



Smart Sensor Network Organization: Sensor Data Fusion and Industrial Fault Traceability

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Introduction

Industrial environment usually contains multiple motors that are supplied through a common power bus. The power line acts as a good conducting environment for signals to travel through the power network. In effect, this influences other motors with noisy signals that may indicate a fault condition. Further complexity arises when signals are generated by motors with different power ratings, a different slip speed and more than one source of fault signals. This sort of complexity and mixing among signals from multiple sources makes them difficult to measure and precisely correlate to a given machine or fault.

This research deals with the development of an approach for fault diagnosis and localization based on distributed current signature analysis through artificial neural network.

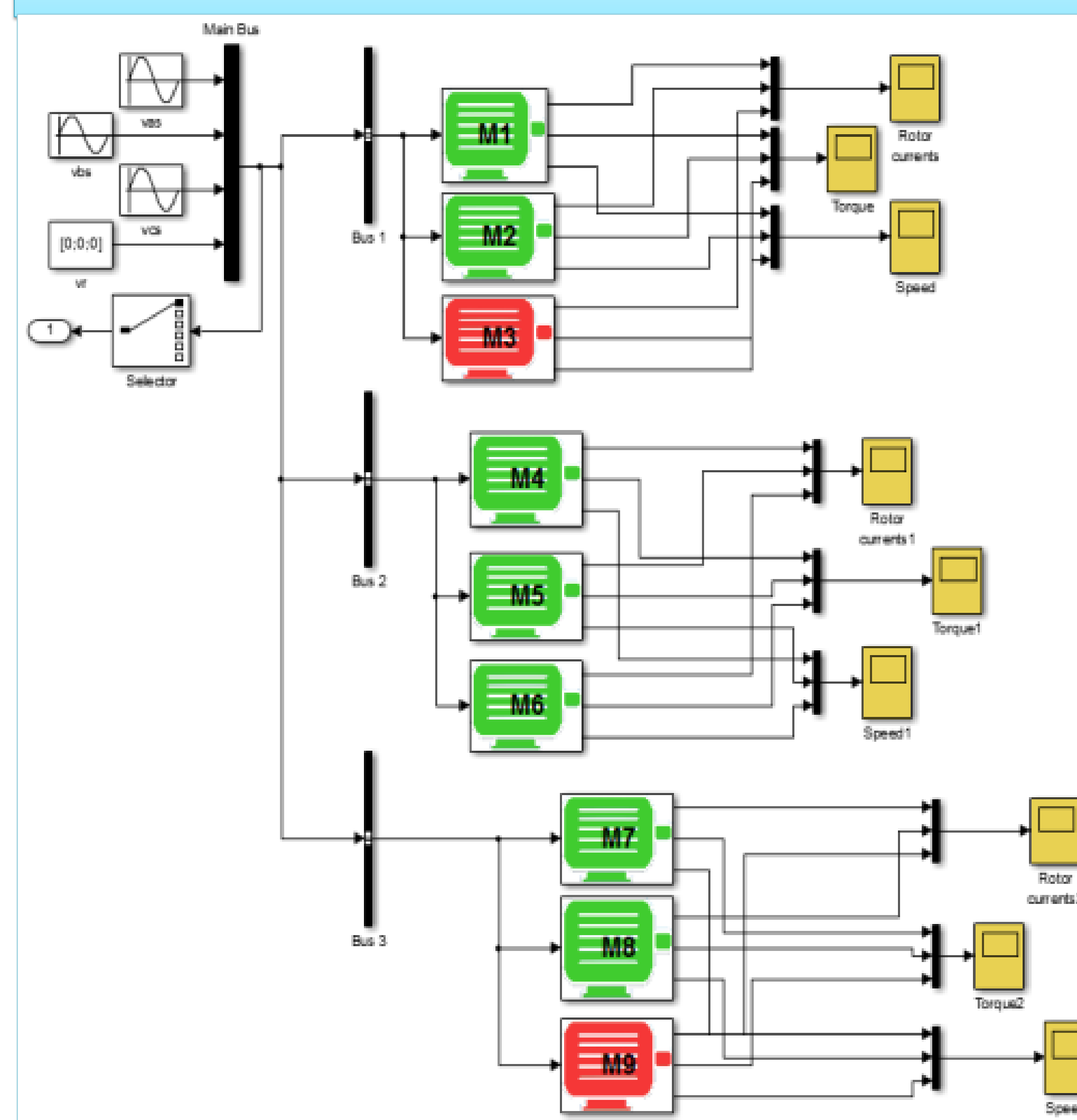
Research Objectives

- ❑ Investigation and development of machine faults library using fault frequency characteristics models
- ❑ Development of a generic concept for an intelligent sensor fusion architecture that act as an environment for fault signatures acquisition, data fusion and diagnosis.
- ❑ Development of efficient machine intelligence approach for fault identification and localization.

