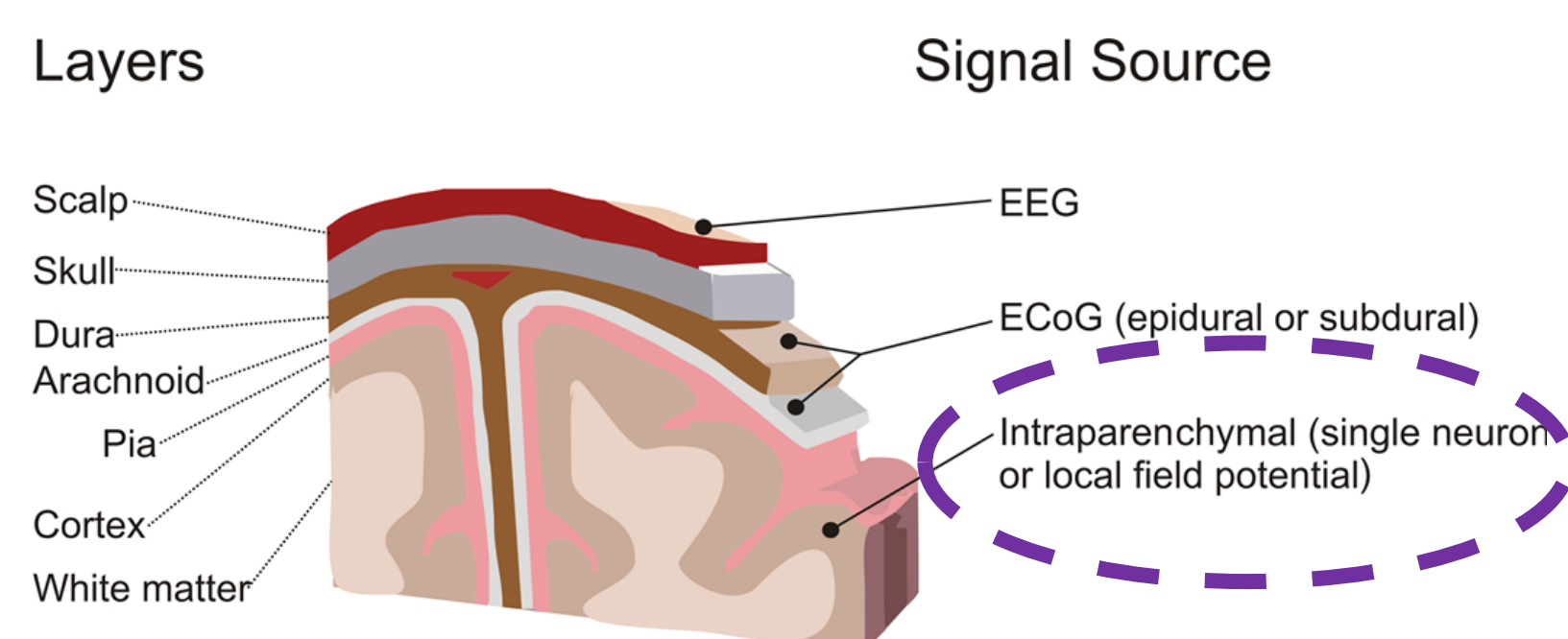


NeuralClip [1]  
Vaishnavi Ranganathan

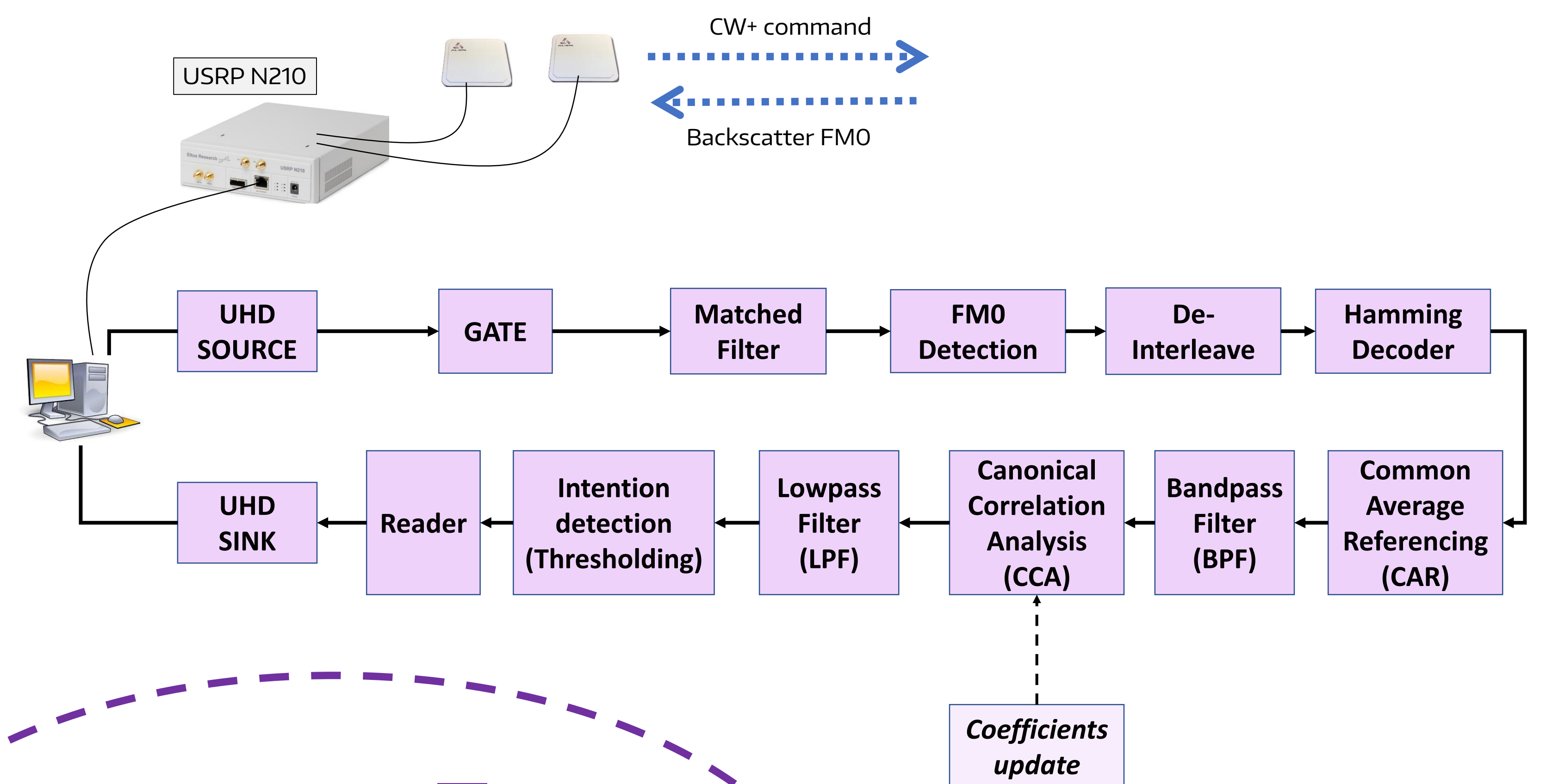


NeuralDisc [2]  
