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Ultrasonic Data Acquisition Interface Using RT-Linux and GTK for Non-Destructive Evaluation of Aircraft Parts

**N. V. Rajeev, Arshad Jamal, V. C. Ravi, Sandhya Naik, V. V. S. S. Prasad, Sartaj Singh
S. R. Chandra Mouli, C. R. J. Prakash Naidu, N. Sitaram**

Institute For Robotics and Intelligent Systems, Center for Artificial Intelligence and Robotics
Rajbhavan Circle, Bangalore

Abstract

This paper elucidates the practical development and implementation details of an ultrasonic Non-Destructive Evaluation System based on Pulse-Echo method for composite Aircraft components. Composites are made of several layers of nonmetallic substance. The system consists of an ultrasonic probe as the primary transducer and a probe positioning mechanism that is a 3-axes gantry robot with 2-axes wrist. Coupling between probe face and test material surface is achieved through a water jet. The probe positioning mechanism can position the probe at any particular point of a given specimen with probe facing normal to the surface of the specimen. A Pulser-Receiver unit, integrated with the acquisition system, excites the probe with a narrow high voltage pulse and receives its echoes from various depths. A PC-based data acquisition system enables acquisition and characterization of the echo signal using the transit time (TT) and attenuation (dB) to derive the structural information of the test specimen at that point. Continuous excitation of the probe with a particular pulse repetition frequency, while probe position is varying through a scan path over the specimen, gives a series of point information (A-Scan), which is combined to form the area information technically termed as C-Scan. To our knowledge this is the first time Real-time Linux is used as the OS to carry out time critical echo capture and robot positioning operations in the field of ultrasonic NDE. RT-Linux is public domain software and thus freely available source code was helpful in more appropriate integration. GTK based application GUI enables the operator to interact with the real-time system. C-Scan Images of various standard test specimens are taken using this system and compared with those taken through other standard systems.