

# **Early Detection of Equipment Failure Using One-class Support Vector Machine**

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## **Abstract**

Equipment failure is a typical problem, and it is difficult to detect it in the current technology-based industry. There are many different approaches to diagnostic reasoning such as Rule-based reasoning, model-based reasoning, and qualitative model-based reasoning in preventive maintenance. In this paper, we developed a model-based approach namely one-class Support Vector Machines (SVM) to detect the faults in the oil industry. Real data like pressure and temperature readings were collected from sensors which are placed at different parts of machines at each minute. Also, failure occurrence of each machine is recorded. Before applying the model, as an initial step, the data ('n' hours just before the occurrence of a failure) is fine-tuned using Exponentially Weighted Moving Average (EWMA) method to remove the external noise factors which occurred while taking the readings. After fine-tuning the data, features like mean, median and peak values were extracted at the time interval of fifteen minutes. These features were also extracted using the correlation between sensor values and the information from the people who have domain knowledge on these machines. After this, we developed one-class SVM model on the data. We also built multiple one-class SVM models by 'k' fold cross validation which reduces overfitting. During this process, if the model indicates an outlier, it indicates that there is a chance of failure occurrence.

## **Keywords**

Equipment failure, Fault Diagnosis, One-class SVM, Oil Industry, EWMA.

## **Biographies**

**K Subash Nirmal** is currently pursuing Dual degree(B.Tech, M.Tech) in the Department of Industrial & Systems Engineering at Indian Institute of Technology, Kharagpur. His projects were mostly based on the application of machine learning, data-mining techniques and embedded electronics to solve real-world problems in Supply Chain Management and Failure detection. He also worked on predicting gross of Bollywood movies, Indian Premium league Auction price prediction. He carried out research on Vehicle Routing problem by collaborating with Kaizing Delivery Services, a startup of IIT Kharagpur. He got an appreciation for his work on image processing based soundless honking system in KPIT-Sparkle. At present, he is working on a collaborative project with Shell India Markets Private Limited.

**Prince Agarwal** is currently pursuing Bachelors of Technology in the Department of Industrial & Systems Engineering at Indian Institute of Technology, Kharagpur. His project work mostly includes the applications of machine learning, data-mining and embedded electronics techniques to solve real-world problems in Supply Chain Management and Failure detection. He had also worked on the behaviour-based analysis of Malware. He had been a part of a robotics-based research group of IIT Kharagpur which aimed at designing and fabricating Soccer playing robots. He also worked as an associate member of a society of his college named External Relations Cell which aimed at promoting career opportunities to students. At present, he is working on a collaborative project with an Oil and Petroleum based Company.

**K Nageswara Reddy** is the Doctoral Student in Department of Industrial and Systems Engineering at Indian Institute of Technology, Kharagpur, India. He has published journal and conference papers. His publications appeared in such journals as International Journal of Production Economics, International Journal of Production

Research and European Journal of Operational Research. His research interests include operations research (optimization), transportation, logistics and supply chain management. He is a member of IEOM, INFORMS, IISE, POMS and IEI.