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Title:

Observing early stage rail axle bearing damage

Authors & affiliations:

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

This work presents initial results from a new approach to condition monitoring of rail axle bearings, in particular some early-stage failures.

Background:
Premature failure of rail axle bearings causes a significant increase in train operating costs and can impact on train safety. Rail axle bearings have an anticipated service life; however, some bearings do not achieve this. A new approach to degradation diagnostics is now in use on Southeastern / Bombardier trains and provides real-time vibration condition monitoring. Each independent wireless sensor unit bolts to a wheel bearing housing. The units are self-powered by vibration harvesting. This emerging methodology has been made possible by the decreasing power budget of sensor and wireless technologies.

Methods:
In this initial study, real *ex-situ* examples of failures of bearings have been examined. The damaged regions of the bearings are examined using a suite of non-destructive techniques including optical and scanning electron microscopy, computed tomography (CT) and surface profilometry as well as traditional metallographic sectioning methods.

Results:
Figure 1 plots vibration against time as recorded by the on-board sensors. The failed bearing (Figures 2 and 3) displayed consistently higher readings than the other bearings from the same side of the same unit. Figure 4 shows subsurface damage visible on a CT slice.

Discussion:
A new on-board condition monitoring system has made possible the examination of the onset of in-service bearing degradation, allowing identification well in advance of catastrophic destruction of the evidence. Initial results indicate that the vibration sensors are correctly identifying failing bearings. CT damage maps are allowing targeted metallographic sectioning of the samples. Correlation between vibration data and the bearing damage parameters will improve diagnostic accuracy and ultimately improve train safety.

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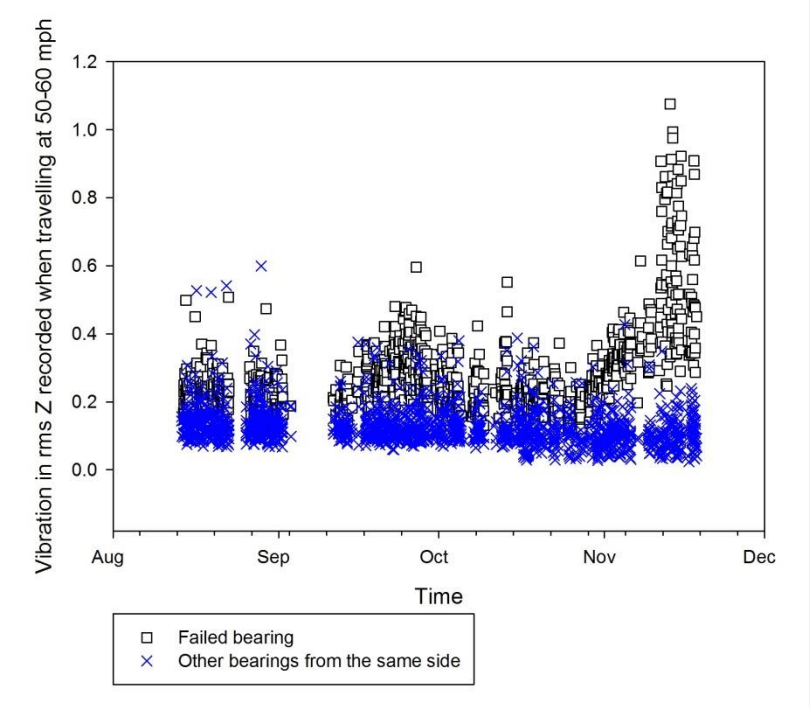

Figure 1: Vibration data

Figure 2: Damaged bearing

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Figure 3: Damaged outer race

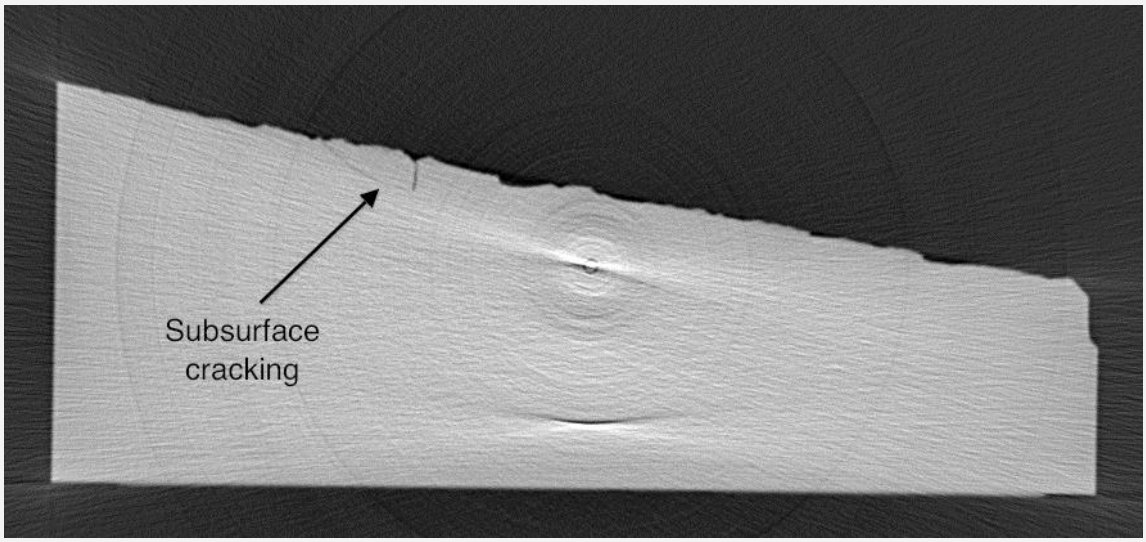

Figure 4: CT section