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The Effect of the Rotary Inertia on the Reaching Movement in Virtual Space Using VR

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Abstract— **In this study, we constructed an experimental system using virtual space, and prepared a virtual arm whose movement dynamics parameters in the computational model were different from those of the subjects in the virtual space. In particular, an experiment was conducted to evaluate motor adaptation when the rotary inertia of the human arm was changed. The state of motor adaptation to the change in the rotary inertia was observed, and it was found that the subject can maintain the movement accuracy prior to the change.**

I. Introduction

In previous research, we theoretically examined the Fitts' Law and Isochrony principle and proposed a computational model for human arm movement time and movement trajectory planning [1]. In this study, we constructed an experimental system using virtual reality (VR) and conducted experiments. By doing so, we will evaluate the validity of the computational model for human arm movement time/movement trajectory planning and consider changes in the movement function from the computational model. Specifically, we prepared an arm in a virtual space whose movement dynamics parameters in the relational model of human arm movement time and movement accuracy are different from those of one's arm. In this study, we investigated the rotary inertia of the link around the joint as the movement dynamics parameters, and examined adaptation before and after the dynamics change.

II. Method

Three healthy men aged 22 to 23 years (all right-handed) participated in the experiment. The subject performed the reaching movement task in four directions towards the target displayed on the monitor and table prepared in the virtual space. The experiment consisted of 3 sessions. Session 1 and Session 3 were conducted without changing the movement dynamics, and Session 2 was conducted with changing the movement dynamics. Session 2 has Training trials and Catch trials. In the Catch trial, the arm in the virtual space was hidden to confirm the after effect of motor adaptation. In this experiment, we prepared an arm whose rotary inertia of the link around the joint was different from that of the subject. The rotary inertia in Session 2 was 0.1 greater than the subject's rotary inertia. To evaluate adaptation we measured hand trajectory. The tangential velocity was calculated, and with 5% of the maximum value as the threshold value, the sample exceeding the threshold value was determined as the start of the movement, and the sample below the threshold value was determined as the end time of movement. Then, the square error of the end-point in each direction of the task was calculated.

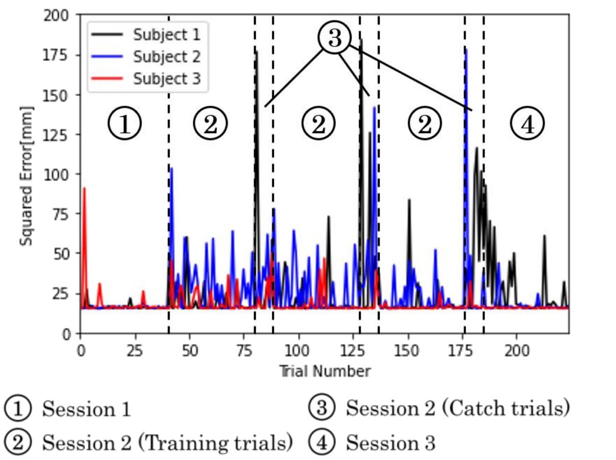

Fig. 1 Squared error between the position and the end point targets.

III. Result

Fig. 1 shows the result of the square error between the position at the end of the movement and the target of each trial for each subject. When rotary inertia was 0.1 larger than the subject's rotary inertia was used, the square error tended to decrease with each trial in the training trials of Session 2. In Session 3, after the squared error increased again, it was seen that it declined to the right.

IV. Discussion & Conclusion

In this study, experiments were conducted to evaluate changes in movement function from a computational model using VR. we investigated whether it was not possible to adapt to the change and generate a movement with the same accuracy as when moving with one's arm. As a result, the error increases temporarily; however, motor adaptation is observed. Therefore, this result might not be explained by changes in movement function with rotary inertia alone.

References

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