Condition Monitoring Using Accelerometer Readings

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Accelerometer Sensor Locations

Centrifugal Pump

Motor
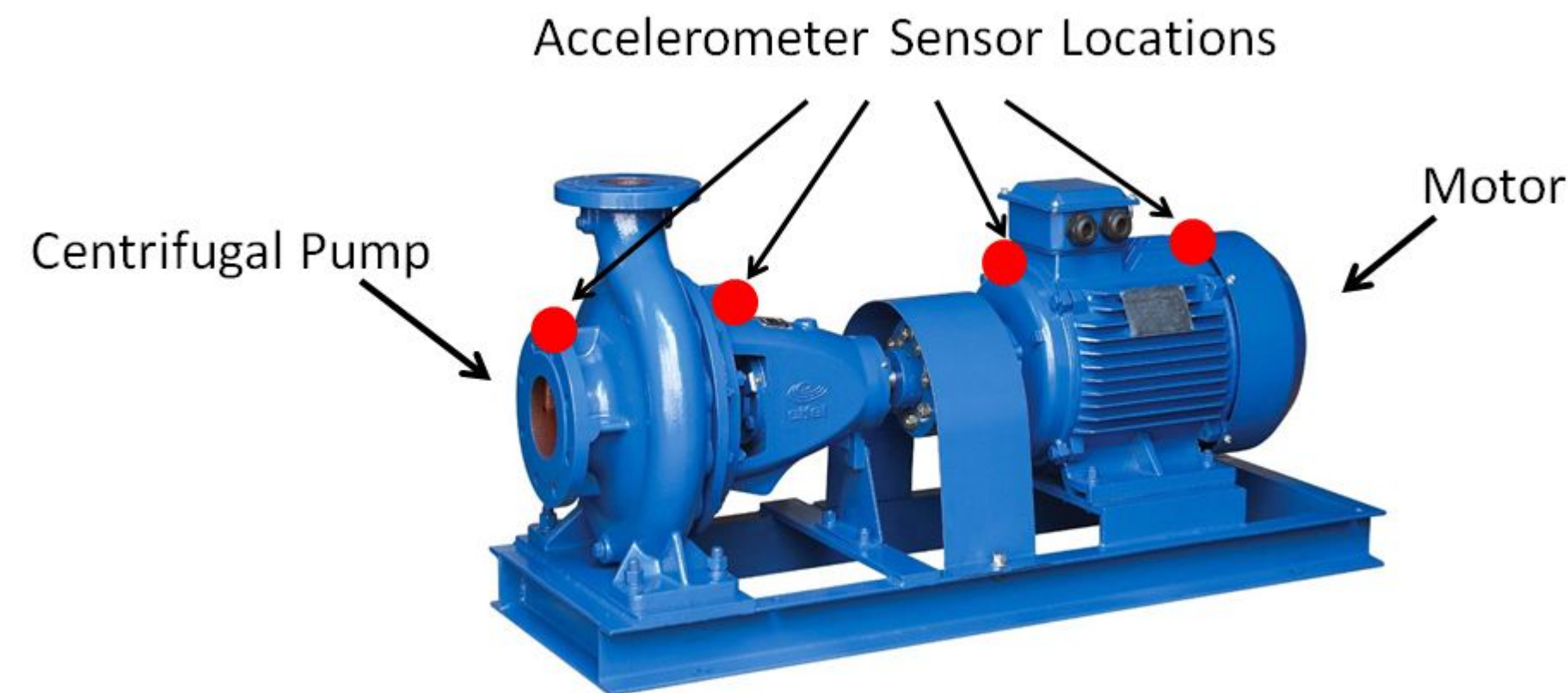
Vibration analysts most frequently use data from accelerometer sensors to identify patterns indicative of machine wear or malfunction, which can save manufacturing