Facial Feature Identification, Metrology, and Expression Recognition in Augmented Reality

Augmented Reality (AR) technologies provide a powerful environment of human machine interaction. They have been applied to practical use such as maintenance training, commodity exhibition, and product design evaluation. However, there exist several limitations in AR that prevent it from extension to new applications. The recent progress of non-contact metrology devices has shown a good potential of eliminating these limitations. These devices facilitate advanced human-centric applications based on AR. This research studies facial feature identification, metrology, and expression recognition in an AR environment. A high speed 3D face scanner will be used to simultaneously capture both the geometric and image data of human face. These data supports real-time tracking of facial feature points and automatic calculation of key anthropometric dimensions. First, we will establish a database system of 3D facial geometry and expressions. A parametric model of 3D human face will be developed based on the database. In addition, a novel concept is proposed for facial expression recognition. Mass training data can be generated from the parametric model under various lighting/motion conditions using a computer graphic program. The goal is to analyze the deformation of human face for different expressions. Machine learning techniques help estimate the corresponding motion patterns of facial feature points, which enable instantaneous facial expression recognition. Finally, an AR-based prototyping system will be implemented to verify the effectiveness of the proposed methods. This work empowers AR technologies with a real-time sensing capability of human face. Such a capability opens up a variety of novel applications. Simultaneous use of geometric and image data brings new technical merits to traditional facial recognition. Not only will the computational efficiency be significantly improved, it also facilitates integration of AR with engineering, ergonomic, and medical analysis. This research will result in a series of innovative AR-based research and realize human-centric ICT applications.

Keywords: Augmented reality, facial anthropometrics, facial recognition, 3D metrology, 3D human face