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Development of a robotic system for the automation of the decontamination process of nuclear power plants

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Abstract. As part of Phase II of the ROBDEKON (Robotersysteme für die Dekontamination in menschenfeindlichen Umgebungen) project, funded by the German Federal Ministry of Education and Research (BMBF), an automated process chain for the decommissioning process of nuclear power plants is being developed at the Karlsruhe Institute of Technology Institute of Technology and Management in Construction (KIT-TMB). In this project, technical solutions for the autonomous environmental exploration and detection of radioactive contamination, modeling and digitization with building information modeling (BIM), automatic decontamination, and contamination measurement have been developed. The aim of the research is to develop universal, robot-based solutions for a complete, automated decontamination process that can be flexibly adapted to changing environmental conditions. In the following, the third process step, the automated decontamination, is described in more detail. The basis for the automated decontamination system is a mobile platform. For the transformation of the platform into an automated decontamination system, it is first equipped with the necessary components. The control unit (PLC) is connected via a gateway to the sensors required to determine the position of the manipulator and motor controllers. The motor controllers send back essential information, such as motor current, motor voltage, and motor temperature, to the PLC. To locate the decontamination system in its environment, two safe lidar sensors are attached to the platform. The lidar sensors provide the positions of the decontamination system with respect to a reference coordinate system in the PLC. In addition, the lidar sensors are capable of detecting people in the vicinity of the decontamination system and, if necessary, generating a warning signal to prevent an accident. Furthermore, the platform is equipped with additional safety sensors that also generate a warning signal in case of danger. The warning signals are transmitted to the PLC. In the case of a warning signal, the decontamination system stops and either waits until the situation is safe again or selects a different trajectory to the target point. The decontamination system will operate in teleoperation and automatic mode. For this purpose, a user-friendly interface will be developed so that users can operate the system without deep technical knowledge. For the investigation and decontamination of flat wall structures in a nuclear facility, two tools were developed that can be mounted on the robot platform: an automatic milling tool and a tool for detecting and measuring radioactive contamination. As part of the planned presentation at safeND 2023, a brief introduction to the automated decommissioning chain will be given first. Furthermore, the current design of the decommissioning system, as the third step in the chain, and the pending sensor integration will be presented. Subsequently, the control concepts required for automation, the concepts for trajectory planning that have to be programmed on the PLC, will be presented.

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