Object Pointing: A Complement to Bitmap Pointing in GUIs

ABSTRACT

Pointing has been conceptualized and implemented so far as the act of selecting pixels in bitmap displays. We show that the current technique, which we call bitmap pointing (BMP), is often sub-optimal as it requires continuous information from the mouse while the system often just needs the discrete specification of objects. The paper introduces object pointing (OP), a novel interaction technique based on a special screen cursor that skips empty spaces, thus drastically reducing the waste of input information. We report data from 1D and 2D Fitts' law experiments showing that OP outperforms BMP and that the performance facilitation increases with the task's index of difficulty. We discuss the implementation of OP in current interfaces. Key words: Input and Interaction Technologies, Pointing, Fitts' law.
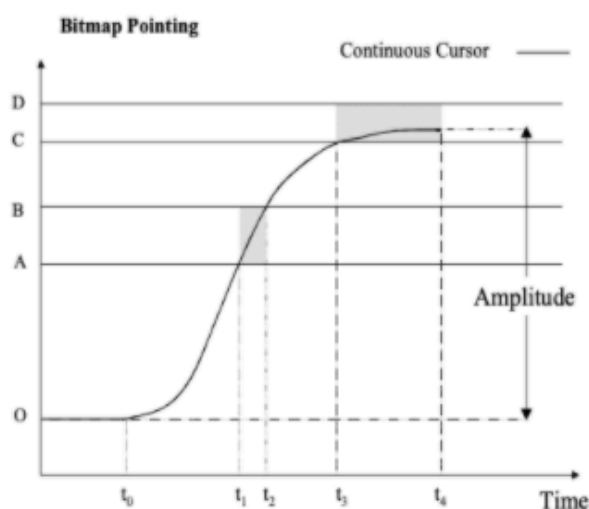
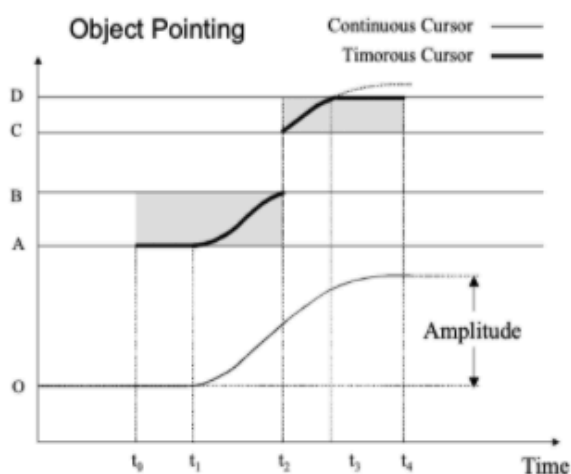Figure 1: Cursor motion in an elemental 1D pointing movement, using the current BMP mode.

Figure 2. Tim's jumping course in the OP mode, along with the continuous trajectory followed by the standard cursor.

Table 1. Task parameters for Exp.1. Underlined are the values that were expected to be problematic for participants.

	Screen Space (pixels)		Tablet Space (mm)		Task Difficulty	
	D	W	D	W	Ratio D/W	ID (bit)
Exp. 1A	800	114	238.7	34.0	7	3.00
	800	18	238.7	5.4	44	5.51
	800	3	238.7	0.9	267	8.06

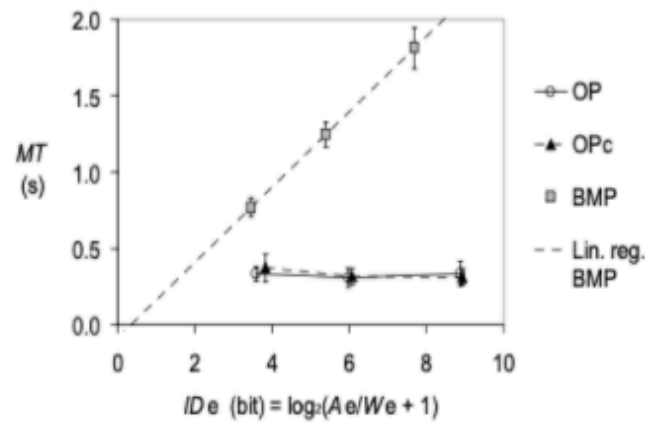|	Screen Space (pixels)		Tablet Space (mm)		Task Difficulty	
	D	W	D	W	Ratio D/W	ID (bit)
Exp. 1B	10	1	3.0	0.3	10	3.46
	250	25	74.6	7.5	10	3.46
	1230	123	367.0	36.7	10	3.46

Figure 3. Effect of effective task difficulty on movement time, for each pointing technique (Exp.1A). Error bars on the Y axis represent $\alpha=.05$ confidence limits based on between-participant standard deviations (SD).
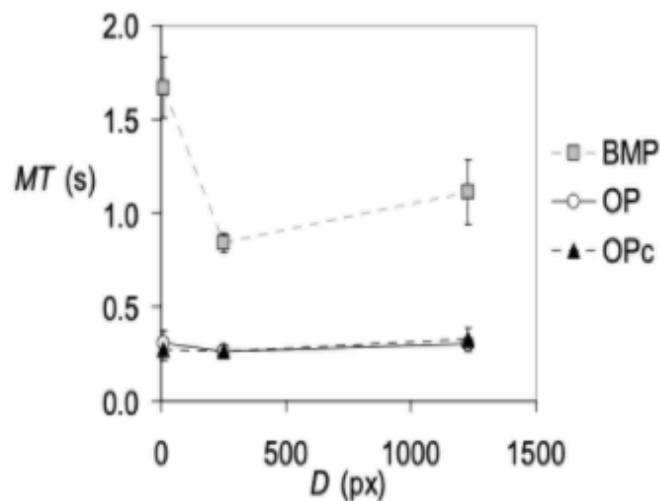

