

Bidirectional/Recurrent BCIs

Bishal Paudel

PhD 2nd Year

NeuRonICS lab, DESE

Indian Institute of Science, Bangalore

Under the guidance of **Prof. Chetan Singh Thakur**



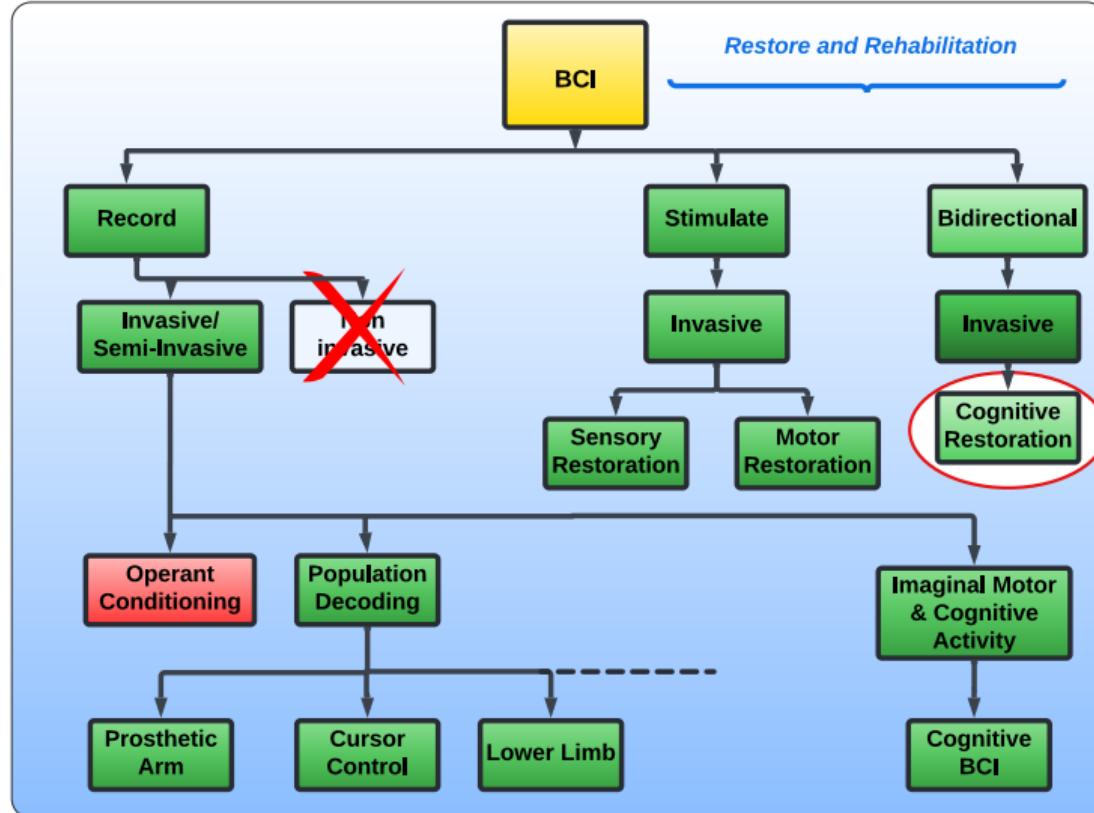
Department of
Electronic
Systems
Engineering



Contents

- 1 Bidirectional BCI
- 2 Examples of Bidirectional BCI
- 3 Futuristic Idea: Brain-to-Brain
- 4 References
- 5 Thank you

Probable Applications of BCI



Establishing Connections between Brain Regions [3]