plants up to millions of dollars in repair costs. This process involves first making sure the data isn't corrupted by sensor malfunction or noise from atypical test conditions, then examining the data from fault indicators. Common machine faults include shaft imbalance, looseness, bearing wear, and misalignment.
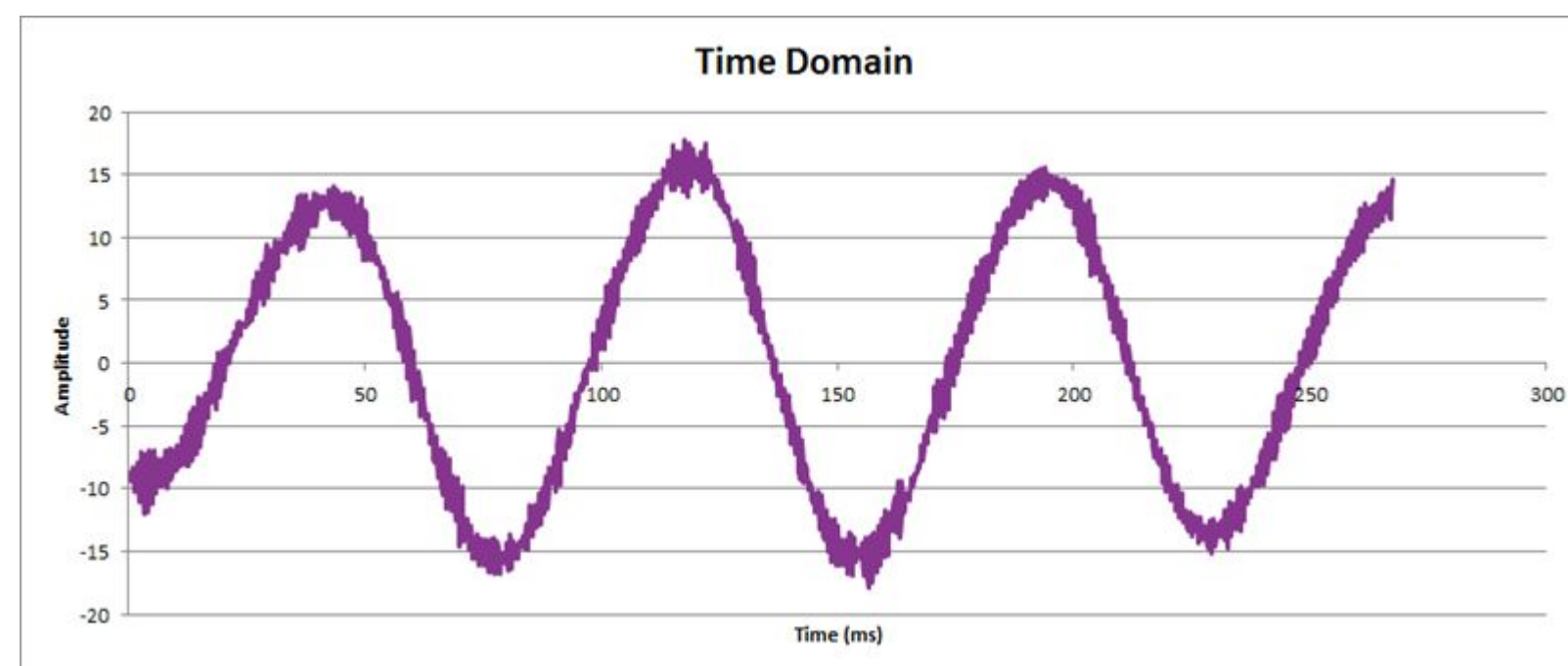
Time Domain

