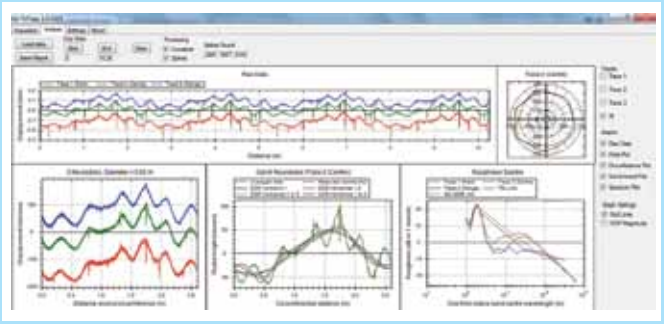
Wheel irregularities, out-of-round, acoustic roughness, diameter, corrugation: TriTops

TriTops

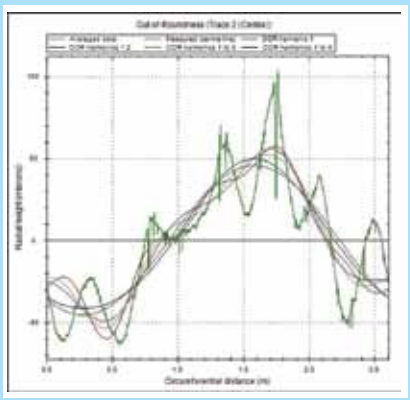
TriTops in two configurations: attached to a rail (left) and to part of an underfloor wheel lathe (right). The instrument takes three measurements simultaneously around the periphery of a wheel. Data are logged to a laptop computer.

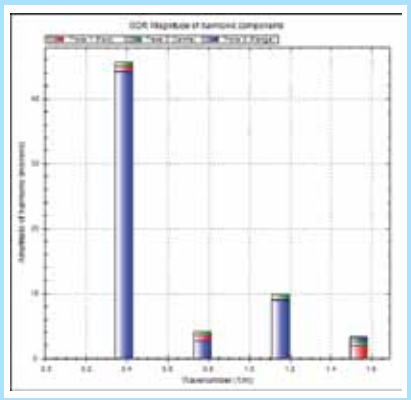
RailMeasurement's **TriTops** equipment has been developed to satisfy different requirements. Vehicle suppliers and maintainers are particularly interested in measuring out-of-round (polygonisation) and diameter of wheels, and irregularities such as wheelflats. Acousticians are particularly interested in acoustic roughness and irregularities.

TriTops can be carried, placed in position on a rail and manipulated by a single user. It has been designed to fit neatly into the constrained space that is available for measuring railway wheels. Measurements are made in a similar manner to that used with other equipment of this type. The wheelset is jacked slightly off the rails, the instrument placed on the rail and slid into position. The position across the tread is adjusted (a built-in scale is provided to help with this) and the instrument clamped in place with a magnetic base. With TriTops a measurement is taken during a few complete rotations of the wheel. The software automatically calculates the diameter and splits the record into a number of complete revolutions. This offers a routine method of checking repeatability.



Screen dump from a TriTops measurement of a wheel with out-of-round, a wheelflat of about 70µm depth (at about -155°) and a few smaller irregularities e.g. at -90°. Software shows that 3 full revolutions of the wheel have been made. The wheel diameter is calculated to be 0.83m. This analysis can be undertaken by clicking the appropriate tab and selecting a file as soon as a measurement is completed.



