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Neural control of a robotic hand prosthesis by posture-related activity in the grasping circuit

Hunaid Hameed[1], Andres Agudelo-Toro[1], Marco Controzzi[2], Hansjörg Scherberger[1,3*]
[1]*German Primate Center, Göttingen, Germany;*
[2]*The Biorobotics Institute, Scuola Superiore Sant'Anna, Pisa, Italy;*
[3]*Department of Biology and Psychology, University of Göttingen, Göttingen, Germany*
*E-mail: HScherberger@dpz.eu

Introduction: Spinal cord injury can severely limit hand movement capacity, making it a top recovery priority for patients [1]. Although significant progress has been made towards hand neuro-prostheses, these devices are still limited to basic grasping and cannot reproduce the rich set of configurations of the native hand yet. Despite evidence of abundant posture information in cortical hand areas [2], hand neuroprosthetic protocols have focused predominantly on the movement velocity aspect of control, using this approach to control hand joint synergies, or individual finger movements [3, 4]. We recently demonstrated that the cortical posture signal in hand-related areas can support accurate hand neuroprosthetic control for multiple DOFs in a virtual environment [5]. Whether this technique extends to robotic control is yet to be tested.

Material, Methods and Results: Working with a macaque monkey implanted in motor cortex, we demonstrate that posture signals in hand-related cortical brain areas can support neuroprosthetic control on a robotic arm and hand platform (Fig. 1). Our intention estimation protocol incorporates position and velocity control through re-fitting to kinematic trajectories. The protocol assumes that the subject aims to execute a transition in the space of hand configurations, extending intention estimation for velocity control to posture-based control. In the present work, we aim to determine the changes in neural activity required to support posture based control and the lessons learned when porting our protocol to the robotic platform.

Conclusion: We demonstrate our posture and velocity intention estimation technique can extend to a robotic device, opening the door to future implementations using this additional position signal.

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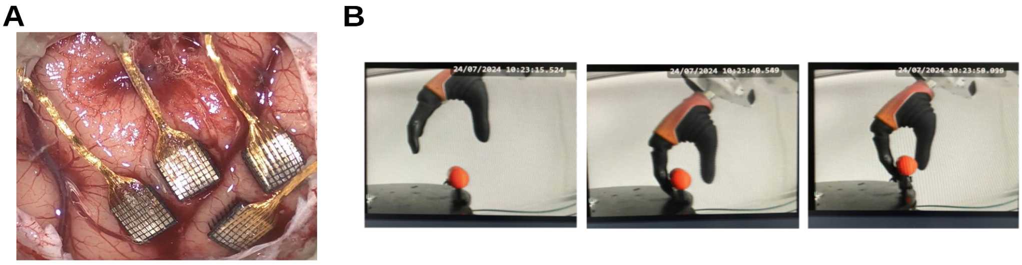

Figure 1: A. *Implant on areas M1 and S1 of monkey N. Only M1 was used for decoding. B. Example grasp and lift with the robotic platform.*

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