Drawing Assist System with Focusing on the Velocity of Involuntary Movement

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Abstract— Creative activities such as painting and music are one source of satisfaction and fulfillment for people with disabilities. However, some individuals with a disability cannot satisfactorily enjoy such activities because of involuntary movement or spasms. In this study, we developed a drawing assist system for patients with cerebral palsy of the tension Athetosis type. We designed a variable filter to attenuate involuntary movement on the basis of the behavioral characteristics of the velocity component with respect to involuntary movement. We verified that it could support patients with such physical disabilities of weak severity.

I. INTRODUCTION

Many people with physical disabilities enjoy creative activities as a means of self-expression and motivation in life. Painting is one such activity that disability person can perform using residual functions. Whether the act of painting can be satisfactorily enjoyed depends in part on the degree of the individual’s disability. Insofar as involuntary movements affect body control, precise fine-motor movements become difficult to perform, limiting the ability to perform desired tasks such as painting and drawing.

To address these problems for people with involuntary movements who draw using computer graphics, studies have been conducted on systems that filter the effects of involuntary movements from the input signal of a device so that the on-screen pointer does not show any unintended movement. IBM developed the Assistive Mouse Adapter by using a simple design where the cut-off frequency of the linear low-pass filter is tuned with a dial [1]. Morimoto developed a painting tool based on the moving average method that attenuates the effects of involuntary movements in real time, and proposed the averaging switching and compulsory compensation methods as solutions for attenuating the effects of sudden shaking [2].

Our research group has proposed a method that changes attenuation based on the strength of involuntary movements by using the magnitude of velocity from a three-dimensional input device [3]. However, at that time we conducted the experiment only for a user with strong involuntary movements. The system which can be used regardless of the severity level is ideally desirable. Therefore, we carried out tests with another user with weak severity using developed system.

II. DRAWING ASSIST SYSTEM FOR PATIENTS WITH CEREBRAL PALSY

The proposed drawing assistance system consists of an input device that the users manipulate directly, a computer that runs our controller and a drawing software, and an output device that displays the result image. We also used a compact haptic interface, the Phantom Omni and the raster graphics editor, ArtRage, version 3.0 [4][5]. The experimental environment is shown in Fig. 1.

III. EXPERIMENTAL RESULT

In drawing assist experiments using an adaptive involuntary behavior attenuation filter the user could draw curves that require continuous veering, even when involuntary movements caused loss of drawing control. Additionally, our system enabled drawing based on the user’s own senses. We verified that it could support patients with such physical disabilities of weak severity.

REFERENCES