ACARP Matters

Cutting Edge Condition Monitoring Technology

Cuts Costs and Improves Reliability

A cutting edge approach to condition monitoring is helping Australian coal mines to dramatically improve the way they maintain their mining fleets, resulting in reduced maintenance costs, improved equipment reliability and productivity gains.

Each year the coal industry spends tens of millions of dollars monitoring the condition of mining equipment so that maintenance teams can identify and address

changes in equipment performance before a catastrophic failure occurs. As part of this process, lubricant samples are regularly taken from all equipment components for off-site analysis by professional laboratories. With enormous amounts of data being generated from this process, maintenance teams are often forced to prioritise the immediate and critical issues over an examination of longer term trends in equipment performance.

Endellion Technology and Bluefield AMS joined forces in 2016 to tackle this data management challenge by using a combination of numerical and text analytics, artificial intelligence (AI) tools and data visualisation methods. The outcome of this work is a new technique that semi-automates the process of reviewing laboratory reports. Using this technique, samples outside historical norms that require further engineering scrutiny are identified via simple daily or weekly reports, and samples that conform to historical norms but require further action are moved straight to work orders. This semi-automated process reduces the time required to review and enter work orders into a computerised maintenance management system (CMMS). It also identifies trends across thousands of historical samples in easy step.

Endellion owner Richard Marshall and Bluefield Managing Director Gerard Wood led this research project. Richard managed the analytics and AI side of the project and Gerard provided the equipment, maintenance and industry expertise. In collaboration with Anglo American, the research team processed 17 years of lubricant sample data from a fleet of dozers using the data analytics algorithms it had developed.

Richard said the algorithms had been designed to provide site maintenance teams with regular updates on fleet health and operational insights from historical data across the life of the fleet.

“Text analytics allows high quality insights from professional laboratories to be interrogated in a similar way to numbers. Mines have already paid for this analysis and can now use it more effectively,” he said.

“Through our research we have found that our algorithms can provide on-site engineers with the means to reduce their condition monitoring data analysis and transactional workload by around 80%.

“The algorithms review the historical data we have inputted into the project database. If the recommendations in a new laboratory report already exist in the database; that is, they are a

common occurrence, corrective actions are developed and work orders are raised automatically without having to involve the site engineer to determine what those actions should be.

“If the result or recommendation is not yet in the database; that is, it is an anomaly, it is flagged for further investigation by the site engineer. Our research has shown that these anomalies account for only 20% of the sample data.”

Gerard said one of the challenges facing the research team was the enormous number of corrective actions in the project database.

“We have identified more than 400 actions that had been recommended in the laboratories’ analysis reports. These actions need to be consolidated. One recommendation may be to resample every 75 hours but there may already be a recommendation that says to resample every 100 hours. It doesn’t really make sense to have two actions that are different. We need to build a set of consistent actions that work for the main and give the guys the right direction,” he said.

An industry monitor said the project undertaken by Endellion and Bluefield addressed a critical issue in mine maintenance.

“Condition monitoring techniques are well known and well utilised, however realising the benefits offered by these techniques can be very time consuming and requires a high level of technical expertise. This project presented an opportunity to address both of these issues through automation and natural language programming techniques,” he said.

“The view of the ACARP committee is that this project has delivered the original scope. As with any research, there are always surprises. In this project the main area where the full potential was not realised related to the sentiment analysis. Fortunately, this had no material impact on the success of the project. We are now starting to see the research applied to the real world.”

Trading under the name Relialytics, a proprietary company formed to commercialise the results of this research, the team is delivering a condition monitoring data analysis service to clients. Relialytics has already saved one small to medium-sized contractor tens of thousands of dollars a year by addressing the way it manages its oil and oil sampling for one component in one machine type.

The team has applied for further ACARP funding to enhance the accuracy of the supervised machine learning models and the full development of a semi-automated condition monitoring data review system, including the generation of work orders.

Richard and Gerard attribute their success in addressing this industry challenge to industry collaboration; their ability to integrate AI/analytics and maintenance knowledge.

