Tutorial: Psychophysical Methods in Haptic Research
Lynette Jones and Hong Tan

ABSTRACT
Haptics research is by definition a very interdisciplinary field, with scientists and engineers building and evaluating tactile and haptic displays and exploring the domains in which the technology developed can be most optimally used. Central to this process are human user studies in which the displays are evaluated in terms of their capacity to present information to users and the sensitivity of the user to changes in display parameters. A variety of psychophysical procedures are employed for this purpose, most of which have been adapted from research on the visual and auditory systems. The sensory systems involved in processing haptic information present unique challenges due to the active nature of sensory exploration and these need to be taken into account in designing psychophysical experiments with tactile and haptic displays. In this half-day tutorial we will give an overview of psychophysical methods that can be used to analyze haptic perception, including those associated with measuring thresholds, information transfer and multi-dimensional scaling. We will also consider how these methods should be employed in the context of studying novel tactile and haptic illusions.

1. Organizers:
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2. LIST OF PRESENTERS
Lynette Jones and Hong Tan (confirmed)

3. LIST OF TOPICS
a. Theoretical approaches (i.e. classical psychophysical theory and the theory of signal detection) and methods used to measure absolute and differential thresholds
b. Supra-threshold stimuli and psychophysical ratio scaling
c. Estimating information transfer rates
d. Multidimensional stimuli and scaling
e. Employing psychophysical techniques to quantify the strength and robustness of tactile and haptic illusions
4. MOTIVATION AND OBJECTIVES

In the survey completed at the end of the WHC in 2009, the use of psychophysical methods in haptics research was one of a few topics that a considerable number of participants identified as being of interest for a future invited session at the WHC. The motivation for the workshop also comes from the many manuscripts on tactile and haptic devices and reports on new illusions involving haptics that we see as editors for IEEE Transactions on Haptics and other journals in which the psychophysical methods used to evaluate the device or study the illusory phenomena have not been appropriate or not been used correctly with the result that the experimental findings are difficult to interpret. In addition, many people use psychophysical techniques in their research without understanding the theoretical basis and underlying assumptions of the different techniques. Knowledge of these assumptions is essential for the selection of appropriate psychophysical methodology. There is often an excessive reliance on using classical psychophysical methods to measure absolute or differential thresholds, even though other aspects of perception (e.g. measuring information transfer rates or using multidimensional scaling to discover the differences between stimuli) may be of more relevance for the particular device or phenomena under study. The organizers of the workshop will provide participants with information about these techniques and offer additional reading material for those who want to pursue the subject matter in more depth. At the end of the workshop, participants are expected to be able to select an appropriate psychophysical method for their study, taking into account the match between the research question and the assumptions associated with the methodology. They are also expected to derive the proper performance metrics from the collected data and interpret the results in a manner that is consistent with the theoretical basis of the methodology.

5. INTENDED AUDIENCE

Conference participants who want to understand the theoretical bases of psychophysical methods and how they can be optimally employed.

6. TENTATIVE SCHEDULE AND AGENDA

The proposal is for a half day workshop in which both presenters will give lectures on the topics described above. Where appropriate, short demonstrations using both visual and haptic stimuli will be used to illustrate specific psychophysical methods. Hong Tan has developed a set of online visual demos (http://cobweb.ecn.purdue.edu/~ece511/OnLineLabs/Index.html) that will be used together with haptic and tactile demos that Lynette Jones has developed to inform tutorial participants about how different psychophysical procedures can be used in research.

7. RELATION TO FORMER WORKSHOPS / TUTORIAL

Lynette Jones has been involved in workshops conducted at the IEEE VR meeting on haptics and psychophysical methods and in workshops on tactile displays at the Human Factors Society meeting and at the Army Research Laboratory.