

Semantic Pointing: Improving Target Acquisition with Control-Display Ratio Adaptation

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Abstract

We introduce semantic pointing, a novel interaction technique that improves target acquisition in graphical user interfaces (GUIs). Semantic pointing uses two independent sizes for each potential target presented to the user: one size in motor space adapted to its importance for the manipulation, and one size in visual space adapted to the amount of information it conveys. This decoupling between visual and motor size is achieved by changing the control-to-display ratio according to cursor distance to nearby targets. We present a controlled experiment supporting our hypothesis that the performance of semantic pointing is given by Fitts' index of difficulty in motor rather than visual space. We apply semantic pointing to the redesign of traditional GUI widgets by taking advantage of the independent manipulation of motor and visual widget sizes.

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Keywords: Control-display ratio, Fitts' law, graphical user interface, pointing, semantic pointing

INTRODUCTION

Pointing is a fundamental task in graphical user interfaces (GUIs). To help manage the growing complexity of software, such as the increasing number of toolbars and menu commands, the HCI literature has introduced new interaction techniques that attempt to reduce pointing time. This paper explores the idea of assigning two separate sizes for objects in the interface: a visual size for display, and a motor size reflecting the importance of the object for interaction. We

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hypothesize that task difficulty depends on the motor, not visual size of objects, and control the motor size by adapting the control-display (C-D) ratio. We call this technique *semantic pointing*, since motor sizes are used to reflect the local semantics of the screen.

Fitts' law [6] is widely used to design and evaluate interaction techniques and input devices [16]. It links the movement time (MT) to acquire a target to the task's index of difficulty (ID). ID is the logarithm of the ratio between target distance (D) and target width (W). MT is a linear function of ID characterizing the system. The implications of Fitts' law have been used in several techniques to facilitate pointing tasks by enlarging the target or by reducing its distance [4, 1, 18, 5, 24, 9].

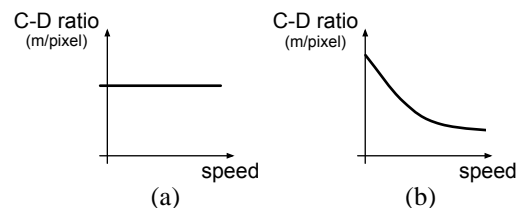


Figure 1: C-D ratio as a function of mouse speed
(a) constant C-D ratio (b) mouse acceleration

Control-display ratio adaptation [13, 23, 5] is another approach for facilitating target acquisition. This technique improves pointing performance but has not been analyzed in terms of Fitts' law, and its possible use in real GUIs has not been fully explored. The C-D ratio [17] is a coefficient that maps the physical displacement of the pointing device to the resulting on-screen cursor movement in a system where there is an indirection between the pointing device and the display (typically with a mouse). The C-D ratio defines the distance the mouse has to cover in the physical world (dx in meter) to move the cursor on the screen by a given distance (dX in pixel)¹. The C-D ratio is dx/dX . A typical C-D ratio adaptation is the so-called mouse 'acceleration'. The cursor moves by a larger distance when the mouse covers a given ampli-

¹We use the following conventions: capital letters denote quantities (e.g. distances) concerning the screen, while lower case letters denote those concerning the physical world. For distances, we use two different units (pixel and meter respectively) to disambiguate ratios that would otherwise be dimensionless.

