The Implementation of RBF Kernel Support Vector Machine Classifiers with Discrete Wavelet Transform on an Electroencephalographically Controlled, Finite Elementally Analyzed, and PID Stabilized Exoskeleton

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Approximately 5.4 million individuals within the U.S. have been diagnosed with a certain order of paralysis. Although these patients have dysfunctional neuromuscular connections, prohibiting desired movement, they emit electric signals read through EEGs. Using Support Vector Machine (SVM) classifiers with optimal margin hyperplanes, specific electrical potentials can be associated with respective classes. Applying the Automatic Artifact Removal (AAR) toolbox, the system minimizes the error associated with electroencephalographic signal classification by removing repetitive or erroneous data. The signal is then decomposed using Discrete Wavelet Transform (DWT) into vectorized features for classification. The EEG classification will be implemented on an exoskeleton framework to execute actions on behalf of the patient. A Proportional Integral Derivative (P.I.D) controller accounts for imbalances in the system's center of mass and allows for added stability when the patient is wearing the exoskeleton. Prior to the implementation of this system, computational mechanical models were developed to anticipate the framework's mechanical variables, including degrees of freedom, axial loads, and configuration space, allowing for predictive error analysis.The exoskeletal system had statistically significant similarities ($a < 0.01$) with the computational simulation in terms of reaction functions and error minimization within the linear actuators. In addition, the SVM classifier, after the completion of its training stage, successfully classified incoming electric signals with statistical significance ($a < 0.01$). With the continuation of modeling methods and SVM training, the system would be able to permit paraplegics to partake in routinely tasks.

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