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Presentation Abstract

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Abstract: Myoelectric prosthetic hands are currently controlled by EMG activity from the remaining arm muscles in an amputee. However, many amputees do not use their prostheses because the control is inaccurate and non-intuitive. In this study, we explored whether such a system could be improved by accessing native commands from human motor cortex using sub-dural surface electrocorticographic (ECoG) signals. Signals were recorded from one research participant undergoing ECoG monitoring for epilepsy, who performed 416 grasps and finger movements (Blabe et al., SFN 2011). A total of 64 channels were processed (Gilja et al., SFN 2011). Power in the high-gamma band (72-244 Hz) was used to decode which movement the participant had been performing with a Naive Bayes classifier using full cross validation.Overall, using a 2 sec integration window during known movement periods, one of five isometric grasps (fist, pinch, point, splay) and rest could be successfully identified 90% of the time (20% chance). One of four fingers (all but pinkie) and rest could be identified correctly 83% of the time (20% chance). When the participant was asked to simply imagine the movements, performance remained substantially above chance, with 65% correct identifying grasps.However, the data also illustrate two challenges to achieving this accuracy in a clinical system. First, sensory signals, which will presumably not be present in an amputee, are likely inflating performance. While it is possible to remove electrodes that are primarily sensory from the decoder (using imagined tasks and anatomical location as a screen) many of the remaining electrodes display a second rise of gamma power during isometric contractions, potentially also reflecting sensory activity. Restricting the decoder to 500 ms of neural activity prior to movement onset reduces performance from 90% to 77% correct.Second, it is important to determine whether classifiers will function in the presence of other arm movement. Therefore, the participant was asked to perform simultaneous wrist flexion and extension with the same hand during grasps. Consequently, grasp classification performance dropped from 90% to 68%. This is because most active electrodes showed generalized responses to any hand movement, which can obscure small power differences between grasp types. Further work is required to determine if robust classification can be done in the presence of other movements.All together, these results suggest that ECoG may be a potential signal source for intuitively controlling a prosthetic hand. Performance could potentially be improved by using more optimally placed, higher density ECoG grids or intracortical electrodes.

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