Development and Evaluation of a Simple Load Lifting Techniques

Abstract

Conventional ergonomics utilizes second-order control systems and three-dimensional models, but their complexity makes them unsuitable for practical development. In this paper, a simple mechanism for lifting objects by temporarily setting the load to zero was devised by applying basic techniques of kobujutsu (Japanese ancient martial arts). The accuracy of this mechanism was confirmed by simulation and experiment. This mechanism reveals that the speed of reflection of signals by the brain is important to essentially increase the output of human muscles, enabling efficient and simple movements. It is suggested that the method of lifting objects revealed in this paper is not limited to martial arts and other sports fields but could be applied to a wide range of fields such as nursing care and agricultural work. The development and evaluation of the simple object lifting technique demonstrated in this paper is expected to activate and improve the motor skills of the public and have a positive impact on health maintenance activities.

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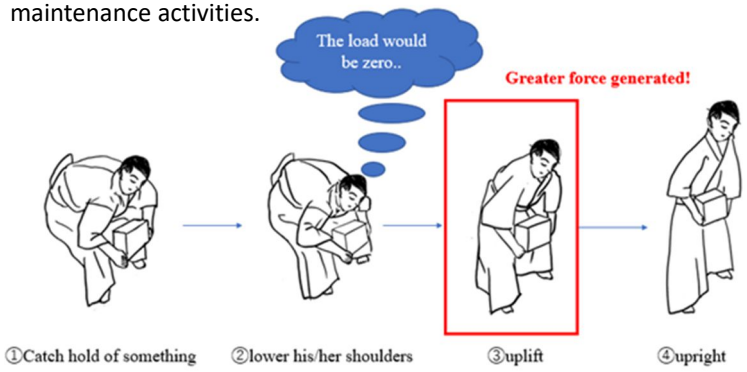
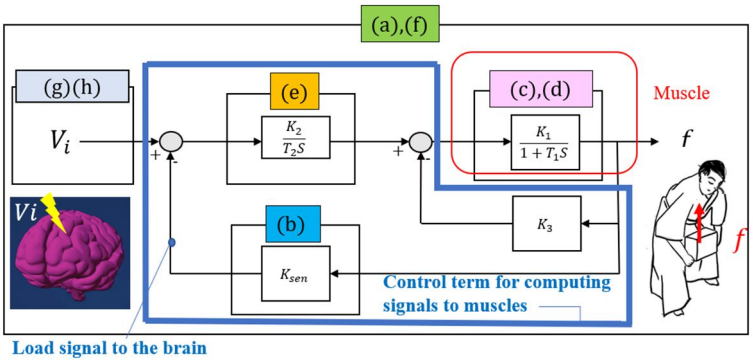




(a)Modellingand initial-value assignment

(b) Sensor is set to zero for 0.5 sec

(c) Vary the time constant T_1

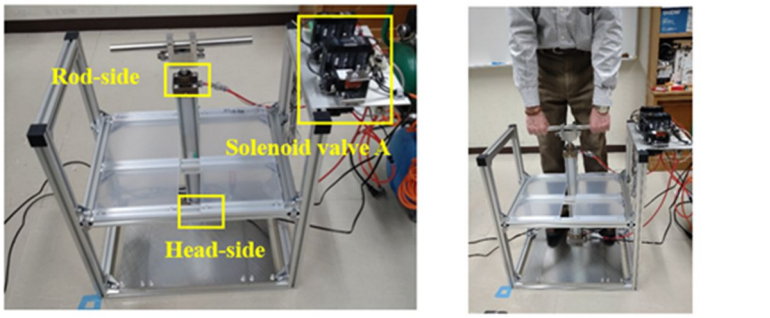
(d) Vary the proportional gain K_1

(e)Vary K2 related to head signal processing speed

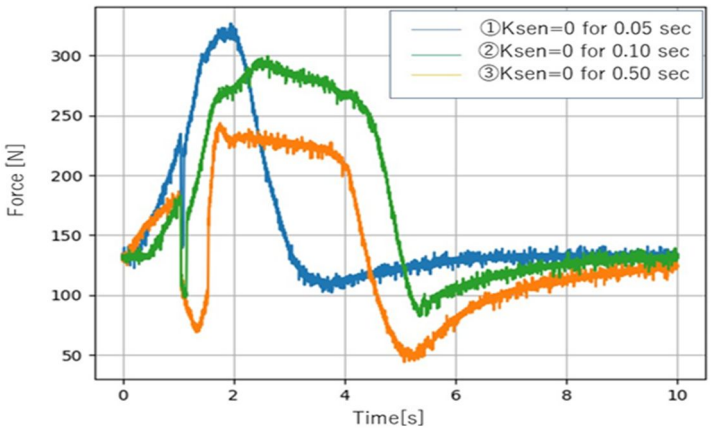
(f) Assign Vi model to coefficients that are consistent with actual human models

(g) ConvertVi's model from step to ramp to get closer to actual brain signals

(h)Bring the command signal Vi from the head closer to the masters of ancient martial arts.



(a) Experimental apparatus in lifting objects (b) When the object is made to pull a lever



Conclusions

The authors have shown that brain activity must be fast for humans to draw on the potential power associated with physical actions in sports and daily life, by means of a first-order delay control system. This mechanism confirms that the speed of signals (reflexes) sent from the brain is an important factor in muscle movement. The development and evaluation of this simple mechanism facilitates an essential understanding of human physical behavior. For example, a change in the input signal alone does not lead to an increase in force. Therefore, if you intentionally remove the force yourself, the integrator ceases to function. In martial arts, the upper body is temporarily lowered while force is applied, leaving the muscles intact. By dropping the body, the load is reduced to zero, which can be used to generate greater force when lifting objects. This method of lifting objects will make a significant contribution to the fields of nursing care and agriculture. In addition, as neural networks develop with the advent of the Singularity era, devices and training methods that activate the brain will be developed. The authors hope that the control model for lifting objects based on this theoretical background will help the public to improve their motor skills associated with the activation of their motor nerves and maintain the health activities.