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New Technology Could Transform Every Train into A High Speed Cracked Rail Detector

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Researchers in the University of Warwick's Department of Physics have developed **a novel non-contact method of using ultrasound to detect and measure cracks and flaws in rail track –** particularly gauge corner cracking - that has the potential to simply be attached to a normal passenger or freight train travelling at high speeds.

Current ultrasonic techniques for detecting defects only work at much slower speeds (around 20-30 miles an hour). A handful of special trains have been created using conventional contacting ultrasonic techniques but there are severe limitations as to when and where they can be used without disrupting the network. The new technology, developed by Dr Steve Dixon, Dr Rachel Edwards and Mr John Reed at the University of Warwick, makes use of a particular form of ultrasonics – a “low frequency wide band Rayleigh wave” to produce a crack testing technique that works at high speed and could transform every train in the country into part of a 24 hour network of rail crack detectors.

The researchers have taken pairs of “electromagnetic acoustic transducers” (EMATS) which generate and detect the “low frequency wide band Rayleigh wave” on the rail without touching the rail. This Rayleigh wave travels along the surface of the rail head, along the length of the rail, penetrating down to a depth of several millimetres. They simultaneously use a wide range of frequencies within a single Rayleigh wave pulse (hence their description of it as a “wide band Rayleigh Wave”) as different frequencies allow penetration of the rail to a range of precise measurable depths.

When the wave,which travels along the surface of the length of the rail at 3000 metres per second, interacts with a crack the different frequency components of the signal are blocked to differing degrees, or are reflected from the crack. The researchers can determine the exact location of a crack by observing the loss of signal as it is blocked by the crack or, at lower speeds, by observing the sudden enhancement in signal created by the interference of waves reflected back from the crack with fresh waves generated by the first EMAT.

Not only can the researchers pinpoint the location of cracks using this technique – they can also ascertain the exact depth of the crack by observing how the frequency content of the Rayleigh wave changes as it moves through a region containing a crack.

The researchers also have had some results that suggest the technique could also be used to get some sense of the change in microstructure and stress levels of a section of track and thus identify sections of track that are more likely to crack or fail – but more testing is required on a greater range of rails before they can be sure of this additional benefit of the technology.

The research has just been published in the June issue of the journal of the British Institute of Non Destructive Testing "Insight" and will also be presented on Tuesday 6th July at the 7th International Railway Engineering conference at the Commonwealth Institute in London.

Dr Steve Dixon said: "Given the will and funding this technology could transform every train in the country into an army of highly sophisticated rail monitors with zero disruption to the rail network".

Source: The University of Warwick

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