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HIGH INFORMATION TRANSFER RATES IN A NEURAL PROSTHETIC SYSTEM

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Information extracted from neural prosthetic systems may be used in various ways, including maneuvering a robot arm or selecting characters in a spelling device. Bits per second (bps) quantifies the information transfer rate of such communication systems. Researchers have reported bit rates approaching 0.5 bps (EEG) to 1.6 bps (intracortical). We attained information transfer rates exceeding 5 bps using a neural prosthetic system. We trained a rhesus monkey to perform delayed (200−1000 ms) center−out reaches in several target layouts. Cortical neural activity was recorded and decoded as we described in Ryu et al., also in this volume. During prosthetic icon trials, we predicted the most likely reach target using 100−275 ms of delay activity starting 150 ms after target onset. Trials ended ~40 ms after the neural analysis window. The mutual information between the presented and predicted targets was calculated providing an estimate of the bits extracted by the system per trial. The analysis window length presents a fundamental trade−off between accuracy (bits per trial) and overall trial time (the denominator in the bps calculation). Based on the average total time per trial during icon runs, the maximum sustained transfer rate was 5.3 bps obtained with the 8 directions, 1 distance (8x1) target layout and 200 ms of delay activity. Based solely on this 200 ms analysis window, the maximum sustained transfer rate was 11.3 bps. Sequential icon success rate was 77.4% (343 of 443 icon trials, one session). The error structure contributed to the bps as most misestimations were adjacent to the true target (90 of 100 errors). For other layouts, we observed the following −− (2x1): 1.5 bps; (4x1): 3.4 bps; (4x2): 3.6 bps; (8x2): 2.5 bps. To our knowledge, our classification approach to icon positioning results in the highest information transfer rates reported for brain−machine interfaces.

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