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QuantX Interrogator Unit Enables Distributed Wheel Flat Detection

Producing fibre optic sensing solutions with the required levels of performance to deliver railway condition monitoring applications has been a long-standing goal for both technology manufacturers and railway operators. Wheel flats are a common problem which often cause extensive damage to rolling stock and railway infrastructure, as well as having the potential to trigger safety related incidents. The possibility of using trackside fibre optic cable as a sensor capable of accurately detecting and monitoring wheel flat occurrences across a network offers significant operational advantages for many railway owners and operators.

OptaSense's QuantX Distributed Acoustic Sensing (DAS) interrogator unit was developed specifically for advanced railway applications and delivers long-range quantitative data performance with high fidelity and sensitivity. QuantX interrogates the fibre with a sequence of launch pulses that unwrap higher fidelity phase and amplitude locked information from the Rayleigh backscatter. With an operational range of up to 50 km QuantX can transform long fibre optic cable lengths into a dense sensor array required for multiple railway applications.

The OptaSense QuantX Distributed Fiber Sensing Interrogator Unit.

The results from recent studies conducted with a leading European railway have demonstrated the step change in performance that QuantX achieves over previous generation solutions for the detection of wheel flats.

Figure 1 shows the acoustic "waterfall" trace produced by QuantX from a freight train moving from right to left. This trace clearly shows the noise intensity generated by the general movement of the rolling stock (yellow / green areas) and a number of areas of higher intensity (red areas) which occur regularly as the

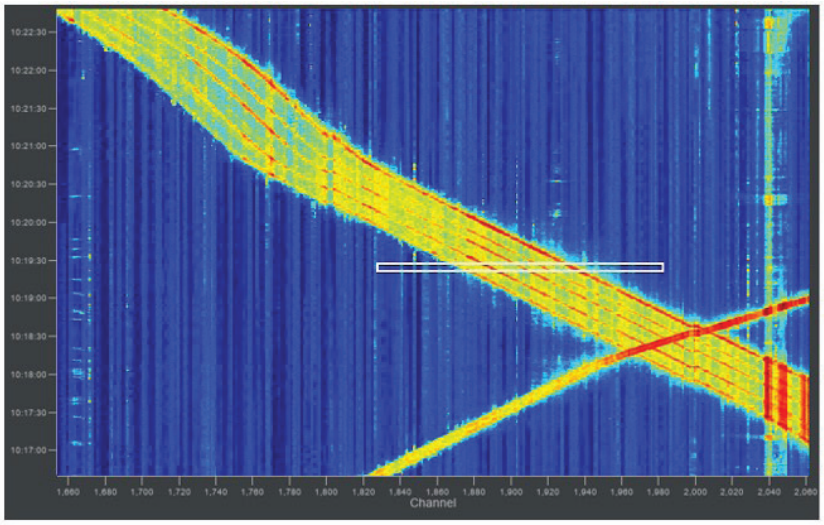

Figure 1 (left): A freight train moving from right to left along the monitored fibre length. The Y-axis shows approx. 6 minutes of time with the X-axis showing approx. 4 km of monitored track

White rectangle is area of detail in Figure 2.

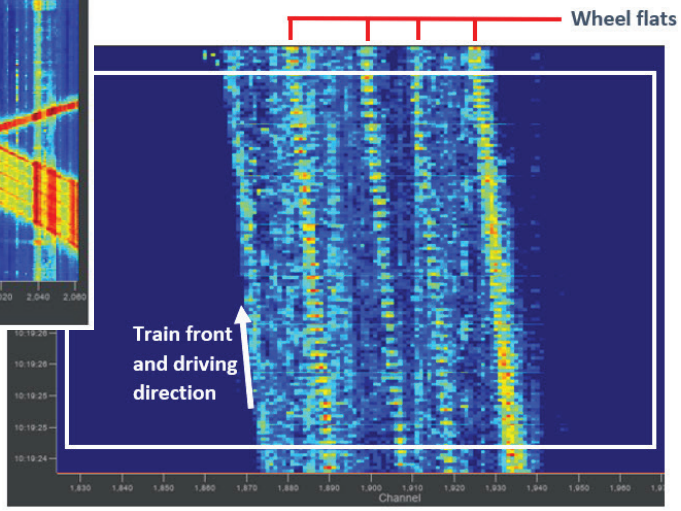

Figure 2 (right): Area of detail with Y-Axis now approximately 8 seconds of time.

train moves along the track. Figure 2 reveals the rich acoustic dataset delivered by QuantX. The areas of higher intensity are now revealed to be periodic impacts travelling along the track at train speed – clear indications that these impacts are caused by wheel flats.

Furthermore, when the QuantX data at a specific location (see Figure 3 below) is analysed we can see both the periodicity and the signal level associated with each impact which enables categorisation of wheel flat severity.

OptaSense continues to work with its railway partners to deliver on the potential of QuantX for wheel flat detection and other railway condition monitoring applications.

Integration with information held in other railway systems (e.g. numbering information and timetable information) would enable rail operators to match wheel flat data with specific rolling stock to deliver a powerful solution capable of generating immediate or advisory wheel flat notifications to be output.

Additionally, the spatially rich information available from a distributed fibre optic sensing based solution opens up the possibility to better understand the origin and distribution of Wheel flats across a rail network in a way which is not practical with point solution alternatives – this could improve the effectiveness of various management and mitigation strategies and initiatives related to wheel flats.

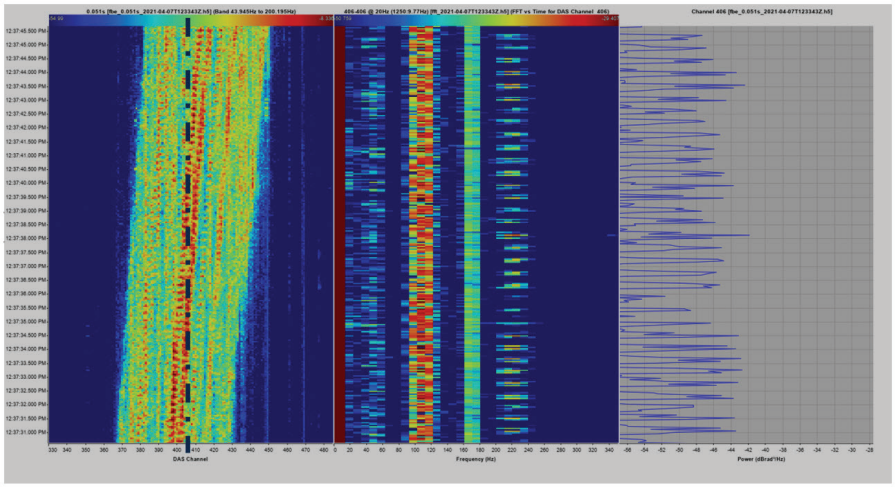

Figure 3 - A time history plot of the signal level as a train passes with wheel flats showing impact periodicity and severity at a single location. A freight train with two wheel flats (left). The dashed blue vertical line at channel 4 is shown as a spectrogram (middle) and time history (right) summed between 200 Hz – 300 Hz showing the levels of the impacts.

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