24 time domain features: RMS, peak, kurtosis, crest factor for X, Y, Z velocity and acceleration
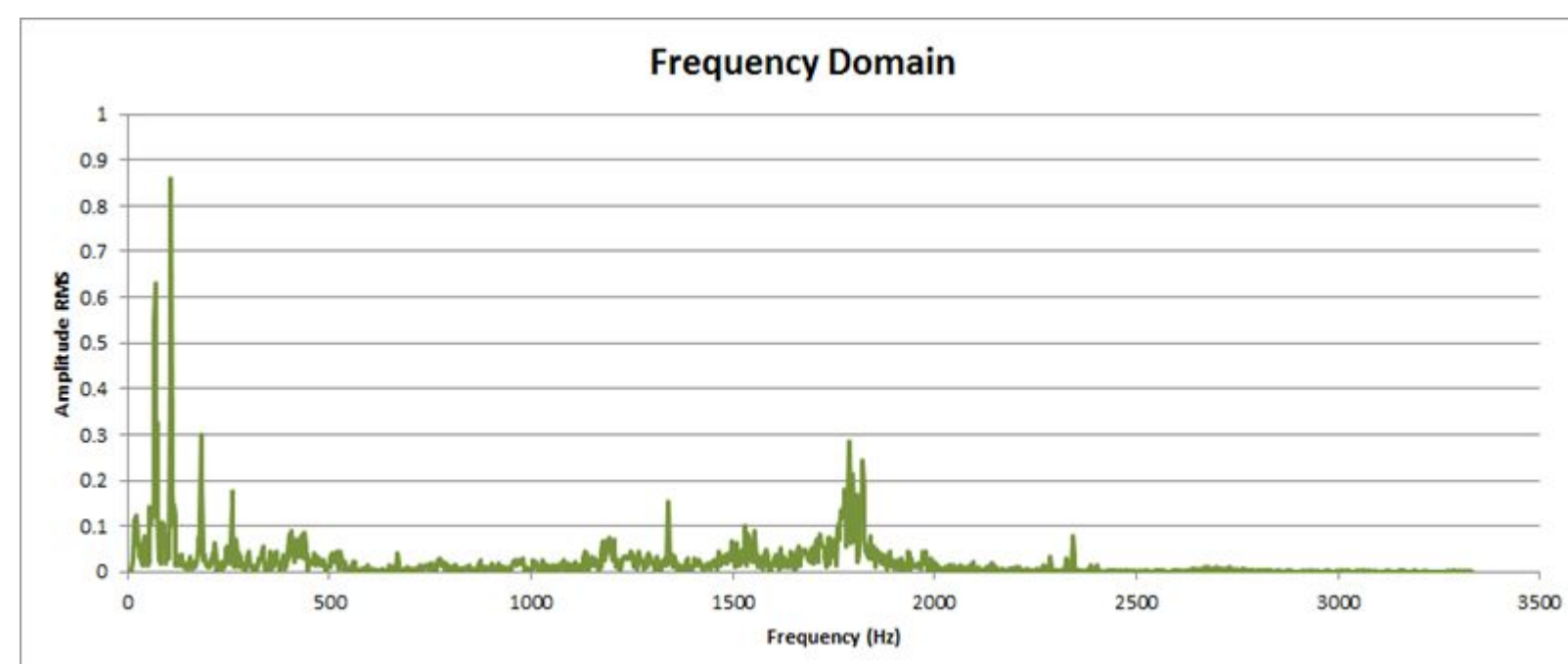
Frequency Domain