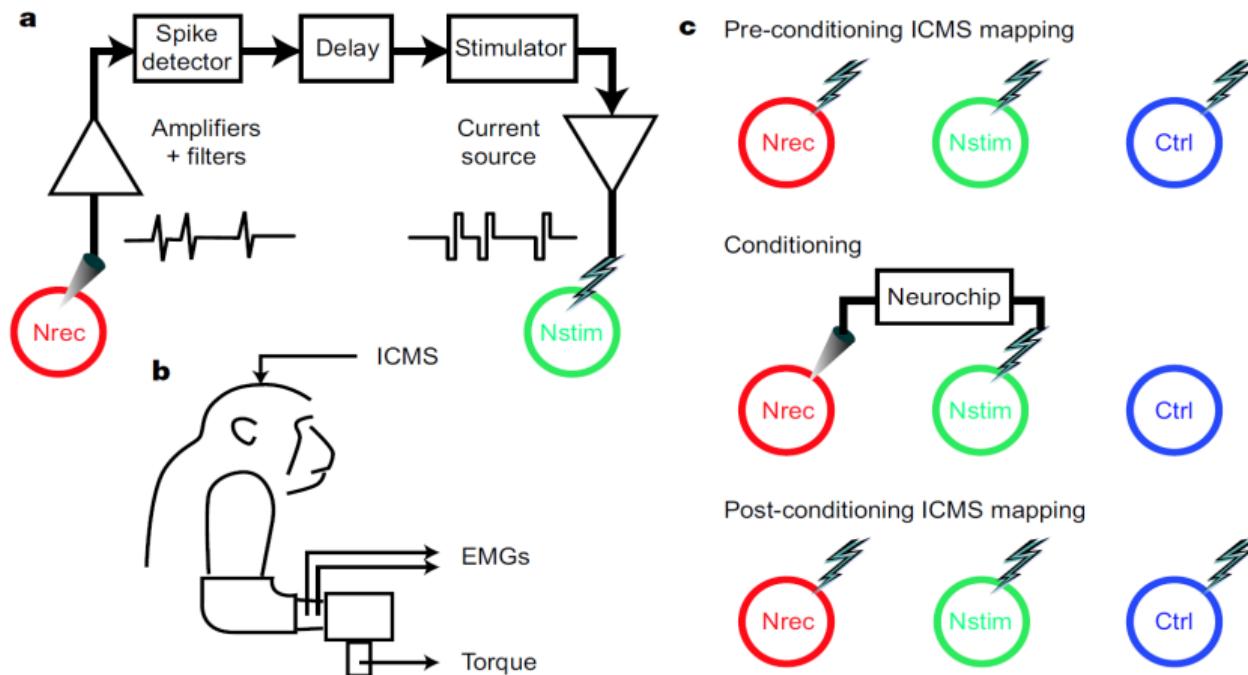


Figure: Inducing **Hebbian Plasticity** using a bidirectional BCI.

Example: Tactile Exploration (2006) [5]

