

# Non-Destructive Quality Control of Automated Weld Processes

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## A patented system for nondestructively measuring weld characteristics

This method for nondestructively measuring weld characteristics generates narrowband ultrasounds and uses a signal processing procedure that combines wavenumber-frequency (k-w) domain filtering and synthetic phase tuning to reduce the complexity of Lamb-wave signals.

Laser generated ultrasound methods have previously been used to measure weld penetration depth in thick plates using time-of-flight diffraction techniques to determine weld quality. This method no longer works when the thickness of a structure decreases to the wavelength of an ultrasound signal. In these thinner structures, determining weld penetration requires the ability to measure the diffraction of highly complex Lamb waves. These waves vary with material density and thickness, and robust computational systems are required to evaluate feedback signals.

This technology uses k-w domain filtering to remove unwanted wave components and synthetic phase tuning to amplify and isolate a particular Lamb-wave mode. The signal processing procedure facilitates the calculation of reflection coefficients of Lamb waves that result from the presence of weld joints. This results in an effective, nondestructive method of evaluating penetration depth of butt welds in thin plates.

## Summary Bullets

- **Eliminates cut checks:** Provides a nondestructive method for evaluating weld quality
- **Real-time inspections:** Allows for automation of welding operations
- **Goes long:** Uses Lamb waves to test welds over a larger area than is possible using higher frequency ultrasound waves

## Solution Advantages

- **Eliminates cut checks:** Provides a nondestructive method for evaluating weld quality
- **Real-time inspections:** Allows for automation of welding operations
- **Goes long:** Uses Lamb waves to test welds over a larger area than is possible using higher frequency ultrasound waves
- **Cost effective:** Is faster, less labor intensive, less material waste

## Potential Commercial Applications

This technology can be used in a wide range of industrial welding applications, such as automotive and aerospace manufacturing. It is ideally suited for robotic or automated manufacturing that relies on real-time quality inspection.

### Background and More Information

This technology provides a fast, real-time, nondestructive method for measuring weld characteristics, particularly in thin-plate joins. Butt joint welding is an essential process of joining parts in many industries. Traditional methods to check weld quality involve cutting a sample across the weld and visually inspecting the weld penetration. This process is time-consuming, destructive, and cannot be automated. Ultrasonic inspection techniques offer nondestructive testing; however, these have not yet been developed for automated real-time inspection during manufacture, nor are they effective for thin-plate joins.

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### Publications

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