

## Computational Modelling of Musculoskeleton to Predict Human Response with Upper Arm Exoskeleton

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### ABSTRACT

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There are many situations where elderly people find it difficult to do their daily work, stroke affected people face difficulty in doing their daily routines independently, soldiers of the country also face problems in carrying heavy loads in rough terrains for long time. An external wearable outfit which increases the capabilities of a normal human being is called the exoskeleton. To design and manufacture an upper arm exoskeleton for upper extremity of human body, computational studies and analysis is to be made as the working model is a wearable device, it should not harm the user in any condition. To analyze the effect of wearing an upper arm exoskeleton, an inertial measurement unit is placed on a subjects forearm at the center of mass point. The specified arm movement considered in sagittal plane is performed wearing the IMU so that the angular displacement readings are extracted. The extracted data is fed to a human body simulation software lifemod where the human model does the same arm movement as the subject. Kinematic parameters are plotted from the software, to check whether the software's reading is appropriate a mathematical model is developed using lagrangian equation for the same arm movement in sagittal plane and the torque equations obtained are solved using matlab software. Both the plots of kinematic parameters are compared. The plots from both software's match perfectly proving that the simulation software readings are near to reality. Muscle activation plots without exoskeleton condition are plotted for different weights and for different wrist positions. An upper arm exoskeleton is designed in ADAMS software and is imported to the model and analysis is made while lifting different weights and for different wrist positions. Muscle activation plots are obtained for all the cases with exoskeleton condition. Muscle activation values from with and without exoskeleton condition proves the usefulness of using an exoskeleton. The muscle activation is very low in case while using an exoskeleton which shows that with minimal human effort more work can be done.