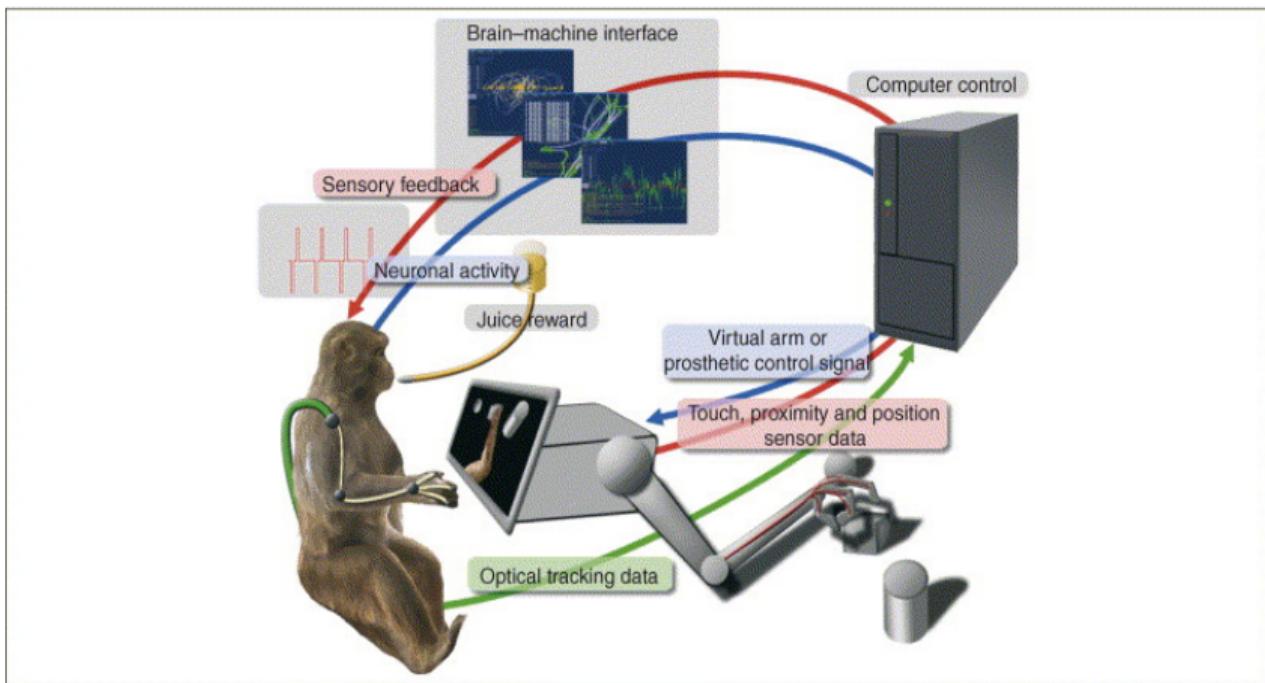
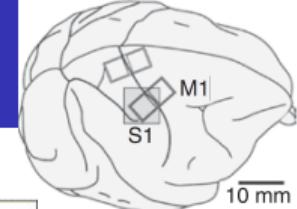


Figure: Making the prosthetic feel like the subject's own limb using microstimulation of **cortical sensory areas**.

Example: Reaching and Grasping (2012) [2]

