Fault Diagnostics of Railway Point Machines

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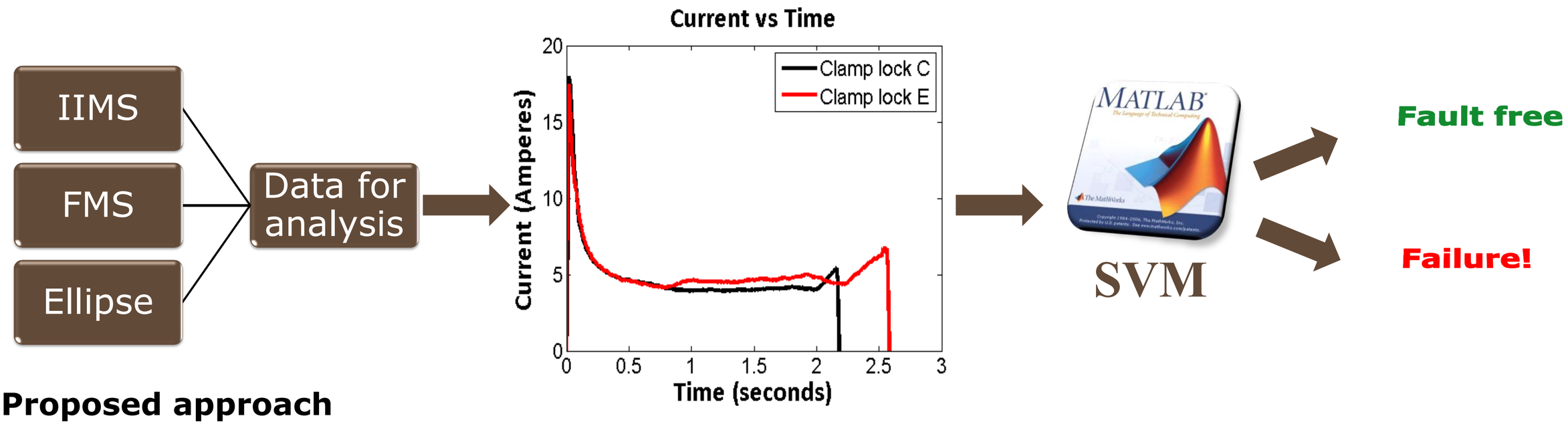
Introduction

The railway point systems allow trains to change tracks, by moving the rails from one track to another before the train reaches the crossing. Failures of these systems cause a lot of train delays in the UK. In order to minimize the unexpected failures of railway point systems and the maintenance needed by the railway point machines, an effective fault diagnostic system is required. The main aim of this research is to create an online point machine condition monitoring system based on the current measurements trends, which would allow the engineers to detect the faults in their earliest stage or prior to its happening.

Databases

Data for fault diagnostics is extracted from 3 Network Rail databases (IIMS, FMS, Ellipse). The IIMS database logs the current measurements, the FMS database logs the repairs or adjustments made to the point machines and the Ellipse database has the information about point machine type, ID and other information that helps to link data from IIMS and FMS databases. Clamp locks are chosen to be the initial point of interest of this research. Clamp locks are further categorised by their planning length: 4.25 metres (C switch) and 7 metres (E switch) are considered.



Proposed approach

Faults detection is considered as a pattern recognition problem. Support Vector Machines (SVM) are chosen for this task, since they are superior to its concurrent approaches. SVM minimizes the structural risk by finding the boundaries of the different classes with the maximum margin of separation. The representatives of each class, that are the most difficult to classify, forms the decision boundary. They are called the Support Vectors.

Testing and results

MATLAB was used to implement the training and testing of the SVM. A binary SVM was constructed to classify normal and faulty currents of C and E switches. Total number of 80 movements for C switch and 105 for E switch was used in the analysis. The raw data of the current was interpolated with splines in order to decrease the dimensionality of the input to the SVM. A leave one out validation was used to test the performance of the SVM. The results are as follows:

Switch type	# of normal currents	# of faulty currents	# of normal currents classified as faulty	# of faulty currents classified as normal	Total error rate
C	40	40	3	0	3.75%
E	54	51	9	1	9.52%