Modeling Mid-air Gestures With Spherical Coordinates

Darren Guinness, Andrew Seung, Ashley Dover, G Michael Poor
Dept of Computer Science Baylor University
Waco, TX 76798 USA
{darren_guinness, andrew_seung, ashley_therriault, michael_poor}@baylor.edu

Alvin Jude
Ericsson Research
200 Holger Way
San Jose, CA, 95134
alvin.jude.hari.haran@ericsson.com

ABSTRACT

Generally, touchless mid-air gestural interaction use some form of Cartesian coordinate system within the input space. Most implementations map the input space in 3-D and map it to the 2-D of the monitor for output. In our previous work we showed that modeling the interaction space produces better interaction[1]. In this study, we use the Myo armband to show that a modeled interaction space also benefits devices that use spherical coordinates.

Keywords

Fitts; Pointing Device; Gestural Interaction; Modeling;

CCS Concepts

•Human-centered computing → Gestural input;

1. INTRODUCTION

Touchless gestural interaction is an interaction style which has seen a sharp increase in interest in recent years. One vein of research has demonstrated that calibrating the user's gestural input space in Cartesian coordinates resulted in a better interaction[1]. In this work, it was hypothesized that improving the existing hyperplane input space to a better model would yield positive results for users. One such method would be to use a spherical coordinate system where the interaction space is essentially one portion of a sphere. However, this model would require the system to measure the length of the forearm and infer the angle of the arm based on the position of the palm. Fortunately, a newer product in the market called the Myo Armband [2] provides the angle of the arms directly. This experiment was designed to evaluate the merits and feasibility of a modeled interaction using spherical coordinates.

2. INTERACTION DESIGN

The unmodeled approach was performed with *Global Mouse Control* interaction by Myo's developers, while custom software was written for the modeled approach. Both approaches use the Myo's Euler angles (pitch, yaw, and roll) but the latter starts with a calibration stage where the user determines their input space. The calibration took 6 seconds, down from 30s in our previous work.

3. EXPERIMENTAL DESIGN

8 participants (M=5, F=3) between 19-28 years (mean=23.1) took part in the experiment. They were asked to perform the ISO 9241-9 pointing task using 3 amplitudes {256, 512, 1024} and widths {64, 96, 128} for 9 unique Index of Difficulties ranging from 1.52 to 4.58 bits. All participants used both interactions, with the starting order counterbalanced with a 2x2 Latin square.

4. RESULTS

	Unmodeled	**Modeled**	***p***	***d***
Bivariate Throughput	1.56	**2.22**	<0.05	2.40
Distance	2156	**1056**	<0.05	5.45
Target Entry	1.26	1.34	0.070	-
Task Axis Change	1.80	1.67	0.120	-
Movement Dir. Change	3.96	**3.30**	<0.05	1.26
Orthogonal Dir. Change	2.74	**1.49**	<0.05	2.20
Movement Variability	90.67	**30.73**	<0.05	5.12
Movement Error	80.41	**31.92**	<0.05	5.24
Movement Offset	**-3.54**	5.86	<0.05	1.25
Fitts Intercept	427.4	**187.68**	N/A	N/A
Fitts Slope	455.16	**352.09**	N/A	N/A
Fitts R^2	0.514	**0.752**	N/A	N/A

Table 1: Means of performance and accuracy measures, with statistical (*p*) and practical (*d*) significance of both interactions. Also shown is Fitts's conformance metrics Intercept, Slope and Coefficient of Determination (R^2)

The results in Table 1 shows that a modeled interaction has better performance, accuracy, and conformance to Fitts' law. This demonstrates that modeling the interaction space results in an overall better interaction, even when the input device uses a spherical coordinate system.

5. REFERENCES

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