Diagnostically lossless compression of pipeline inspection data

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All pipelines are subject to corrosion and require inspection in accordance with regulatory requirements to ensure human safety. Intelligent Pipeline Inspection Gauges (PIGs) as shown in Figure 1 have provided reliable on-line inspection of pipelines for many years, supplying operators with detailed information about pipeline condition. The average transmission pipe length is 300km and the average capacity of the on-board tape is 12GB (uncompressed). The need for accurate topological data necessitates a high density of precision measurements, resulting in a high data rate. Efficient data compression is desirable to reduce, if not obviate, the need for multiple inspections passes, and also enable more rapid collection and analysis of safety-critical data.

We present a method for the diagnostically lossless compression of pipeline inspection data and discuss important pipeline features, e.g. welds, cracks and erosion objects. The dataset, Transverse Field Inspection (TFI) data, is a new type of pipeline inspection data in contrast to the traditional Magnetic Flux Leakage (MFL) inspection data. The nature of the data makes feature preservation essential. TFI pipeline features have been collected, classified and analysed and examples are shown in Figure 2. Feature detection is desirable in order to identify regions of diagnostic interest. Incorporation of region-of-interest (ROI) into the SPIHT encoding scheme enables the allocation of a greater proportion of the total allowance of bits to the regions of the image identified as diagnostically significant. Our quality assessment is based on the preservation of important defect parameters to ensure diagnostically lossless performance. We present results comparing performance between ROI SPIHT and non-ROI SPIHT. Our results indicate that Bior 9/3 ROI SPIHT may be acceptable at 0.8bpp, i.e., a compression ratio of 20:1.

\begin{figure}[h]
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\includegraphics[width=0.4\textwidth]{example1.png}
\caption{An intelligent PIG}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=0.4\textwidth]{example2.png}
\caption{Examples of raw sensor defect signatures}
\end{figure}

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