10,002 frequency features: spectrum for X, Y, Z velocity and acceleration reduced to 1667 features using Z velocity only

While time domain measurements values such as RMS and crest factor are used, as well as overall patterns in the waveform, frequency domain measurements are the most commonly used to diagnose problems. When accelerometer levels at certain frequencies deviate from baseline, it can be indicative of machine wear (i. e., increased levels at harmonic frequencies of the machine shaft speed are indicative of mechanical looseness).

Identify Good/Bad Data

Bad measurements were initially filtered out using a threshold of the velocity RMS levels.

	M1	M3	M4	SN41
Total samples	3370	2325	1478	2170
# filtered out	880	1693	913	497
# retained	2940	632	565	1673
% filtered out	26%	73%	62%	23%

K-means Clustering (SN41)
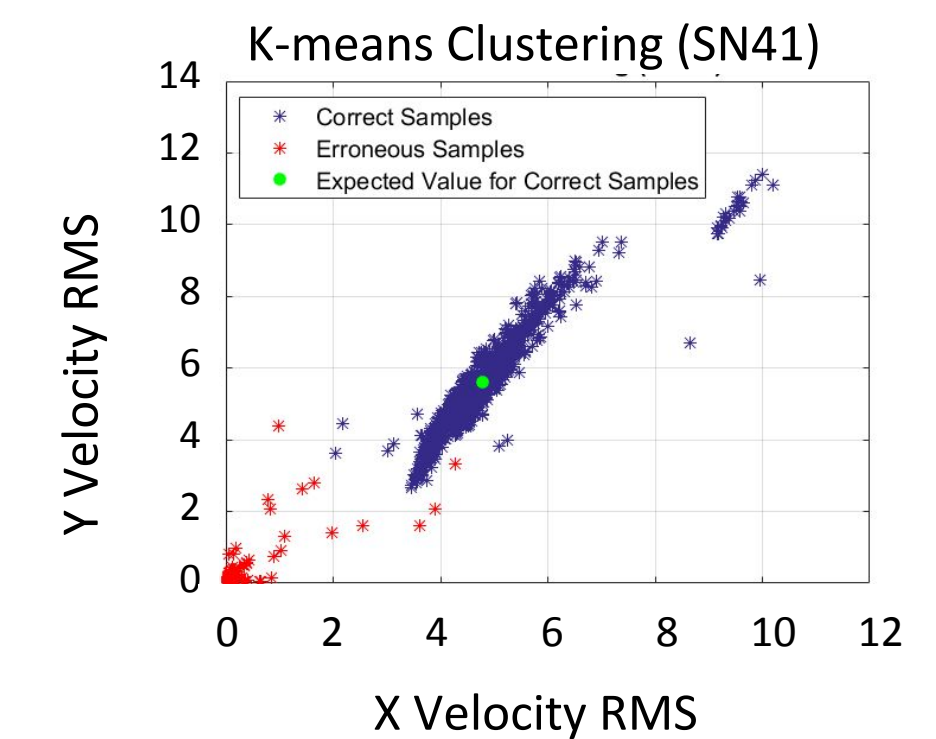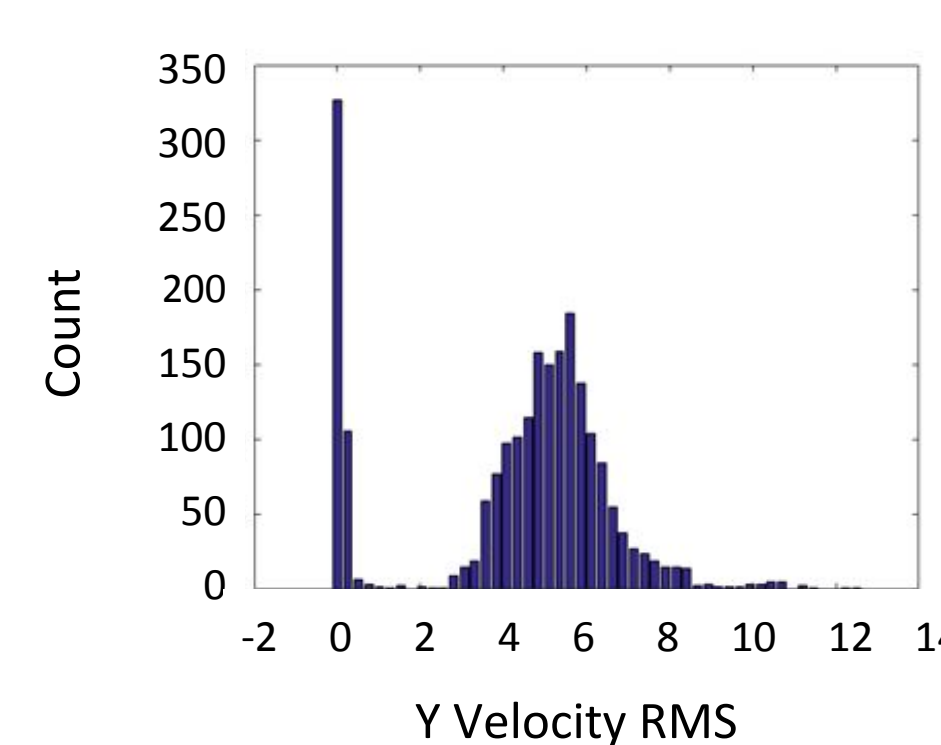
Identify Machine "State"

Multiple supervised learning algorithms were used to classify measurements by machine type, a stand-in for machine state

