Abstract:

Surface Electromyography (SEMG) signal measurement technique in which an electrode connects to the surface of human muscle skin was produced from the mechanics of human muscle contraction. This study presents an off-line design for estimation of the actual joint angle of a human leg afflicted by foot drop disease. Flexion and extension of the leg are performed at low-speed and high speed movements. The design phases (two) first have real human-leg EMG signal measured by SEMG and processed by filtering, amplification and normalization with maximum amplitude, next an Artificial Neural Network (ANN) is trained to predict the joint angle from the parameters extracted from the SEMG signal. Three main parameters of the EMG signal are used in the prediction: the number of turns in a specific period, duration of signal repetition and signal amplitude. The ANN design includes two-speed (slow and fast) identification of the EMG signal and estimation of the knee joint angle by a recognition process that depends on the parameters of the real EMG signal measured from full leg-extension to full leg-flexion in slow motion (3 sec) and fast motion (1 sec). Root Mean Square (RMS) errors were calculated between the actual angle (trigonometric formula applied to human leg gives the real EMG signal measurement) and the angle predicted by the ANN. The design was simulated on MATLAB Ver. R2018a. Satisfactory results obtained show possible estimation of human leg joint angle with RMS errors of (0.065)-(0.015) in fast leg flexion-extension and (0.018)-(0.0026) in slow leg flexion-extension.