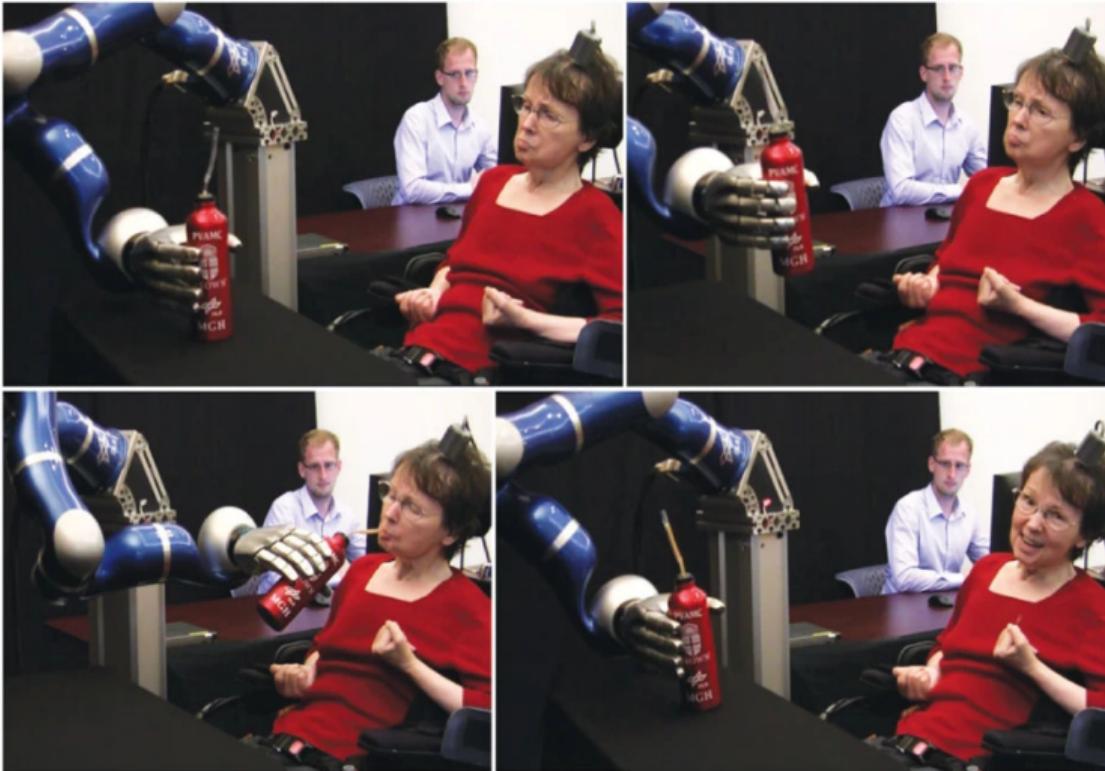


Figure: Intercontinental **brain-to-brain interface** to transfer cortical tactile (Sensorimotor) information.

Example: Restoring Cortical control (2016) [1]

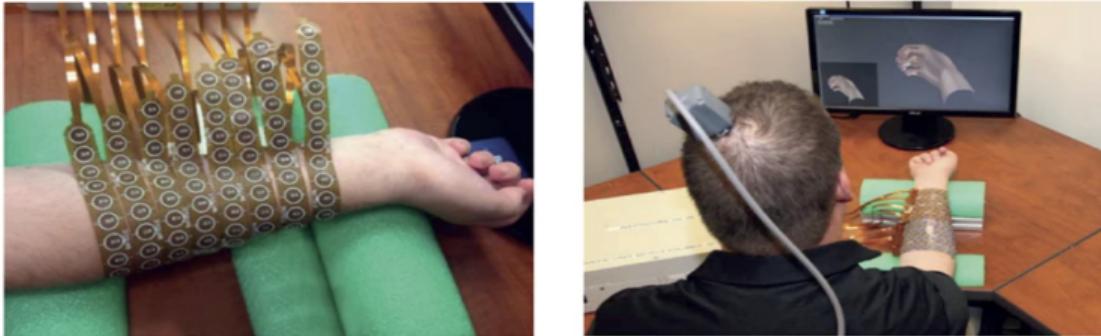


Figure: Neuromuscular Electrostimulation sleeve, Calibration Phase

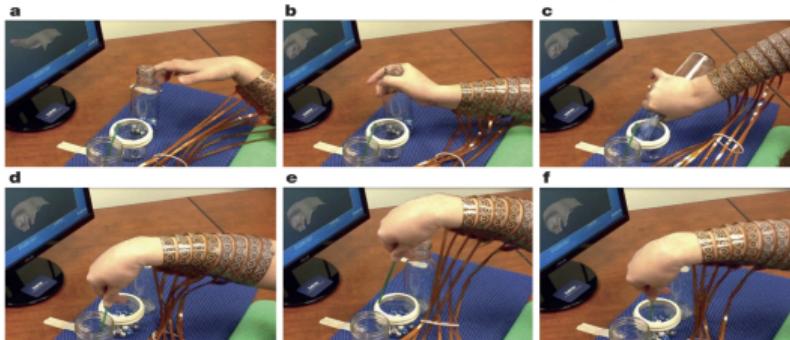


Figure: Ongoing Phase: Grasp-pour-and-stir functional movement task.

