Proposal of an Objective Metric for Hand Posture Comfort/Discomfort Evaluation. *

[Extended Abstract] †

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ABSTRACT

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CCS Concepts

•**Human-centered computing** → **Interaction design theory, concepts and paradigms;**

Keywords

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1. INTRODUCTION

For a traditional desktop computer environment, there exist a number of different standardized interfaces for human-computer interaction using a mouse, keyboard and monitor, that allow the user to complete a variety of tasks effectively and efficiently by providing sets of shortcuts and macros.

However, advancing technological progress as seen in virtual reality, augmented reality, robotics etc. open up new possibilities and create a need for new interaction techniques such as speech, gesture and posture interaction.

In a human-robot interaction context, both speech as well as hand gestures and postures are common concepts. While speech interaction is struggling with ambient noise, speech target identification and the creation of intuitive or learnable command sets, the main challenge for gestures and postures has been fighting physical forces that cause fatigue or discomfort and therefore limiting precision, performance and user experience.

This paper is meant to support the creation and evaluation of hand posture catalogs for effective and efficient human-robot interaction by suggesting a hand posture comfort/discomfort metric, that allows for quick objective hand posture evaluation. For this, state of the art comfort/discomfort models were applied to current hand anatomy and ergonomics knowledge to create models for hand comfort and discomfort. Using a large data set, gained in a user study, a machine learning algorithm generated a comfort/discomfort metric based on our model, which was verified in yet another user study.

We will first explain the theoretical basis of our comfort/discomfort model, before deriving our concrete metric from it. After that we will explain the methodology used for optimizing and validating the metric as well as present the results gained therefrom. Finally we will critically discuss ...

2. THEORETICAL FOUNDATION

... is based on the comfort and discomfort models seen in Vink & Hallbeck [2], defining comfort as a "pleasant state or relaxed feeling of a human being" mostly caused by subjective impressions and expectations and discomfort as "an unpleasant state of the human body" occurring from physical stress. Using this information and knowledge of the human hand anatomy, we broke down human hand comfort and discomfort in an non-resting (as opposed to resting on an object) hand into the following four components:

2.1 The Distance to Range of Rest Posture

The Range of Rest Posture (RRP) as described in Apostolico et al. [1] is a range of angles for an articular joint, where the joint "can be considered statistically in rest", caused by muscle relaxation and therefore creating a maximum of comfort in this particular joint. In our case, we considered the human hand to have one RRP for each finger joint in a non-resting position with the palm facing downwards, resulting in a range of relaxed hand postures, similar to the one shown in Fig , where the comfort is maximized. A deviation of the hand posture from this range, should therefore result in lowered perceived comfort.

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2.2 The Inter Finger Angle

2.3 Finger Abduction

2.4 Finger Hyper Extension

3. HAND POSTURE COMFORT/DISCOMFORT METRIC

4. METHODOLOGY

5. RESULTS

6. DISCUSSION

7. ACKNOWLEDGMENTS

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8. ADDITIONAL AUTHORS

9. REFERENCES

[1] A. Apostolico, N. Cappetti, C. DâĂŹOria, A. Naddeo, and M. Sestri. Postural comfort evaluation: experimental identification of range of rest posture for human articular joints. *International Journal on Interactive Design and Manufacturing (IJIDeM)*, 8(2):109–120, 2014.

[2] P. Vink and S. Hallbeck. Editorial: Comfort and discomfort studies demonstrate the need for a new model. *Applied ergonomics*, 43(2):271–276, 2012.