ONLINE MARKERLESS AUGMENTED REALITY FOR REMOTE HANDLING SYSTEM IN BAD VIEWING CONDITIONS

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Remote handling in harsh environments usually has to tackle the lack of sufficient visual feedback for the human operator due the limited number of on-site cameras and poor viewing angles, etc. Augmented reality (AR) enables the user to perceive virtual computer-generated objects in a real scene, the most common goals usually including visibility enchantments and provision of extra information, such as positional data of various objects.

The proposed AR system first recognizes and locates the markerless object by using a template matching algorithm, and then augments the virtual model on top of the found item. The tracking algorithm is exploited for locating the object in a continuous sequence of frames. Conceptually, the template is found by computing the similarity between the template and the image frame, for all the relevant template poses (rotation and translation). Briefly, the employed AR technology utilizes several procedures including image processing, tracking and virtual augmentation, to give the operator positional and orientation information of a selected markerless object.

The Water Hydraulic MANipulator (WHMAN) is a dexterous robotic arm, designed and developed to carry out wide variety of remote handling operations inside the ITER divertor. These operations include cutting, bending and welding of pipes, locking and unlocking of cassettes and assisting CMM during the installation and removal of cassettes, etc.
The objective of this paper was to investigate the benefits of AR technology in ITER remote handling at DTP2 facility. As a case study, AR interface was displaying measured orientation and transformation of the WHMAN divertor preloading tool, in near real-time tracking.

Generally, it is difficult to install 3 degrees of freedom orientation sensors to detachable tools, requiring huge amount of wiring. Therefore, an important advantage the operator gains from AR application in ITER remote handling was identified as related to testing the sensitivity of WHMAN system, for slight rotation and transformation. The machine vision based 3 degrees of freedom orientation of preloading tool was provided to the operator as user aiding functions.

The method in this paper was validated in real-time operational context. The developed method proved to deliver robust positional and orientation information while augmenting and tracking a moving tool object.