Futuristic Idea: Brain-to-Brain (2013) [6]

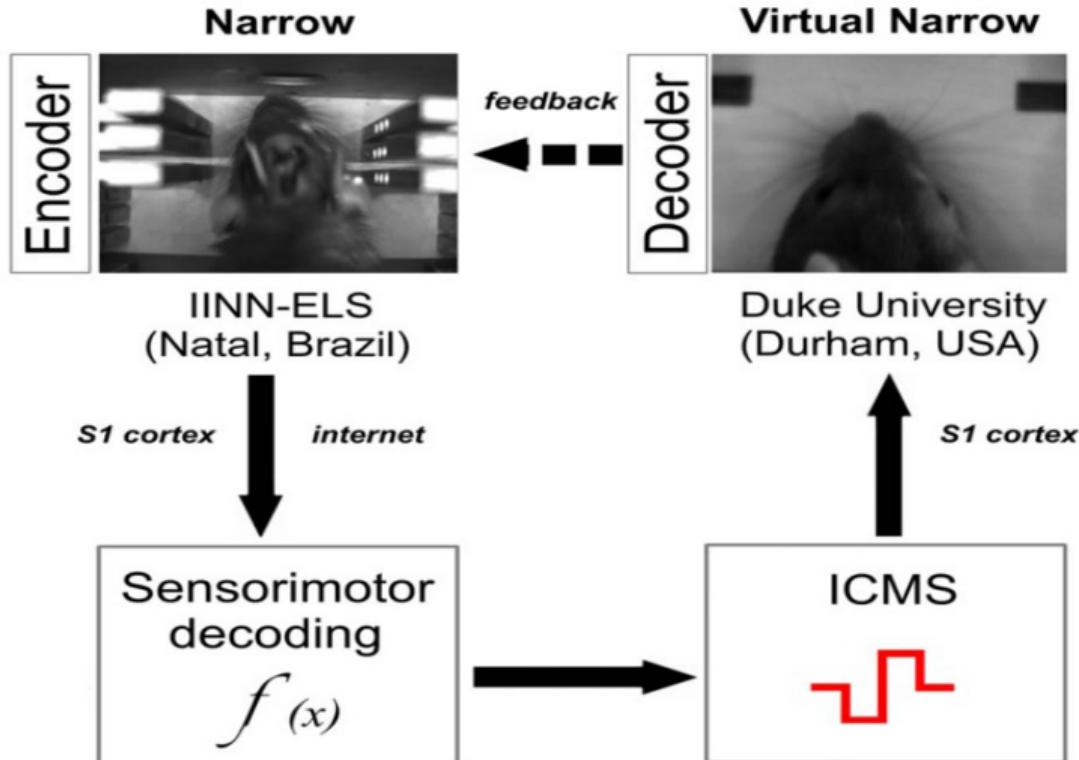
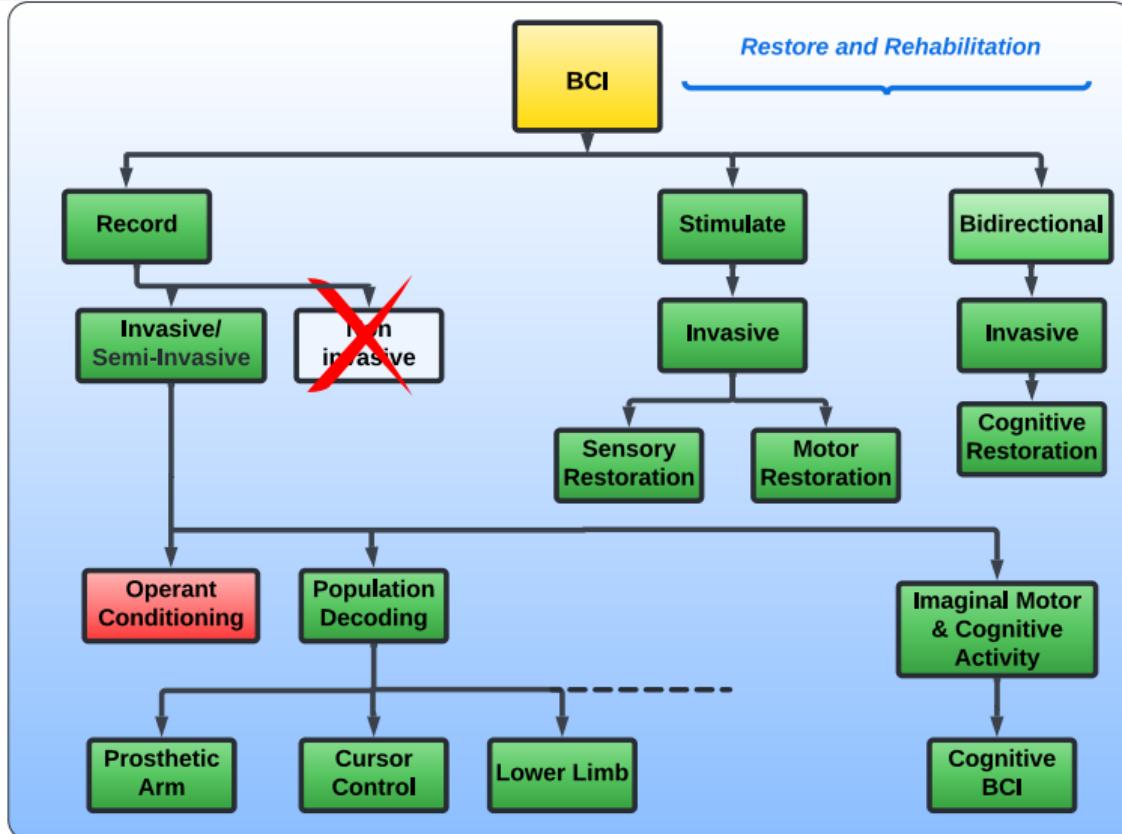


