International Journal of Innovative Computing, Information and Control
Volume **6**, Number **5**, May **2010**

 ISSN 1349-4198
pp. 2103–2111

FLUID AND NATURAL PEN INTERACTION TECHNIQUES BY UTILIZING MULTIPLE INPUT PARAMETERS

Chuanyi Liu and Xiangshi Ren

The School of Information
Kochi University of Technology
Tosayamada-cho, Kochi 782-8502, Japan
ren.xiangshi@kochi-tech.ac.jp

Received October 2008; revised April 2009

Abstract. *Nowadays, commercial electronic pens commonly possess multiple input parameters (e.g. stroke, pressure, tilt angle, twist angle and azimuth). Current studies on the utilization of the parameters typically focus on the human ability to control the input parameters or on novel techniques which exploit only one parameter. In this paper, we discuss how to employ multiple parameters for pen input to make operation more fluid and natural than the current case with traditional interfaces.*
Keywords: Multiple parameters, Pressure, Tilt angle, Azimuth, Pen-based interaction, Continuous interaction

1. **Introduction.** Pen-based interfaces have been explored extensively in recent years. Nowadays, commercial electronic pens commonly possess multiple input parameters (e.g. stroke, pressure, tilt angle, twist angle and azimuth). The utilization of pen input parameters can widen the human-computer interaction bandwidth. Therefore, some studies have explored the human ability to apply pen input parameters in human computer interaction (e.g. [10, 22, 25]). Others have focused on pen parameter-enabled applications or techniques (e.g. [16, 19, 24]). However, few studies have explored the simultaneous utilization of more than one pen input parameter with the intention of making operation more fluid and natural than traditional interfaces.

Commonly, a computer task is performed through three phases in the following order: object selection, command selection and object manipulation. Switching between these phases can be performed by tapping on menu items or by pressing down predefined hot keys in the traditional WIMP (Windows, Icons, Menus and Pointing devices) interfaces. However, in most pen-based interaction environments, the hot keys are not available and it is tiring to move the pen tip repeatedly over long distances. Therefore, it is worthwhile to enhance the continuity of pen-based operations. Continuous interaction is a very important feature in pen-based user interfaces [14]. Liu and Ren have comprehensively evaluated six pen-suitable mode switching techniques [12] and proven that smooth operation with a pen-suitable switching mode is more efficient than the traditional interfaces [13] used in pen-based systems. Through the studies of Liu and Ren, we found that pen input parameters have the potential to make operation more natural and intuitive than traditional interfaces.

Based on these considerations, we designed four techniques, which integrate and exploit multiple pen input parameters and allow users to operate fluidly and naturally throughout the whole process from object selection to object manipulation. All the techniques were implemented and combined in a pen-based drawing application which we developed for testing.