

Clasp-Knife Model of Muscle Spasticity for Simulation of Robot-Human Interaction

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Abstract

The objective of this research was to replicate the muscle tone moment feedback of elbow upon passive mobilization and classify them based on modified ashworth scale criterion using a mathematical model. The proposed model enables the visualization of muscle tone pattern for robotic interaction simulation. A concurrent muscle tone model necessitates a jerk effect to fully replicate the catch and release effect, also known as, clasp-knife phenomenon of muscle tone feedback. However, the research of passive mobilization control interaction between robot and subject does not emulate such phenomenon. Thus, the model was improvised to replicate the clasp-knife phenomenon according to the robot's gross kinematics and dynamics. The model was designed based on the quantitative pattern of muscle tone feedback from subject with spasticity. The simulated model was then correlated to clinical measures using similar kinematic and dynamic input. The velocity dynamic input was splined to obtain the velocity trend without the jerk effect. The results obtained from the proposed model were relatively promising with an overall (n = 9 x 4) linear (Pearson) correlated average of (r) over bar = 0.8348 for nine subjects with correlation significant at the 0.01 level (p < 0.01) and five of them presented a distinctive clasp-knife phenomenon with correlation average of <(r)over bar> = 0.8631.

Keywords

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