James Rosenthal

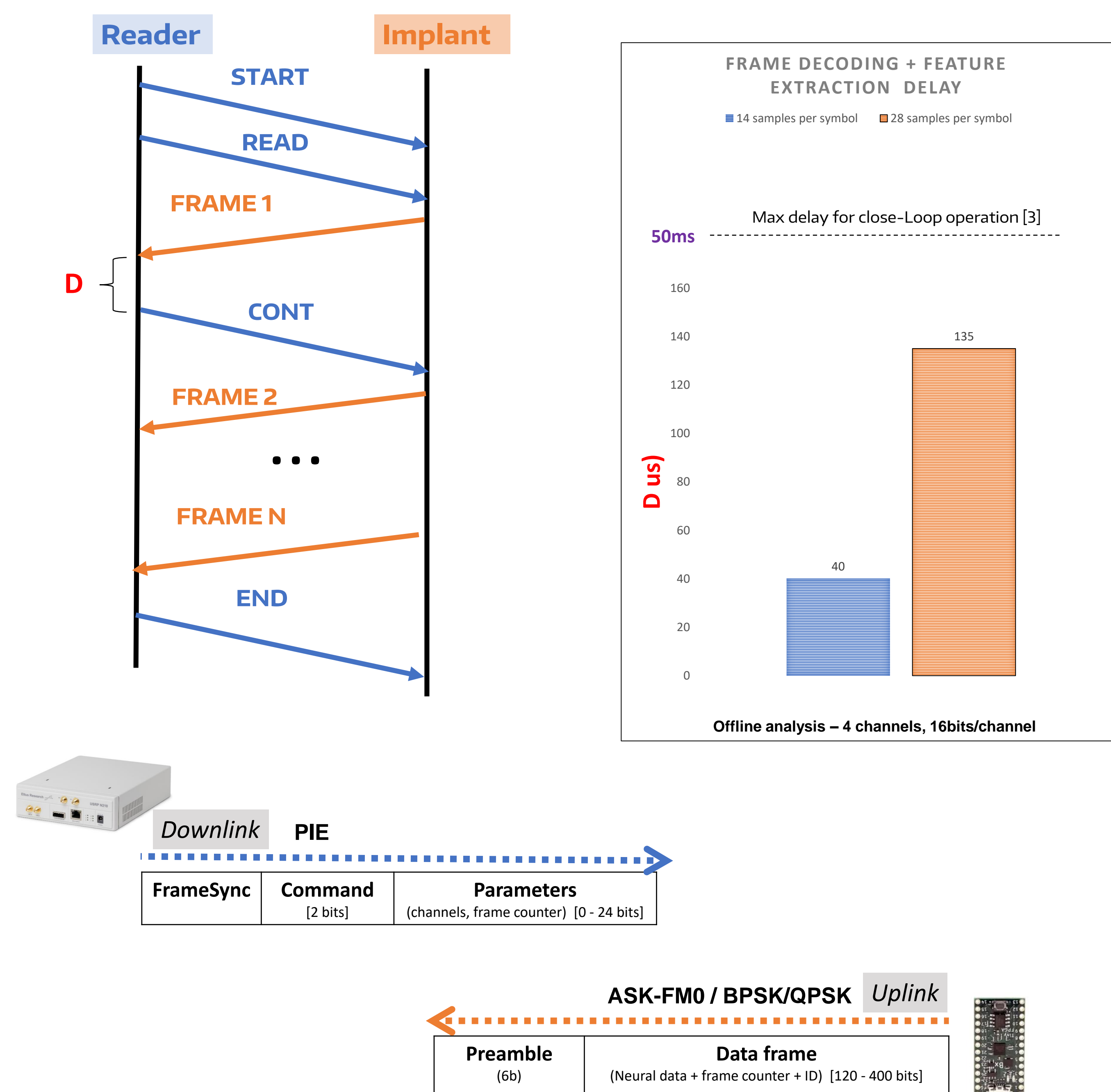
- Computation: Low-Power FPGA
- High data rates (stream recorded signals)
- Low power consumption
- Neural chip: Intan RHS2116
  - 20 Hz to 1000 Hz
  - Multiple unipolar channels (N = 4 to 16)
  - 16 - N channels can be used for stimulation