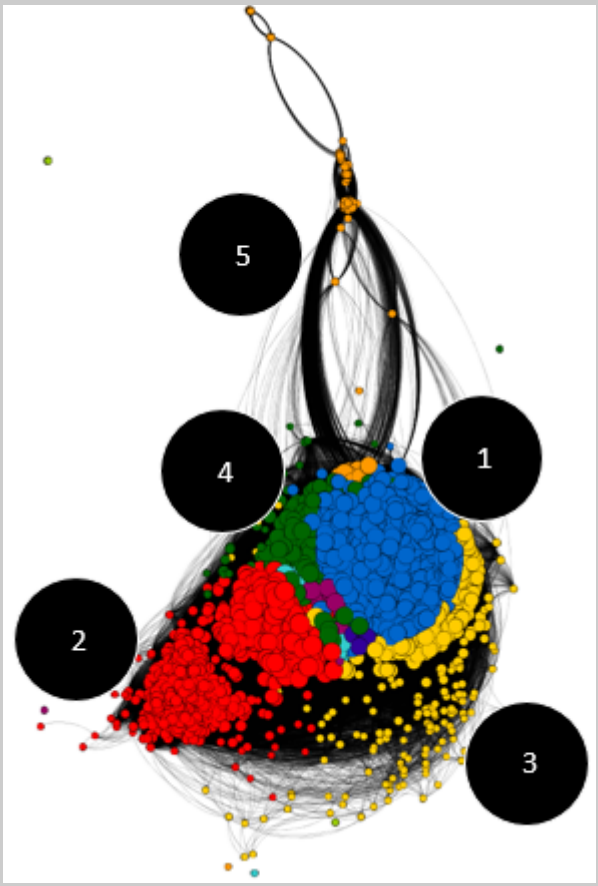

Figure A - Graph coloured to reflect different communities/clusters of samples eg:
- cluster 1 (blue) & 5 (orange) represent normal samples
- cluster 4 (green) samples with high to low viscosity but with dara recording issues
- cluster 2 (red) viscosity ranging from low to very low and wear materials present
- cluster 3 (yellow) dirt and wear materials present

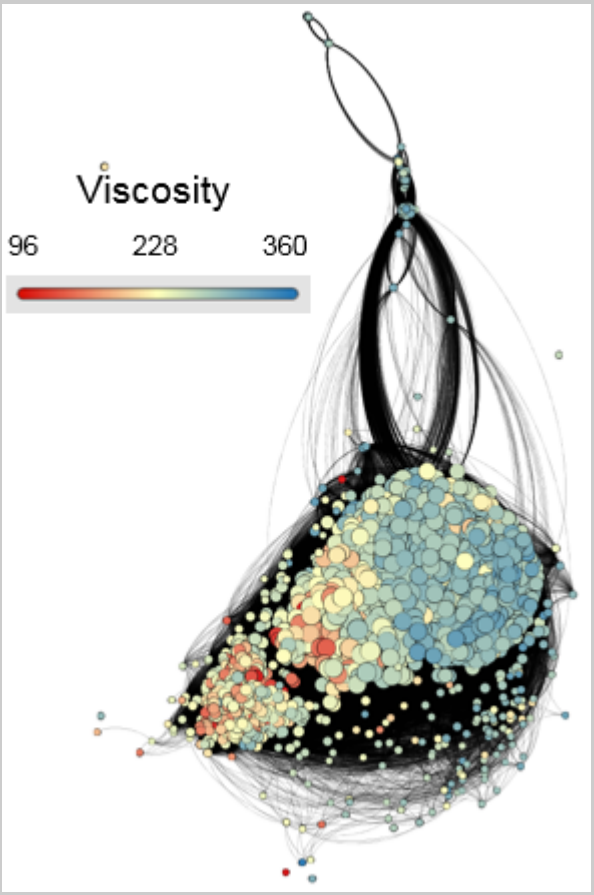

Figure B - Graph coloured to reflect range of viscosities. Includes all left final drive samples. A quick review of the graph shows that low viscosity is a clear issue for the dozer final drives.

For further information:

The final report is available from the ACARP website. Report number C26031

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