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SIMULATION STAND FOR REFUELING A SPHERICAL FUEL TANK IN VIRTUAL REALITY

Abstract

The introduction of new technologies, methods of production, and training approaches from Industry 4.0 is changing the world that we live in. Visualization of numerical simulation data of aerodynamic, thermal, and strength calculations is one of the most interesting applications of virtual and augmented reality. Even though this technology is not yet very used, the potential of its impact is quite large. In the last few years, augmented reality has been used in such companies as Lockheed Martin Corp., Boeing, and Airbus. The use of virtual reality tools allows a better understanding of the calculation results of different structures of a spacecraft. The application of augmented reality is associated with the simultaneous solution of machine vision problems. Augmented reality is often used in cyber-physical systems in conjunction with digital twin technology. The constructed mathematical model of the process is compared with the real process result analyzed by computer vision and additional information is given to the user according to the presence or absence of deviations. A similar approach of combining virtual reality and a mathematical model of the process can be used to train personnel in complex and dangerous technical operations such as refueling fuel tanks with toxic, explosive, cryogenic components. The objective of this paper is the creation of a virtual hydrogen fuel tank refueling simulator. The simulator combines a model of the refueling process described by the equations of conservation of total energy and mass, and a virtual model of a spherical fuel tank. The Euler method is used to solve the equations. Virtual reality is used as the facility for the virtual experiment. Working with the setup is done using virtual reality interaction tools. The results are displayed as graphs of pressure and temperature changes. Using the produced virtual facility, it is possible to conduct virtual tests of various filling conditions, solve the problem of finding optimal refueling modes, and train personnel. Development of AR/VR/XR technology, the addition of Internet of Things capabilities in the future will make it possible to create a universal Digital Twin of the refueling stand.