ROBOTIC ARM BASED MULTI CHANNEL IMMERSION ULTRASONIC TESTING SYSTEM FOR INSPECTION OF SHELL COMPONENTS-APPLICATION NOTE

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DHVANI RESEARCH
Making Technology Work

A shell is a projectile used in weapons. It is filled with explosives or other substances. It is similar to a bomb but is made to be shot out of a gun. Shells are usually large caliber projectiles fired by artillery, armored vehicles (including tanks), and warships. A fuse detonates the explosive or releases whatever else the shell may be carrying.

The quality of the shell without defects is crucial for it to maintain the projectile required. The presence of any defects may alter the performance of the shell projectile. In this application note, detection of defects in the shell using ultrasound technology, one of the non-invasive techniques is discussed. Dhvani Research designed and developed a Robotic arm-based Automated Multichannel UT system for this application.

Robotic arm based automated Multi-Channel UT system:

This system is developed exclusively for inspection of Shell components of different variants. This is a completely automated system from material handling to the decision on acceptance/rejection of the sample. An articulated robot arm is programmed for material handling. The system consists of the following sub-assemblies:

1. Immersion tank with 4 axis-gantry
2. Robotic-arm-based material handling system
3. Conveyor system (3 Nos. viz. In feed, accept, reject)
4. Integrated Software
The complete system layout is shown below:

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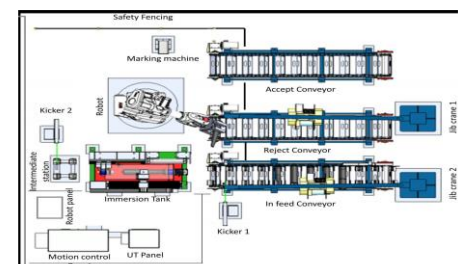
1. Immersion tank with 4 axis gantry:

The UT gantry consists of an immersion tank with 4-axis (X, Z, Alpha, and theta axis). The tank has a sample lock-in mechanism where the sample will be locked between two end stoppers and can rotate while moving the probe along the sample. The X-axis is used for moving the probes along the sample. Z-axis to adjust the height of the water column and Alpha for adjusting the probe angle to follow the sample contour. The scanning follows a helical path as shown below
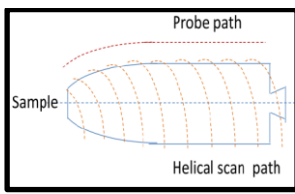
2. Robotic arm-based material handling system:

An articulated robot is used for picking and placing the shell components at various stages during the inspection process. The following are the stages where the robot will be handling the sample:

- Picking shell from the input conveyor
- Placing shell in the immersion tank
- Moving the shell out of the immersion tank after inspection.
- Marking the shell as accept or reject
- Dropping the shell in accept/reject conveyor

3. Conveyor System:

This system has 3 conveyor systems:

1. infeed line
2. Accept line
3. Reject Line.

The robot will pick up the samples from the infeed conveyor line and then places them at the accepting or reject line after testing. The conveyor has a vision-assisted system to test whether the sample placed in the conveyor is the same as the inspection cycle being run on the machine.

4. Integrated Software:

The complete system is computer-con using an integrated single interface software. The software installed in the computer can communicate to all the devices and attain the required functionality.
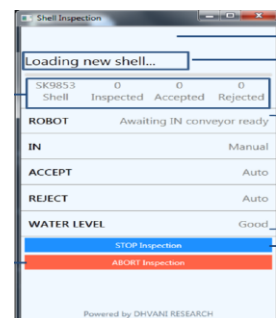
Salient Features of the system:

- Production line UT system.
- Can inspect different variants of Shell components
- 5-Channel Ultrasonic Testing with automatic report generation
- Complete robotic control through the computer by TCP communication
- Articulated robot for shell handling with a maximum payload of 120trolled kgs
- Automatic conveyor system for infeed and outfeed of the samples
- Automatic decision-making on the quality of the sample.
- Automatic job sentencing at the end of the scan with a pneumatic marking system.

Ultrasonic Inspection procedure: The machine is pre-programmed to carry out Ultrasonic scans of various types of shell samples. The shell is rotated about its axis by holding between the rotating mechanisms while the X, Z, A axes move the Probe cluster over the sample according to the profile of the sample maintaining a particular standoff distance from the surface of the shell. The scanning is done in a helical fashion. The pitch of the scan is so adjusted to having enough overlap to make sure the entire shell is covered in the scan. The probe cluster contains 5 probes: Normal, lateral 45 forward, Lateral 45 reverse, Circumferential 45 forward, and Circumferential 45 reverse as shown below:
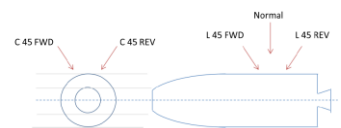

Automated Inspection: All the subsystems in this system are integrated into a single user interface program. The user needs to select the sample from the dropdown list at the time of scanning initiation.

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Robotic Arm Based Multi-Channel Immersion Ultrasonic Testing System – Application Note

A Dhvani Research Application Note

Chennai, INDIA
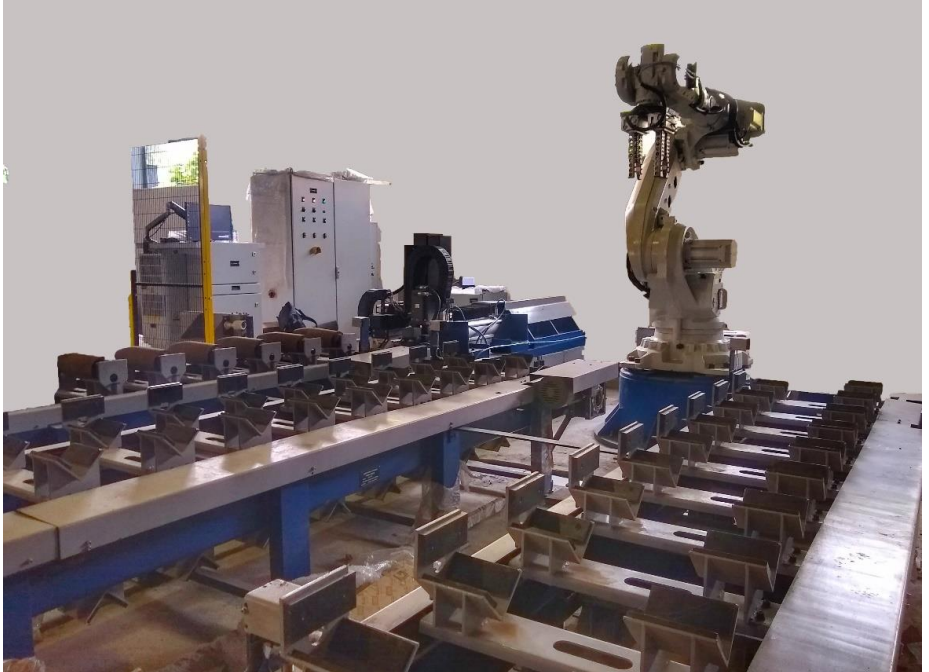
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