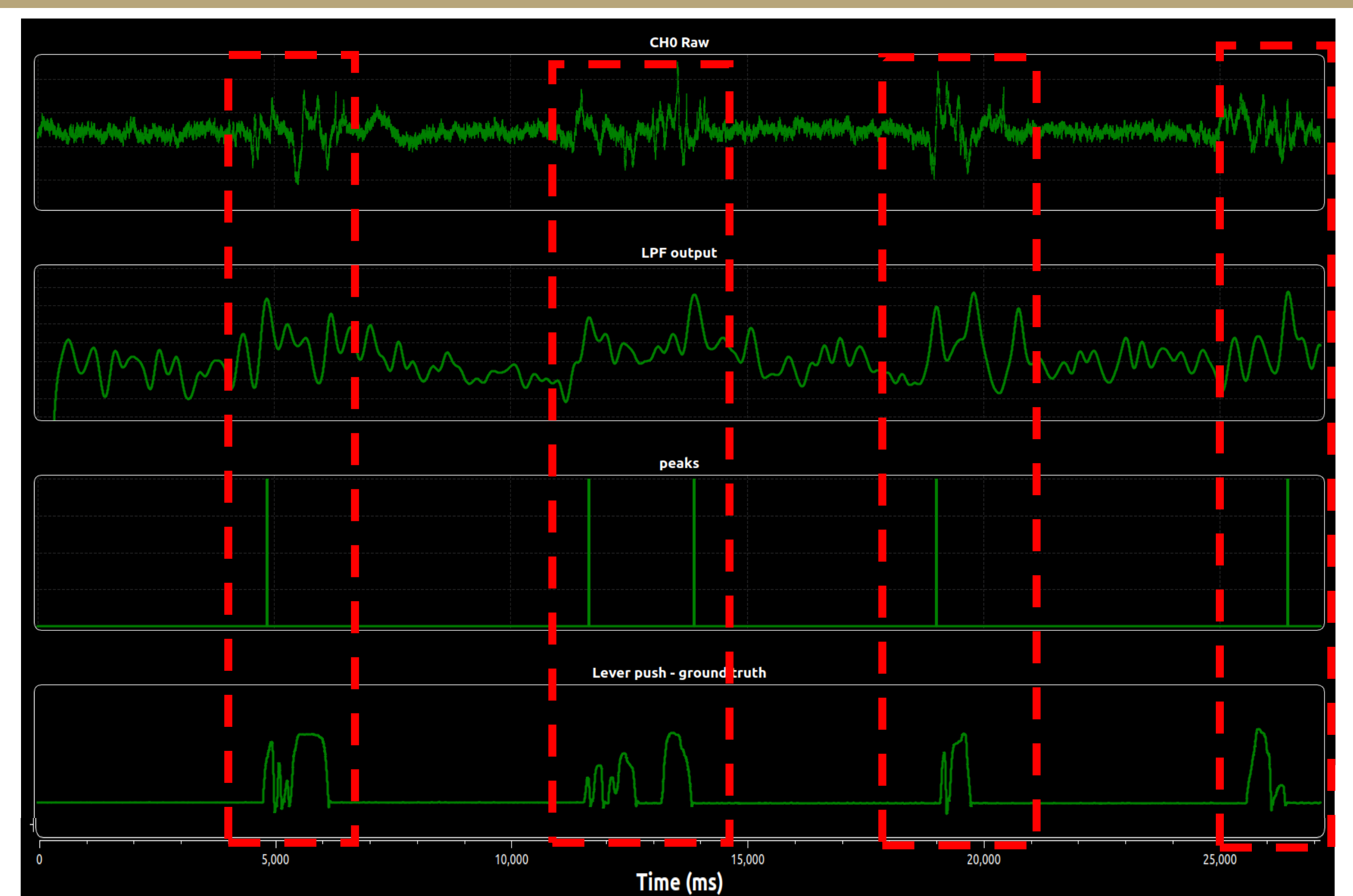
## SOFTWARE DEFINED READER 3 4



## COMMUNICATION PROTOCOL 2



## INTENTION DECODING 3 4



Offline analysis - pre-recorded Neural Data. 4 channels, 16bits/channel  
Ubuntu 18.0 LTS, GNUradio 3.7

## Future Work, Acknowledgments, References

### Next steps

- Generalize: ASK, BPSK, DQPSK
- Tradeoff between implanted and external computation
- Real-time Feature Extraction with neural Implant (TinyFPGA)
- Privacy (cryptography?)

Faculty: Joshua R. Smith, Chet T. Mortiz  
Students: James Rosenthal, Anand Selvan

- [1] V. Ranganathan et al., "NeuralCLIP: A Modular FPGA-Based Neural Interface for Closed-Loop Operation", IEEE/EMBS Conference on Neural Engineering (NER), 2019.
- [2] J. Rosenthal, A. Sharma, E. Kampianakis, M.S. Reynolds, "A 25 Mbps, 12.4 pJ/bit DQPSK Backscatter Data Uplink for the NeuroDisc Brain Computer Interface" IEEE transactions on biomedical circuits and systems.
- [3] A. Jackson, J. Mavoori, E.E. Fetz, "Long-term motor cortex plasticity induced by an electronic neural implant", Nature, vol. 444, 2006