

## Static and Dynamic Characterization of Machining Elements Contact using Ultrasound

### Reflectometry

A novel real-time technique to characterize two-body contact (especially wheel/rail contact)

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#### 1 Introduction

Wear has always been a big issue in wheel/rail system and daily maintenance, a non-destructive measuring technique for monitoring contact pressure and size which is directly related to wear between wheel and rail instantaneously is developed here.

#### 2 Static Test and Results

Wheel and rail specimens were pressed together in a loading frame. The whole test rig consists of a PC, an UPR, an oscilloscope and an x-y scanning tank.

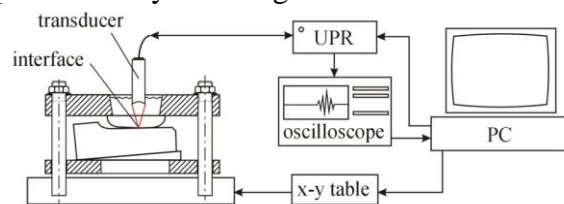


Fig 1 Wheel/rail Static Ultrasound Test Setup

A 10MHz ultrasound transducer was used and a series of loads were applied, peak-to-peak value distributions of reflected voltages are shown below:

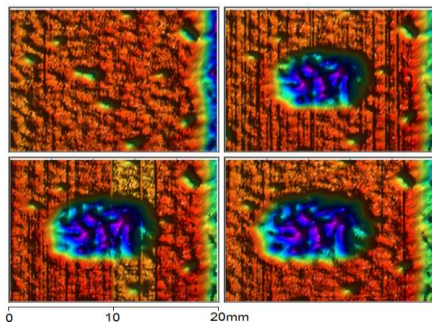


Fig 1 Reflected voltage distribution of wheel/rail ultrasound scanning (from left to right: reference, 40kN, 50kN, and 60kN)

#### 3 Pilot Dynamic Study

A 64 element ultrasound scanning array was used for dynamic test. A nitrile ball rolling over a perspex plate was measured using the array:

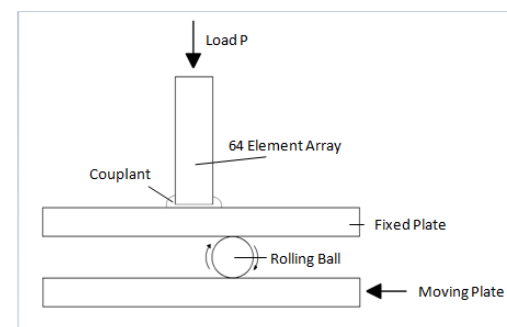


Fig 2 Ball/Flat Rolling Test Setup

A 10N load was applied.

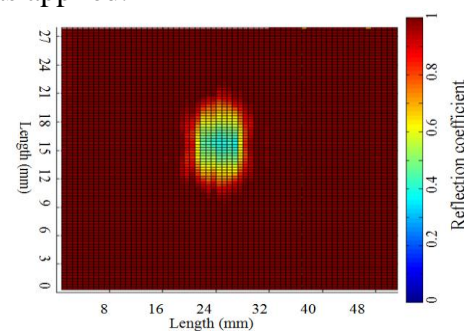


Fig 3 Reflected Coefficient Map

#### 4 Benefits for Industries

- Instantaneously and Non-destructive: ultrasound signals do not change or affect contact conditions.
- Economic: the  $8 \times 8$  element ultrasound scanning array is working 8 elements one time and switching, which is far cheaper than 64 elements one time working array.
- Broad use: ultrasound techniques could also be used for stress determination, cracks detection, etc.
- Adaptive: could adapt a series of complex situations like different materials or curved interfaces.

Interested Industries: Locomotive and rail track related companies, industries related to tribology and wear. Ultrasound techniques industries.