Development and Feedback Control of a Human Machine Interface for Braille Reading

Melda Ulusoy  PI: Rifat Sipahi

Introduction

Background

The experiments [4] carried out with experienced readers reveal that the velocity of the finger changes frequently during Braille reading. It is also reported that the majority of the sentences introduced to the subjects attracted reversals. That is, readers moved their fingers from right-to-left in order to re-scan a previously read word which was not understood completely in the first pass.

Based on the above information, we hypothesize that efficient and rapid Braille reading can be achieved with a finger-speed adaptive device that allows reversals to re-read the text whenever necessary. A good example for such a device would be the rotating-wheel braille reading device utilizing the disturbance adaptive controller as discussed in the next section.

Disturbance Adaptive Controller

Concept: The disturbance adaptive controller is envisioned to be designed for a rotating-wheel display like Braille reading device to enhance its utility via feedback-control in order to provide the user with an interactive Braille reading experience by adapting Braille display speed to user’s finger motion.

Goal: Based on the disturbance adaptive controller we can estimate the finger-motion and control the text flow according to the user’s needs. The figure on the left illustrates a user moving his/her finger right to left on the text to re-read a previously read word and the machine adaptation to his/her finger-motion.

With the user-adaptive control of the text flow in real-time, we aim to achieve reduced number of braille cells needed in a device. This could ultimately lead to low cost and portable braille reading devices.

Proof-of-concept on Machine-to-Machine System: In order to validate the concept, a machine-to-machine system is built, which can be considered analogous to a system in which a finger interacts with a device, and the device adapts to finger movement.

Areas of improvement include:
• Costs
• Portability of the device
• Response time of the braille cells
• User-adaptive interface for easy reading

Future Work

• Human subject experiments with the disturbance adaptive controller (IRB# 13-08-32)
• Evaluation of how effective the proposed controller is in providing Braille reading experience

References


Acknowledgements

1. Mechanical and Industrial Engineering Department