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Estimation of the Human Dynamic Behavioural Model in Human and Rectilinear-Motion-Machine Interaction

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Abstract. Human-machine interface, which is a component of humans being capable of interacting with machine devices in a safe and reliable manner, has become a challenge and crucial issue. Moreover, an understanding of human dynamic characteristics, when haptic interacting with a machine, can significantly influence a conceptual guideline for a robotic human-like control strategy. This paper thus presents the estimation of the dynamic model of human behaviour during performing rectilinear-motion-machine interaction. Object manipulating tasks have been strategically designed and conveyed, in which an influence variable, namely friction force against the object movement, was exerted. During undertaking the haptic interactive tests, human applied force, grasping force, object displacement and its corresponding velocity are simultaneously captured and monitored in real-time. The McRuer extended crossover model has been used in order to identify the human arm behavioural characteristics. The estimated results were mathematically adopted at the consistent perception-reaction time of 0.16 s. It reported that a human loop gain is associated with resistance force applied to the system, in which it ranges between 40-75. Lead-time and lag-time parameters have fluctuated from 0.01 to 0.04 s, which are not significantly affected by changing the frictional forces. In addition, the proposed human dynamic models are in significantly compromising matching with the actual experimental data by representing the model fitting of approximately 73%-75%. Therefore, the extended crossover models can be subsequently used to present the human arm characteristics and will be further implemented on a robot arm to perform the same object-manipulating tasks for future work.