Motor Cortical Encoding of Hand Orientation in a 3-D Reach-to-grasp Task

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Abstract

The Center for Neural Interface Design of the Biodesign Institute at Arizona State University conducted an experiment to investigate how the central nervous system controls hand orientation and movement direction during reach-to-grasp movements. ANOVA (Analysis of Variance), a conventional data analysis widely used in neural science, was performed to categorized different neural activities. Some preliminary studies on data analysis methods have shown that the principal assumption of ANOVA is disobeyed and some characteristics of data are missing from taking the ratio of recorded data. To compensate the deficiency of ANOVA, ANCOVA (Analysis of covariance) is introduced in this project. By considering neural firing counts and temporal intervals respectively, we expect to extract more useful information for determining the correlations among different types of neurons with motor behavior. Comparing to ANOVA, ANCOVA can be one step further to identify which direction or orientation is favored during which epoch. We find quite amount of neurons coding for movement direction, hand orientation, or interaction of both, and some of them are significant in more than one epoch, which indicates there exists a network with unknown pathways connecting neurons in motor cortex throughout the entire movement. For the future studies we suggest to integrate this study into neural networking in order to simulate the whole reach-to-grasp process.