Figure 4. Effect of task scale on movement time, for each pointing technique (Exp.1B).
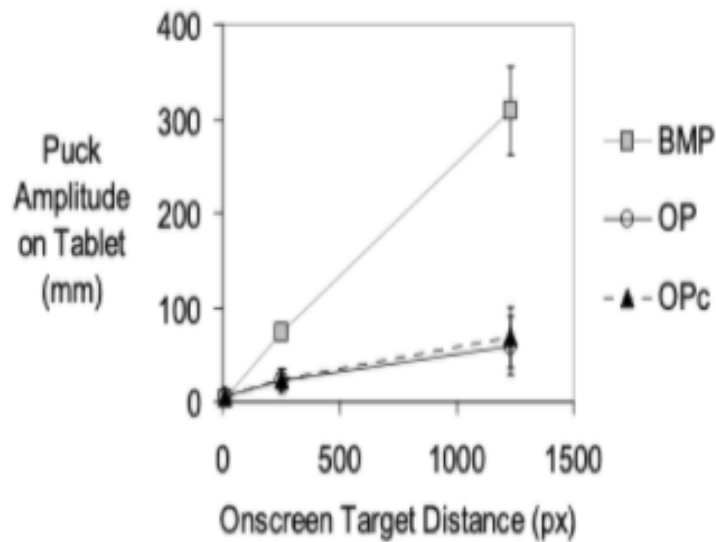
Figure 5. Puck amplitude on the tablet as a function of onscreen target distance, for each pointing technique.

Experimental Task

The pointing paradigm was serial, but no longer reciprocal in the sense of a back and forth (stationary) movement. To track the green target, which every successful click made to jump to another unpredictably determined object, the participant had to produce a series of clicks to follow the path dictated by the program across graphical objects. This task was designed to mimic a rather common situation in GUIs (e.g., reaching and clicking the FILE menu, then the OPEN item, then browsing a tree, etc.). This also show that OP can apply to many types of widgets such as menus, buttons and icons. Within each display, 11 successive clicks had to be made, yielding blocks of 10 measurements of MT. If a target object was missed by the click, it remained the target, waiting for a correct click, and so a 0% error rate was imposed on all participants.
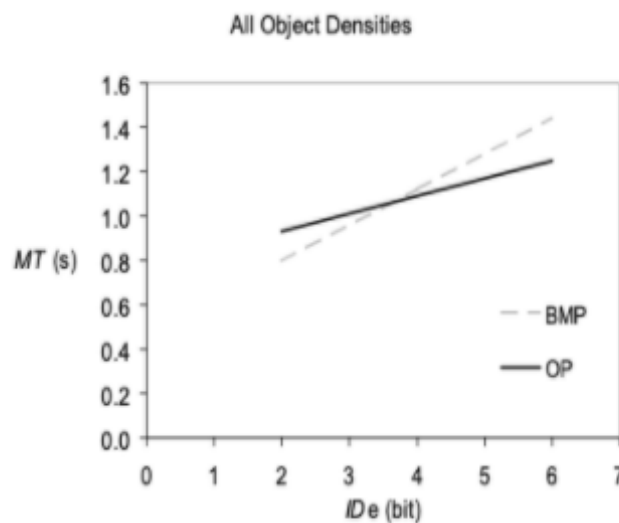

Figure 6. Movement time in Exp.2 as a function of effective task difficulty for the OP and BMP modes.

Implications for HCI Design

Rather than an alternative to BMP, OP should be viewed as an optional mode made available to users beside the usual BMP mode. One should be allowed to switch opportunistically from BMP to OP, via some simple mouse command, to occasionally cope with pixels (e.g., in a drawing task). So the interface should provide the user with some convenient means to switch back and forth between OP and BMP.

Obviously, OP does not yield any benefit for selection within display regions that are tiled with graphical objects, because such regions offer no voids. For example, following a horizontal path to reach the next hierarchical level in a cascading menu costs time [2], but for little or no gain: the probability that the cursor aims at the next (previous) level of the hierarchy when it starts moving to the right (left) is about 1. One solution is to make the menu highlight jump by discrete steps depending on the initial direction of cursor motion [13]. Facilitating pointing across tiled spaces with such a technique might nicely complement OP.

Future Work

One problem that remains to be addressed is the design of an appropriate command to switch back and forth between OP and BMP. Among the possibilities, we may think of a combination of mouse-button presses or a brief oscillation of the cursor. The latter option seems particularly worth examining. Quick, small amplitude oscillations of the hand, very easy to produce [9], might usefully enrich the vocabulary of input commands.