Comparing Speed-dependent Automatic Zooming with Traditional Scroll, Pan and Zoom Methods

Andy Cockburn & Joshua Savage

Human-Computer Interaction Lab, Department of Computer Science, University of Canterbury, Christchurch, New Zealand

Tel: *+64 3 364 2987*

Fax: *+64 3 364 2569*

Email: *{andy,jps42}@cosc.canterbury.ac.nz*

Speed-dependent automatic zooming couples the user's rate of motion through an information space with the zoom level — the faster the user moves the 'higher' they fly above the work surface. Igarashi & Hinckley [2000] proposed using the technique to improve scrolling through large documents. Their informal preliminary evaluation showed mixed results with participants completing scrolling tasks in roughly the same time, or more slowly, than when using traditional methods. In this paper, we describe the implementation and formal evaluation of two rapidly interactive speed-dependent automatic zooming interfaces. The ecologically oriented evaluation shows that scrolling tasks are solved significantly faster with automatic zooming in both text document and map browsing tasks. Subjective preferences and workload measures also strongly favour the automatic zooming systems. Implications for the future of scrolling interfaces are substantial, and directions for further work are presented.

Keywords: navigation, scrolling, zooming, speed-dependent automatic zooming, evaluation.

1 Introduction

Scrolling, panning and zooming are used to navigate through information spaces that are too large to be conveniently displayed within a single window. While

E. O'Neill et al. (eds.), *People and Computers XVII — Designing for Society*

scrolling and panning move the workspace within the window, zooming alters its scale. Because zooming changes the proportion of the workspace shown in each window, more scrolling is necessary when zoomed in, less when zoomed out. Most systems for browsing text and graphical documents support scrolling and zooming, and many also support panning.

Until recently, there had been surprisingly little research into understanding and improving the psycho-motor performance of scrolling. Zhai & Selker [1997] showed that mouse-driven scrolling can be improved through the use of isometric controls that vary scroll rate with force. Hinckley et al. [2002] showed that scrolling is accurately modelled by Fitts' Law [1954] even though it involves acquiring targets beyond the edge of the screen, and that mouse-wheel scrolling is improved by acceleration algorithms. These findings aid the theoretical understanding of scrolling, but they do not alter its basic behaviour. Consequently, they do not address the fundamental limitations of scrolling.

One of these limitations, identified by Igarashi & Hinckley [2000], is the disorientation caused by excessive visual flow when scrolling rapidly. In long documents a small movement of the scrollbar thumb causes a large movement in the document, and the rapid rate of change can be too great for the user to perceive, resulting in a visual blur. Although users can ease this problem by altering the zoom level before and after scrolling, doing so involves tedious interface manipulations.

Igarashi & Hinckley proposed speed-dependent automatic zooming (SDAZ) as a solution. SDAZ automatically varies the zoom level dependent on the scroll rate. When scrolling quickly the display is zoomed out, and when stationary or scrolling slowly the display is zoomed in, as shown in Figure 1. An informal preliminary study (n = 7) of the technique found that in Web and map browsing tasks, the efficiency with SDAZ was, on average, the same or slightly worse than traditional scrolling methods. Subjective preferences were also divided. Their paper and their prototype implementations[1] provide dramatic and compelling demonstrations of the technique. There is, however, a risk that their results were adversely affected by the informal nature of the evaluation and by implementation compromises that were necessary to aid rapid and fluid interaction in their Java prototypes.

This paper describes a formal evaluation of speed-dependent automatic zooming in support of everyday document navigation tasks. Section 2 describes the design and implementation of our document and map browsing applications. The experimental design and results are presented in Section 3 and 4. Results are discussed, compared with related work, and used to direct further work in Section 6. Conclusions are presented in Section 6.

2 Document and Map Browsing Applications

Igarashi & Hinckley described five prototype SDAZ applications: a Web browser, a map viewer, an image browser, a dictionary browser, and a sound editor. The image browser, dictionary browser and sound editor were not promising (as discussed in Section 6), so they evaluated only the Web browser and the map viewer.

[1] A demonstration applet is available at www-ui.is.s.u-tokyo.ac.jp/~takeo/java/autozoom/autozoom.htm