Realistic Augmented Collaborative Design

Due to economics globalization, distributed product development has recently emerged as a trend in industry Collaborative design is considered one effective method for adapting this transformation. It is focused on integrating design resources geographically separated with information and communication technologies (ICT). One crucial task is to perform product evaluation collaboratively at different development stages. However, the current virtual prototyping technologies are lack of support on this. The extension capability of most CAD-based collaboration tools is unsatisfactory, providing limited functions for combining heterogeneous product data. VR/AR tools cannot support high-quality realistic visualization for simulation of precision product assembly. To overcome these problems, this research is to develop a series of innovative *Realistic Augmented Collaborative Design* functions by integrating multiple disciplines including photorealistic graphics, computer vision, geometric modeling, and augmented reality. The main novelty lies in coherent fusion of real images and virtual geometry for representing product data. User will not be able to tell the difference between the real and virtual in both visual and tactile senses. This fusion technology allows assemble a CAD model within the video stream of real scene. For visualization fusion, view, geometry, and illumination consistencies need to be first achieved; then photorealistic rendering is applied to coherently merge the real and virtual objects. For tactile fusion, the first step is to compute 3D geometry from the real scene using stereovision. Mesh smoothening techniques help join together the computed geometry and the existing model. Continuous feedback signals can be thus generated across the boundary between the real and virtual, driving a 5-axis haptic device for maintaining harmonious tactile sense. GPU-based implementation will be conducted for offering a better real-time performance. We plan to test the developed functions on various use scenarios to demonstrate their feasibility and values. The ideas proposed in this work are highly original and innovative. They fulfill the emerging needs in distributed design evaluation, and are applicable to medical simulation and maintenance training. With both intellectual and practical values, this work will produce high-quality research papers in top academic journals as well as patent applications.

Keywords: Collaborative design, augmented reality, virtual prototyping, product evaluation, product assembly