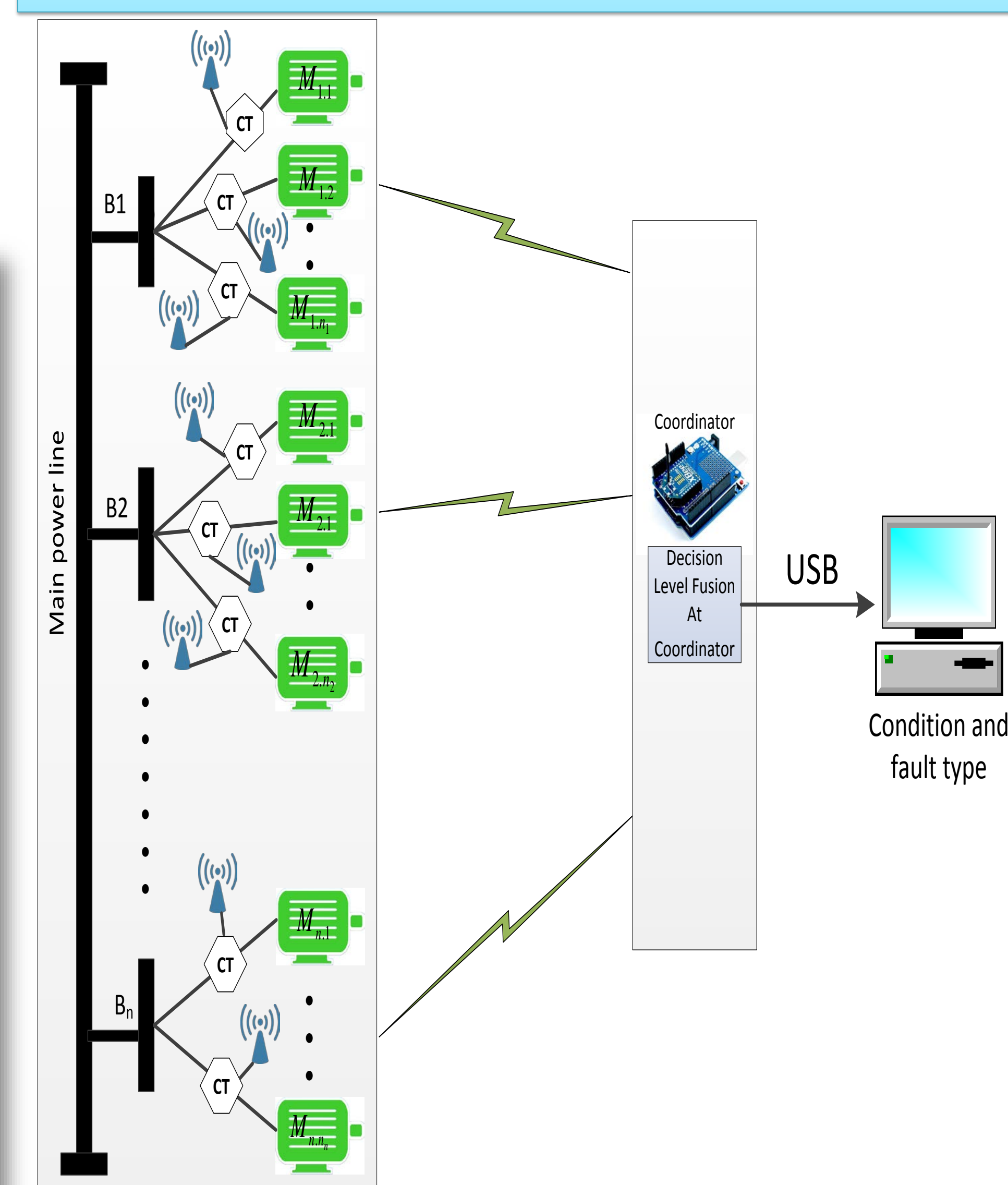
Test Bed Environment



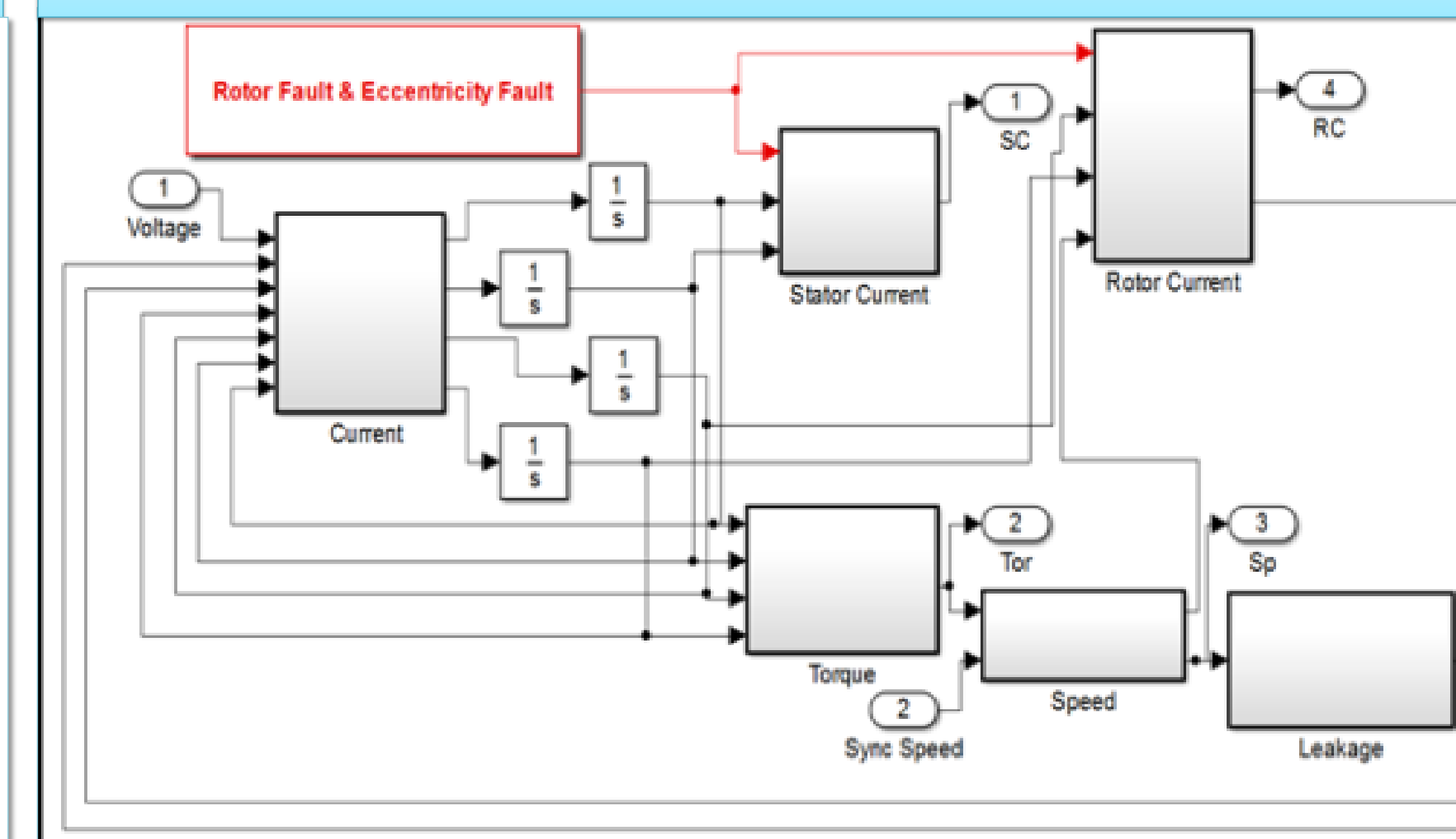
Simulation Model case study



WSN & Distributed Signature Analysis Architecture

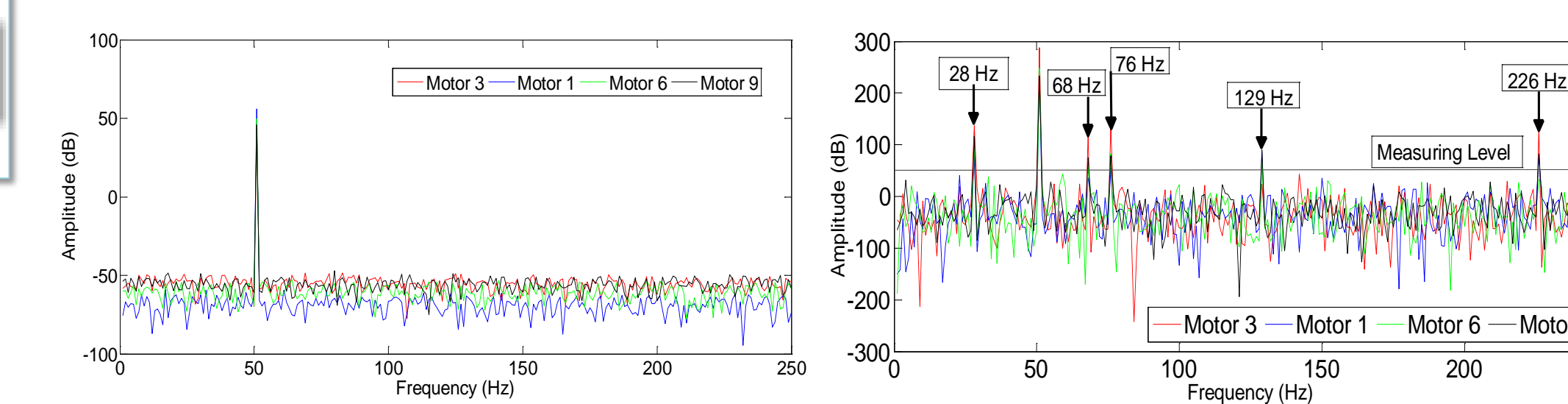


Fault Model in Simulink

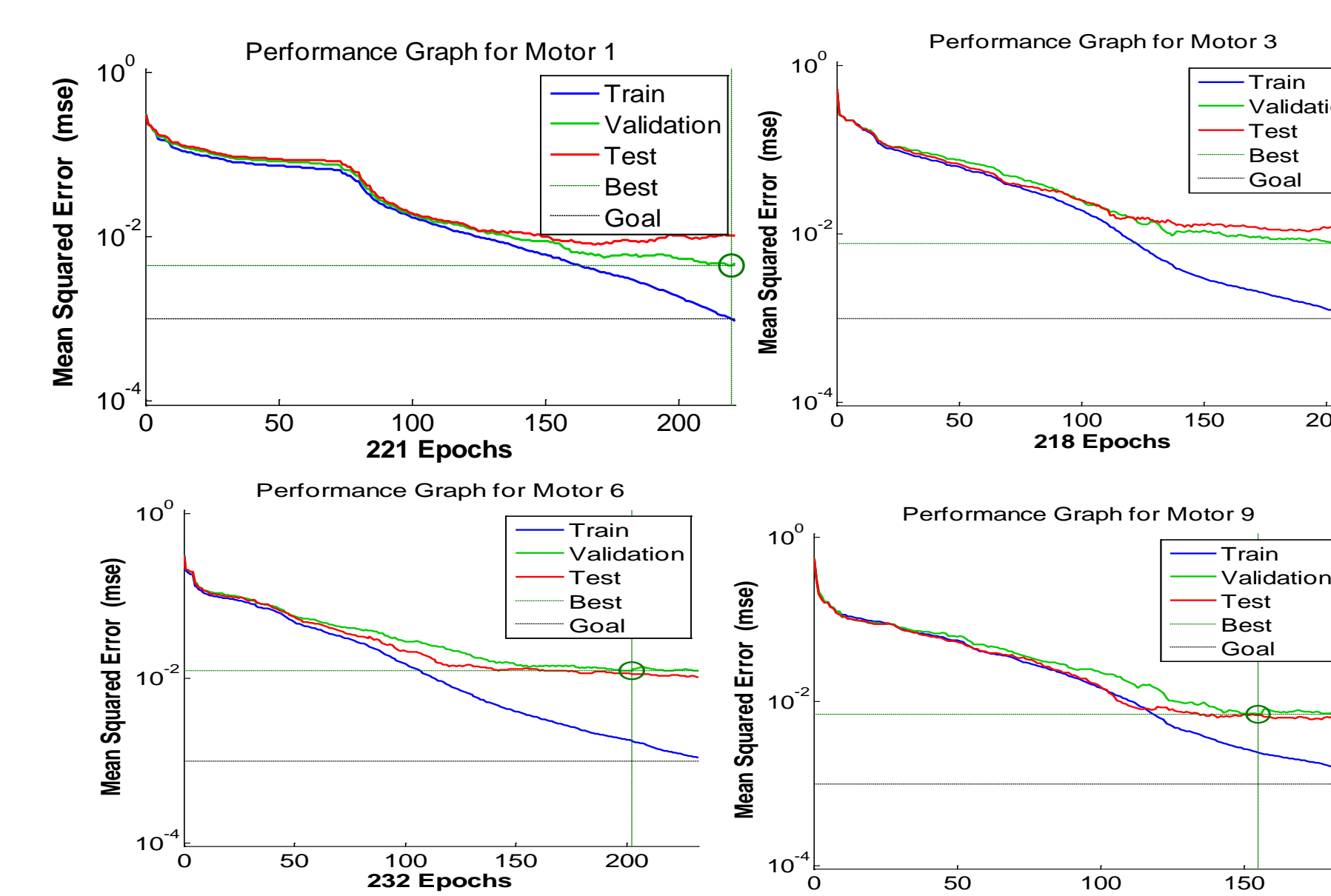


Results

Fault Signal Propagation



Performance Results



Confusion Matrix

Confusion Matrix for Motor 1						Confusion Matrix for Motor 3						Confusion Matrix for Motor 6						Confusion Matrix for Motor 9					
Output Class	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5			
