

SUMMARY OF Ph.D. DISSERTATION

School Science for Open and Environmental Systems	Student Identification Number	SURNAME, First name INAMOTO, Naho
Title Free Viewpoint Video Synthesis and Presentation for Dynamic Events		
Abstract <p>This thesis presents a method for free viewpoint video synthesis and presentation for dynamic events in a large space. The entire scenes of sporting match that are captured using multiple cameras in a stadium are represented from a novel viewpoint. We propose a method of view interpolation for dynamic events and then introduce free viewpoint video presentation systems that allow viewers to fly through in the sporting scenes. The technique of arbitrary view synthesis is extended to the field of Mixed Reality in order to create a new framework for enjoying sporting events such that the viewer can watch the events overlaid onto the real world.</p> <p>In a large space such as a stadium, it is almost impossible to reconstruct an accurate 3-D model of the object because strong calibration of multiple cameras needs many efforts and the movements of each player are complicated. Instead of constructing 3-D models, we use projective geometry between cameras for view interpolation. Since just corresponding natural feature points in images is required for obtaining projective geometry, which is termed weak calibration, our approach can be easily applied to even large-scale events. The appearance of the objects at intermediate viewpoint is generated through transfer of the dense correspondence among real views. Object scenes are segmented according to the geometric property of the scene. The correspondence, which is necessary for view interpolation, is automatically obtained by applying projective geometry to each region. Superimposing intermediate view images synthesized in every region completes virtual views for the entire scene. Free viewpoint video is synthesized by selecting reference cameras, interpolating weight and zoom ratio in each frame of the image sequence. We demonstrate the effectiveness of the proposed method by producing realistic fly-through videos where the entire scenes are naturally reconstructed from virtual viewpoints.</p> <p>In addition, viewpoint on demand system and mixed reality presentation systems are introduced as applications for free viewpoint replays of sporting match. The first system allows viewer to select his/her viewpoint on GUI. The second systems overlay a sporting match onto a stadium model in the real world using a head mounted display and a web camera, respectively. When overlaying a virtual object into the real world, 3-D positional relationships among the virtual object, real world, and user's viewpoint are generally used for the registration. The conventional method cannot be used in our approach where the above 3-D information is not available. We propose an image-based method for geometric registration between virtual view images of players and the stadium model. User's viewpoint is calculated using an image of HMD or web camera and the positions of players are obtained through projective geometry of the ground plane of the stadium. We demonstrate mixed reality presentation systems where virtual soccer match is replayed on a small desktop stadium using multiple soccer videos. This gives impression to the viewer as if the event is taken place in front of him/her. The proposed systems need just uncalibrated cameras for taking dynamic events so that our approach can be extended to other entertainments as well as sporting events.</p>		