Logistic Regression

SVM
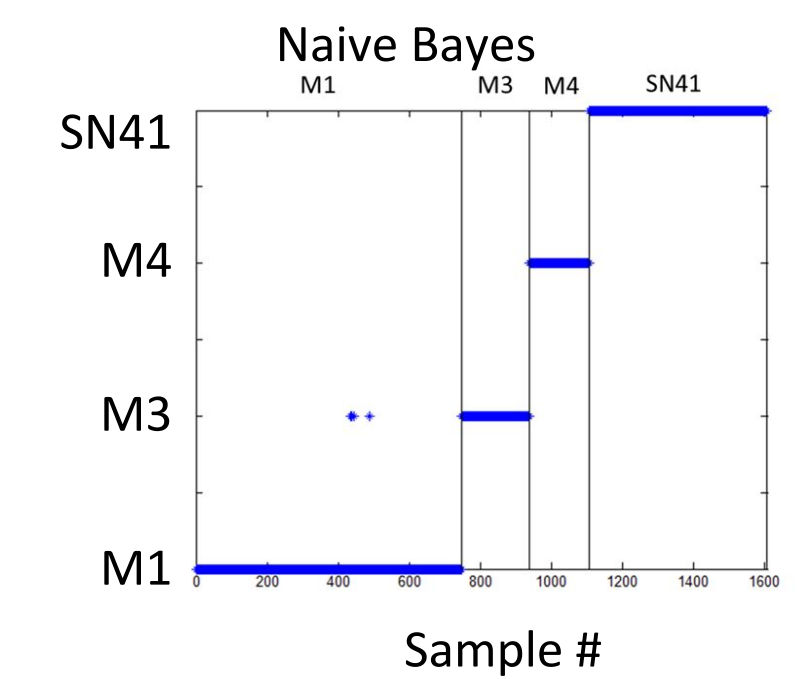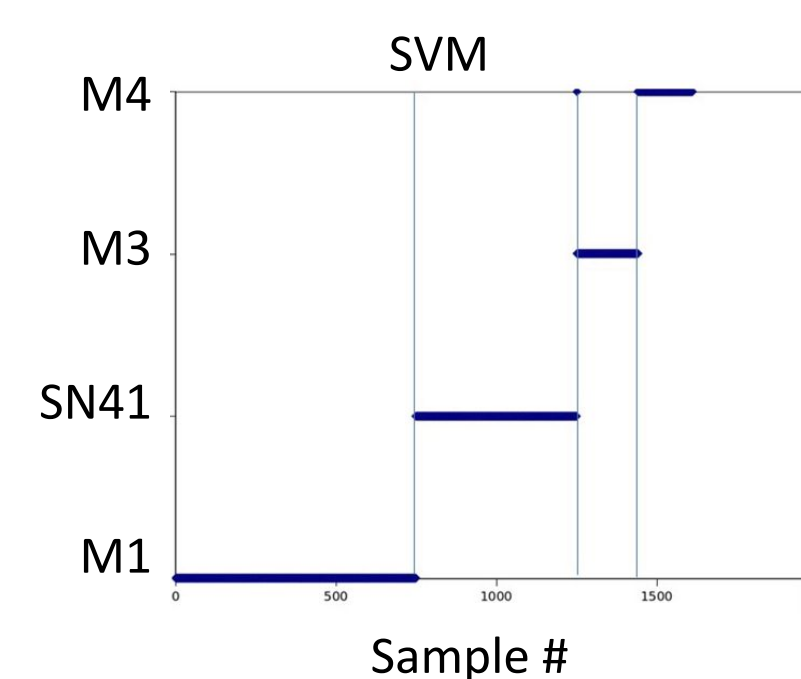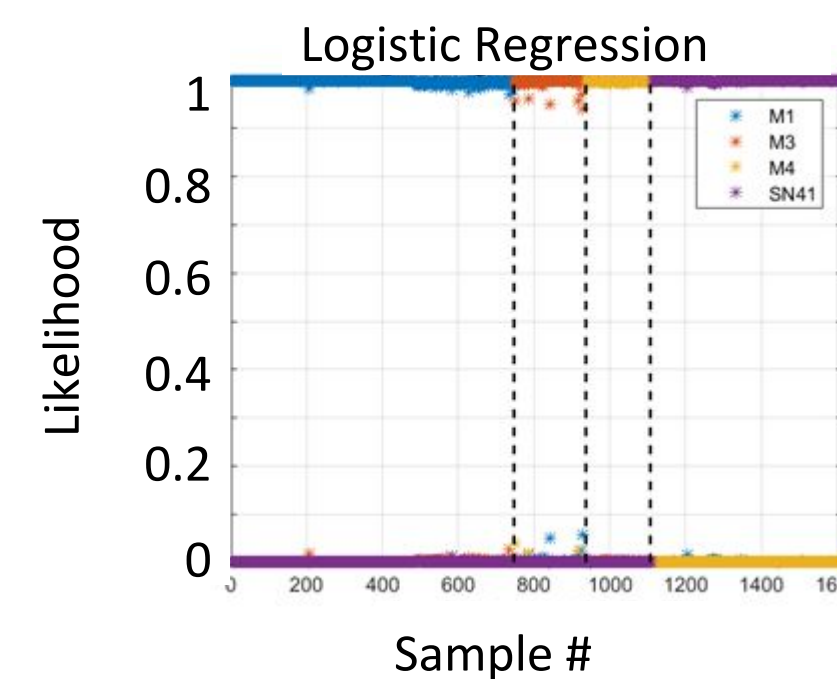
Naive Bayes

Error rates calculated with 30% hold-out cross validation

Learning Algorithm	Time	Frequency
Logistic Regression	0.0%	0.0%*
Naive Bayes	25%	0.37%
SVM	0.19%	0.06%

*Using 50 frequency domain features

Identify Malfunction

Mixture of Gaussians was used to identify samples indicating malfunction.

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