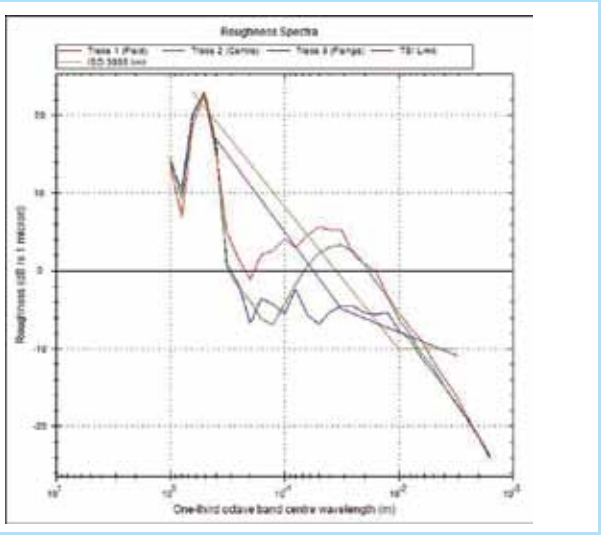


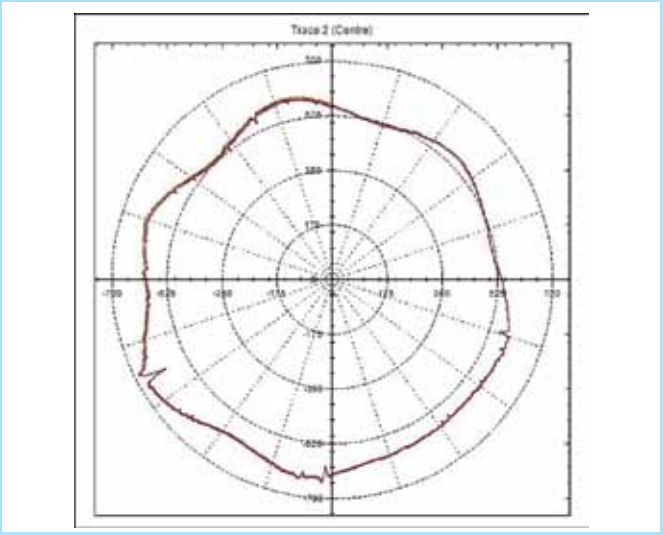
Out-of-roundness illustrated in two different ways. On the left, the harmonic components are summed and graphed as a function of circumferential distance. On the right, the harmonic components are shown. The fundamental harmonic at 0.35-0.4/m is indicative of a wheel that has worn with some eccentricity (about 46µm is suggested by the amplitude of the harmonic component). This is consistent with the "OOR harmonic 1" plot on the left.

RailMeasurement

www.railmeasurement.com

Rail Measurement Ltd
79 River Lane, Cambridge UK CB5 8HP
tel: +44 1223 522475 mob: +44 7803 290252
email: stuart.grassie@railmeasurement.com



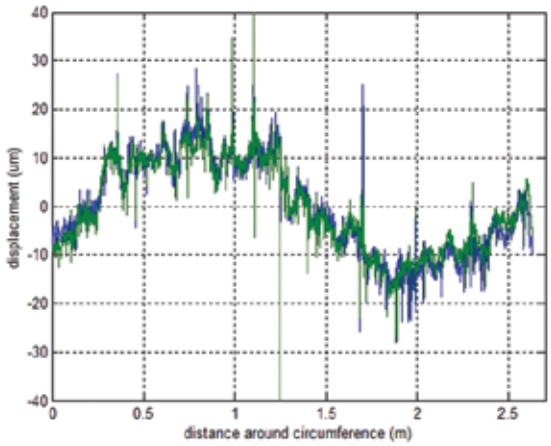


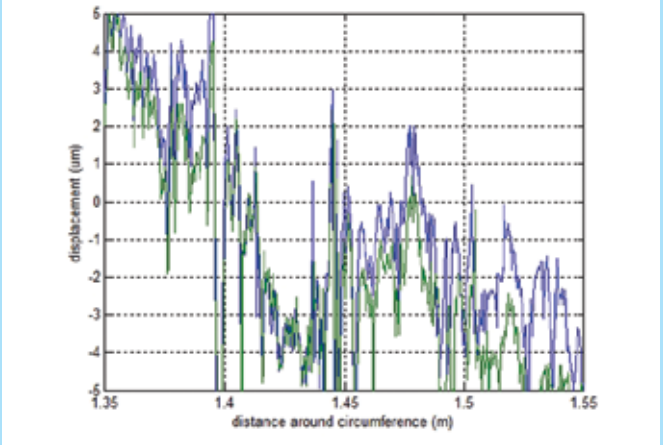
One-third octave spectra for the three traces (left) and polar plot for the central trace (right). The large component of the spectra at 0.5012m is consistent with the 5-6 lobes on the wheel shown in the polar plot.

The TriTops software, which is included with the equipment, records the measurements and undertakes analysis to provide what the acoustician or wheel specialist may wish from such measurements. This includes the following:

- spike removal and curvature processing according to EN15610 (to be updated as this standard develops):
  - calculations can be undertaken with or without either or both of these algorithms
  - the number of spikes that have been detected on each of the traces is shown
- calculation of diameter
- raw displacement for the complete record
- superposition of the records for the number of rotations that have been detected
- polar plots, showing deviation of surface from a perfect circle
- out-of-round, showing effects of summation of harmonics
- harmonic components
- one-third octave spectra

Text files containing these results can be saved to provide a record of the analysis that has been undertaken.





Demonstration of the repeatability of the TriTops. Two measurements are shown from consecutive rotations of the same wheel. On the left are the full records for the two rotations. On the right is a section of record expanded to a scale of +/-5µm over 0.2m of the wheel.

Repeatability and accuracy of the TriTops based on the transducer manufacturer's claim are better than 0.15 microns and 1.25 microns respectively. TriTops obtains measurements at an interval of 0.4mm around the periphery of the wheel.

The equipment weighs 11.5kg when packed in the plastic instrument case, and 6kg in use.

The TriTops is a result of collaboration between RailMeasurement and the railway noise group at the Institute of Sound and Vibration Research (ISVR), University of Southampton, UK.

RailMeasurement

www.railmeasurement.com

Rail Measurement Ltd
79 River Lane, Cambridge UK CB5 8HP
tel: +44 1223 522475 mob: +44 7803 290252
email: stuart.grassie@railmeasurement.com