Brain-Computer Interface to Control a 6 DOF Robotic Arm

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In this study, a brain-computer interface (BCI) system is developed to control a six degrees of freedom robot arm. Such interface systems have a potential application in space missions for astronauts to have supplemental human-robot communication platform. Also, such human-robot interface system can be used to aid and enhance the quality of life for people with disability. However, decoding brain signal information into multi-degree of freedom system is a real challenge as the signals are easily affected by noise and crosstalk. In this research, an integrated electroencephalogram (EEG) and near-infrared spectroscopy (fNIR) system is used to record the brain's electrical activity and its blood-oxygen-level dependent (BOLD) responses. Then an algorithm has been developed and used to classify the signals related to six different directional intents. These six different features were utilized to command a robot manipulator to follow the six directional motions (left-right, up-down, and in-out). The task planning, robot kinematics and dynamics are computed using MATLAB/SIMULINK environment. Polynomial based inverse kinematic approach is applied to find the corresponding robot joint positions. The integrated system was simulated in a virtual environment using unity software. The preliminary result has shown the feasibility of decoding brain signals to create a BCI systems for the control of multi-degrees of freedom robotic system.