Chapter 2

Dynamic Motion Analysis of Gesture Interaction

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ABSTRACT

In human communication, nonverbal information such as gestures and facial expressions often plays a greater role than language, and an increasing number of devices are designed to be intuitively controlled by gestures. However, there are some disadvantages of this intuitive interaction. One of the chief problems is that these devices have difficulty in distinguishing between unconscious and intentional gestures; they tend to respond erroneously to unconscious movements. In this chapter, authors propose a new gesture analysis method based on the dynamic model. They focused on the “exaggerated gestures” that are effectively used in, such as Japanese Kabuki, effectively used in Disney’s animation, and tried to identify their common features and effects. They noted the “preparation” or “follow-through” motions just before and after the emphasized actions and each behavior can be quantified by the undershoot and overshoot value of changes in torque. These methods can provide important knowledge for analyzing features and distinguishing intentions when interacting with gestures.

INTRODUCTION

In face-to-face human communication, nonverbal information such as gestures, eye contact and facial expressions, often plays a greater role than language, and it is well known that gestures serve as a major channel for revealing true feelings within human communication. For instance, Mehrabian (1981) derived the conclusions in his previous researches that about eighty percentage of message was pertaining to feelings and attitudes, and Knapp et al (2013) clarified the effects of gesture, posture, face and eye behavior on human communication and revealed how these nonverbal signals can affect to interact successfully. We frequently use gestures unconsciously, such as waving our hand when we say goodbye and beckoning with the hand when we want someone to come to us. Moreover, in designing the user...
interface of many types of the latest large screen display and mobile devices, intuitiveness and simplicity are very important factors, and interaction with gestures has been an excellent choice as a method for enabling the easy use of such products. However, there are some disadvantages of this kind of intuitive interaction; one of the chief problems with gesture-based interaction is that these devices find it difficult to distinguish reliably between unconscious and intentional gestures: they tend to respond erroneously to unconscious movements, which impedes successful interaction. The typical reason is that many gestures contain not only movements but also comprise several emotions. Generally, there has been numerous researches of human behaviors in such fields as gesture recognition, for instance Gavrila (1999) summarized the work on the various methodologies for gesture recognition, Baur et al (2015) discussed about the outcome of interpersonal interactions depends not only on the contents that we communicate verbally but also on nonverbal social signals. Bulling et al (2014) provided the hands-on introduction to the field of human activity of recognition, specifically focuses on the activity recognition using on-body inertial sensors. Also the mechanical analysis of human motions has been actively studied in such fields of sports kinematics, Putnam (2003) discussed the segment motion sequences are dependent not only on a knowledge of the joint moments driving the system of linked segments but on the way the segments interact as functions of their motions and orientations, and Hansenab et al (2015) examined the role of rotation axes during an overarm throwing ball task, and found that the minimum inertia axis would be exploited during the throwing phases. Furthermore, in the field of biological cybernetics, Zelic et al (2015) suggested that the speech articulators for syllable uttered, making the speech performance more receptive to environmental forces, resulting in the greater entrainment observed to gesture oscillations.

Additionally, many studies of motion analysis of gesture were designed to examine the human communications. For examples, Cassell et al (1994) proposed an implemented system which automatically generates and animates conversations between multiple human-like agents with appropriate and synchronized speech, intonation, facial expressions and hand gestures, and mentioned that conversation is created by a dialogue planner that produces the text as well as the intonation of the utterances, and Siegman and Feldstein (2014) discussed the role of body movement in communication and action in human interactions. The difficulty of research in this area is that many communication gestures are not simply movements but actually contain several human emotions, so there remain a number of barriers in quantifying such ambiguous human factors. In this chapter, the author will discuss the importance of nonverbal cues in human communication via the following approach to quantify the function of gesture interactions especially those including emotions, and would like to start the discussion by giving a basic definition of the dynamic model for analyzing the effects of some special “exaggerated gestures” used in contexts such as Japanese Bunraku and Kabuki (Wood & Hamilton, 2010) and effectively used in dance and Disney’s animation; see Disney’s twelve basic principles of animation (Thomas & Ollie, 1997) which are expressing the special emotions (Truong et al. 2015), and try to model their common features as a first approach. Most people frequently accompany these “exaggerated gestures” when wishing to clearly communicate their true message. In the researchers’ previous works (Naka et al, 2014), they tried to clarify the dynamic mechanisms of the certain characteristic behaviors and revealed that some special gestures were quantified by the torque values of elements of the human skeletal model. We human tend to apply forces to the required portion of our arms and body for emphasized actions; therefore, it is possible to quantify the dynamic effects in terms of the torque applied to each joint. By selecting hundreds of characteristic gestures and applying them to their proposed model, authors found that it could represent the degree of exaggeration in a quantitative manner, and discovered that their model was applicable to the speaker’s emphasized move-
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