Robotic-Based Terahertz 3D imaging system for non-destructive testing of PVC pipe

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The detection and localization of damage in a PVC pipe cap are investigated experimentally using a pulsed terahertz time-domain spectroscopy and a six-degree-of-freedom robot arm. This study deals with the development of the 3D imaging system for the thickness monitoring and defect detection of the 3D structures. To monitor the damage and thickness of the PVC pipe cap, we designed the reflection geometry of the terahertz scanner based on the optical components such as beam splitter and focal lens and controlled six-degree of freedom robot arm for the path planning. A corresponding predicated value for the thickness of the sample is computed as a function of at least one wall thickness parameter of the pipe using a captured terahertz wave because terahertz waves are partially reflected when the medium is changed. The defects are simulated using PVC pipe cap (inner diameter: 89 mm, outer diameter 100 mm) then the specimen was mounted on the six-degree-of-freedom robot arm in order to inspect the whole area of the PVC pipe cap. The obtained reflected signals were analyzed to determine the thickness, defectiveness and the locations of defects through the signal processing in the time-domain and frequency-domain. As a result, it is possible to detect and visualize the various types of defects that are simulated in the PVC pipe and the validity of the SHM method for 3D structures using terahertz wave was successfully verified.