1	410 9.1%	0 0.0%	29 0.8%	0 0.2%	89.7% 10.0%	561 10.8%	17 1.2%	10 0.8%	15 1.2%	62.4% 10.0%	682 13.1%	52 1.1%	52 1.0%	45 1.0%	76.1% 23.9%	512 11.1%	23 0.2%	33 0.3%	43 0.4%	84.9% 15.0%			
2	368 8.8%	1187 28.0%	0 0.0%	0 0.2%	39.9% 29.1%	54 2.0%	1114 24.2%	0 0.0%	0 0.3%	91.0% 9.0%	157 3.4%	1256 24.5%	0 0.0%	0 0.1%	87.4% 12.4%	280 4.9%	1166 25.3%	0 0.0%	13 0.1%	88.1% 11.9%			
3	41 1.0%	0 0.0%	1108 25.2%	1 0.1%	99.9% 0.1%	251 5.0%	0 0.0%	1108 25.2%	11 0.9%	81.9% 18.0%	168 3.6%	0 0.0%	1914 21.3%	22 0.8%	91.1% 8.9%	186 3.0%	0 0.0%	1145 12.4%	0 0.0%	9.6% 9.6%			
4	228 5.5%	0 0.1%	1 0.1%	1179 25.6%	16.6% 16.6%	154 3.0%	29 0.6%	32 0.7%	1118 24.9%	83.9% 16.1%	156 3.4%	22 0.5%	14 0.3%	1139 24.6%	85.9% 14.5%	173 2.9%	0 0.0%	17 0.2%	1131 24.6%	84.2% 15.8%			
5	41.5% 60.1%	99.0% 9.2%	99.5% 9.6%	98.2% 1.6%	84.1% 14.1%	50.1% 49.9%	92.0% 7.7%	96.5% 3.5%	93.6% 6.6%	84.6% 15.4%	64.0% 39.8%	94.2% 6.2%	91.2% 8.8%	94.2% 5.8%	84.9% 14.1%	51.2% 48.8%	97.2% 2.8%	95.4% 4.6%	5.8% 5.8%	85.0% 14.9%			
Target Class	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5			

Conclusion & Future Work

- ✓ The work looked into modelling of distributed industrial induction motor.
- ✓ Developed Multilayer FFNN architecture for the identification of industrial in-system motor's faults.
- ✓ Simulated results showed that accurate recall and generalization behaviours are obtained during the multiple faults diagnosis process in distributed motor network.
- ✓ Future work looks into minimizing the confusion through NN classification at the distributed system level.
- ✓ Establishment of a SN architecture for Motor fault diagnoses based on a scaled down test-bed offering real-time interaction environment.