# Around the World in Seconds with Speed-Dependent Automatic Zooming


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## ABSTRACT

Speed-dependent automatic zooming (SDAZ) interfaces allow rapid navigation through large visual information spaces by automatically zooming out when the user moves quickly through the dataspace. We have implemented a variety of SDAZ interfaces that provide compelling map-based demonstrations of the technique. In particular, our 'globe browser' demonstrates fluid and rapid navigation that fluidly integrates street-level details with continental views. Although other systems such as Keyhole Inc.'s EarthViewer3DPro (www.earthviewer.com) allow similar visual effects, they require the user to switch between distinct control modes to navigate the information space. Our modeless SDAZ interfaces are rapidly and naturally controlled simply by dragging the mouse.

A video demonstration is accessible at:
http://www.cosc.canterbury.ac.nz/~andy/sdaz.mov



**Keywords:** Speed-dependent automatic zooming, scrolling, zooming, focus+context.


## INTRODUCTION

Rapid movement through an information space can cause disorientation and confusion due to motion blur [1] or rapid transitions between pre- and post-movement views. Many computer tools are susceptible to this problem, including any interface that supports scrolling.

One method of reducing motion blur is to zoom away from the information as the rate of motion increases. To our knowledge, this technique was first demonstrated in 1997 in the computer game "Grand Theft Auto" (rockstargames.com) in which the user's view progressively zooms out to show more city blocks as the driving speed increases. The connection between zoom-level and speed was also demonstrated in 1997 by Ware and Fleet's [2] "Depth Modulated Flying", which varied the fly-by speed of visualisations according to the zoom-level.

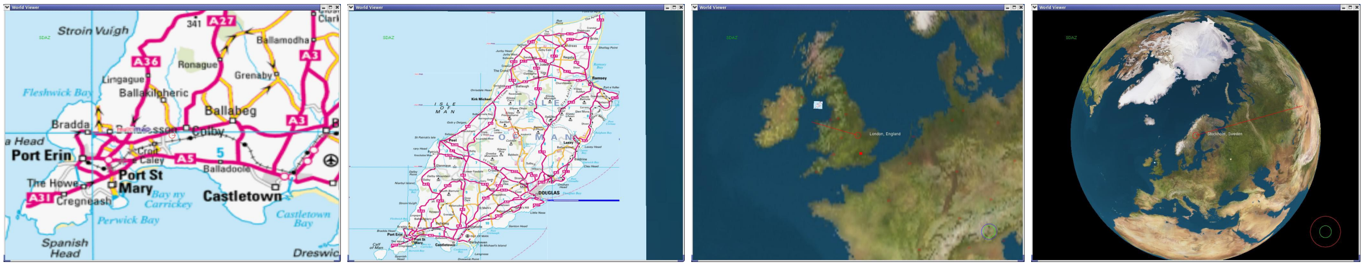
More recently, Igarashi and Hinckley [3] described five "Speed-dependent automatic zooming" (SDAZ) systems that automatically changed the zoom-level with scrolling speed: a web browser, a map viewer, an image browser, a dictionary, and a sound editor. Only the web browser and map viewer were evaluated as the other applications did not seem promising. Their evaluation produced discouraging results, with user performance slower or no different with the SDAZ interfaces than with traditional ones. Igarashi and Hinckley stressed the desirability of further evaluations using real maps—in order to achieve high frame-rates in their Java implementations, they used artificial synthesized maps that lacked many of the contextual cues present in real maps.

Positive results for coupling zoom level (or 'flying altitude') with movement speed were produced by Tan, Robertson and Czerwinski [4] who described a "speed coupled flying and orbiting" interface for navigating a 3D virtual world. Our recent work [5] also showed positive results for SDAZ. We re-implemented and evaluated interfaces similar to the web-browser and map-browser originally demonstrated by Igarashi and Hinckley. Our OpenGL interfaces allowed us to overcome some of the limitations arising from the Java implementations. In particular, we were able to achieve high frame-rates and fluid interaction with real maps, rather than synthesized ones. Results indicated that SDAZ dramatically improved performance in document and map browsing tasks, when compared to traditional interfaces.

## OUR SDAZ INTERFACES

The accompanying video demonstrates our on-going development of SDAZ interfaces, extending it to multi-scale and focus+context interfaces. The globe browser and the 'focus+context' map browsers have not previously been demonstrated or described.

All of our SDAZ interfaces are controlled by dragging the mouse in the direction of desired movement. The speed of motion through the information space (and consequently the zoom level) is controlled by normal rate-based scrolling—the greater the displacement between the mouse-down




**(a) Slow over a detailed map.** **(b) Fast over a detailed map.** **(c) Slow in the global view.** **(d) Fast in the global view.**

**Figure 1. The range of zoom-levels in the globe browser, automatically zooming out with increased movement speeds.**

coordinates and the current mouse coordinates, the greater the speed of motion. To reduce the potential disorientation of rapid changes in the display, all of the interfaces have a maximum rate of change for the zoom-level. For instance, if the user stops abruptly by releasing the mouse button, the 'maximum fall rate' rapidly animates the return to the maximum zoom-in level.

One recent modification to all of our systems (in contrast to those earlier evaluated by us and by Igarashi and Hinckley) is that the 'fall' is not vertical, but centred on the location of the cursor when the mouse is released. Consequently, if the user releases the mouse-button when the cursor is over information "X", then the animated fall occurs on a trajectory that brings "X" to the centre of the display. We made this modification because many test users commented that their eyes naturally followed the cursor (rather than the centre of the screen), and that they felt their target was effectively acquired when the cursor was over the target. With a vertical fall, this visually acquired target would often be outside the displayed region once full zoom was reapplied.

Although the accompanying video provides a brief overview of our document and map browsing interfaces, for brevity we only describe the globe-browser here.

The globe browser[1], shown in Figure 1, provides a powerful demonstration of SDAZ's ability to allow rapid and natural transition between local regions of detail and global contextual information. Images of the Earth's surface are stitched to form a globe, and map details of several cities/regions are overlaid onto the globe. Dragging the mouse in any direction causes the globe to rotate so that the region under the cursor moves towards the centre of the display. Displacing the cursor further from the mouse-down location increases the rate of rotation, and consequently increases the zoom level. When the user stops over a region with no underlying detailed map, the zoom level remains equivalent to that of a high-altitude (Figure 1c). However, if the user stops or moves slowly over a city map, then the display zooms in to a street-name level of detail (Figure 1a). When moving over a detailed map, SDAZ behaviour is maintained, with faster movement resulting in higher zoom-levels (Figure 1b). When the user moves off the edge of the map, they rapidly 'fly' up to a planetary zoom-level (Figure 1c). Full-speed motion over the globe zooms out to a level where a full global hemisphere is visible (Figure 1d).

By automatically coupling rotation speed with zoom-level distant targets can be rapidly acquired without visually stressful motion blur. Furthermore, navigation between focused and contextual views is achieved through a simple and natural interface (dragging the mouse) rather than needing several separate controls for different navigation modes.

While our current globe browser is populated with a fairly sparse set of city maps, the concept could be easily adapted to the diverse datasets traditionally supported by Geographical Information Systems.

## SUMMARY AND FURTHER WORK

Speed-dependent automatic zooming interfaces seem promising. They provide a natural, easy to learn, and efficient mechanism for navigating through large visual dataspaces. Although we have not yet formally evaluated our latest globe-browsing interface, informal reactions to its behaviour have been extremely positive.

## REFERENCES

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