Figure: Intercontinental **brain-to-brain interface** to transfer cortical tactile (Sensorimotor) information.

Global Brain [4]



Time to Choose



References

- [1] Chad E. Bouton et al. "Restoring cortical control of functional movement in a human with quadriplegia". In: *Nature* 2016 533:7602 533.7602 (Apr. 2016), pp. 247–250. ISSN: 1476-4687. DOI: 10.1038/nature17435. URL: <https://www.nature.com/articles/nature17435>.
- [2] Leigh R. Hochberg et al. "Reach and grasp by people with tetraplegia using a neurally controlled robotic arm". In: *Nature* 2012 485:7398 485.7398 (May 2012), pp. 372–375. ISSN: 1476-4687. DOI: 10.1038/nature11076. URL: <https://www.nature.com/articles/nature11076>.
- [3] Andrew Jackson, Jaideep Mavoori, and Eberhard E. Fetz. "Long-term motor cortex plasticity induced by an electronic neural implant". In: *Nature* 2006 444:7115 444.7115 (Oct. 2006), pp. 56–60. ISSN: 1476-4687. DOI: 10.1038/nature05226. URL: <https://www.nature.com/articles/nature05226>.
- [4] Marios Kyriazis. "Systems neuroscience in focus: From the human brain to the global brain?" In: *Frontiers in Systems Neuroscience* 9.FEB (Feb. 2015), p. 122533. ISSN: 16625137. DOI: 10.3389/FNSYS.2015.00007/BIBTEX. URL: <https://www..>
- [5] Mikhail A. Lebedev and Miguel A.L. Nicolelis. "Brain-machine interfaces: past, present and future". In: *Trends in Neurosciences* 29.9 (Sept. 2006), pp. 536–546. ISSN: 0166-2236. DOI: 10.1016/J.TINS.2006.07.004.
- [6] Miguel Pais-Vieira et al. "A Brain-to-Brain Interface for Real-Time Sharing of Sensorimotor Information". In: *Scientific Reports* 2013 3:1 3.1 (Feb. 2013), pp. 1–10. ISSN: 2045-2322. DOI: 10.1038/srep01319.

Thank You!