Investigating Applications for the Three-Dimensional Design Information Verification System at Department of Energy Facilities in the United States

ABSTRACT

The current method used for the annual verification of design information for nuclear facilities under International Atomic Energy Agency Safeguards can be labor intensive since this involves manually verifying that a facility has not been altered over the period of time. This process generally involves comparing new pictures of the facility to previous pictures which can require a great deal of time and effort. A new method was proposed, developed by the European Union's Joint Research Center, which involves using a Three-Dimensional Design Information Verification system. This system uses a laser scanner to take panoramic images of an environment. These two-dimensional images can be made into three-dimensional meshes using accompanying software. The software can automatically compare two three-dimensional images of the same environment and find differences between them. The first of the scans is considered to be a reference scan. The later scan is used for verification, and the verification scan is compared to the reference scan to determine how the environment has changed since the reference scan was taken. In this project, three different environments were set up in order to test the systems capabilities. The first environment was used to determine how well the system could detect large movements (0.5m to 1m) of objects within the environment. The second environment was used to determine how well the system could detect small movements (0.002m to 0.02m) of objects within the environment. The third environment was used to determine if the system can detect the addition of objects to a processing environment. Different conditions were also incorporated into the environments such as making the laser scan through glass and/or water. An analysis of the resulting data showed that the system was able to detect both small and large movements to an accuracy of approximately 4mm, as well as find new objects that were added to the environment. The system is capable of scanning through glass, but not water. The high level of accuracy and the automatic capabilities of the system mean that it will be a significant improvement on the current methods of design information verification for nuclear facilities, although the inability of the system to scan through water might lead to difficulty in some areas that hold large amounts of liquid. Further studies should focus on overcoming this difficulty.