Emission reduction of internal combustion engines with advanced control and machine learning techniques

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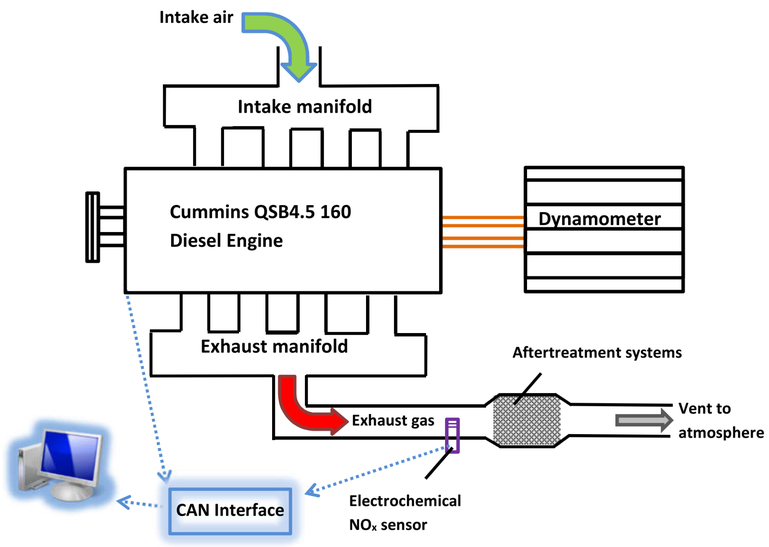
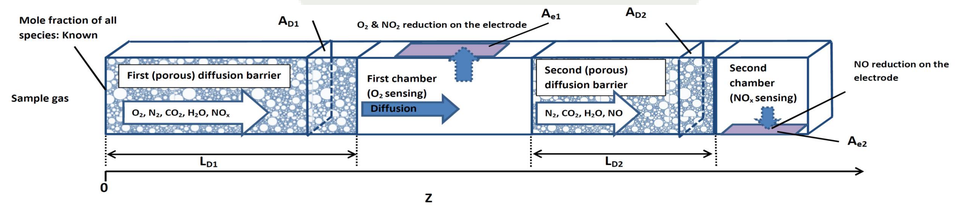
BACKGROUND

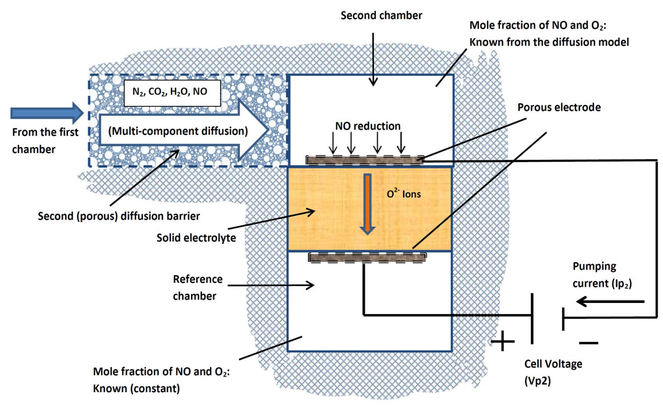
- New engine control strategies are needed to meet the stringent emission regulations.
- High combustion temperature and the lean air-fuel mixture of Diesel engines lead to a relatively high NO_x emission.
- Reducing CO and unburned hydrocarbons are challenges of homogeneous charge compression ignition (HCCI) engines.



AIMS AND OBJECTIVES

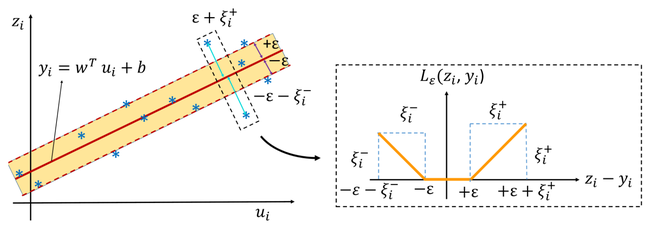
- Fast response emission sensors have become essential for on-board emission measurement in the exhaust gas and for engine feedback control.
- Combining advanced machine learning techniques with physics-based understanding of fast response electrochemical sensors, provides a powerful tool for accurately simulating the sensor and optimizing its performance.



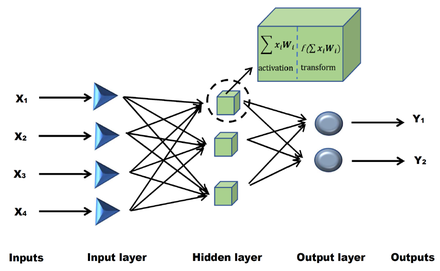


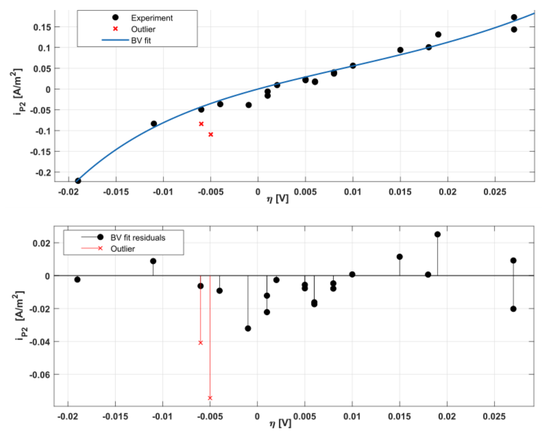
METHODOLOGY

- Advanced Machine learning techniques are used to understand the complex behavior of internal combustion engines and fast response emission sensors.
- Artificial Neural Network (ANN) and Support Vector Machine (SVM) methods are used to predict and optimize the performance of ICEs and electrochemical sensors.



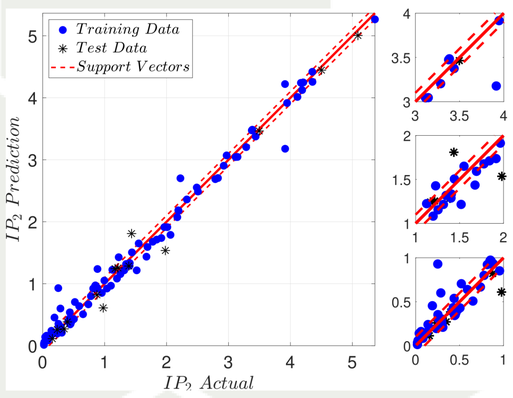
- Physical understanding of the fast response emission sensors are combined with the advanced machine learning techniques to develop smart grey box sensor models.

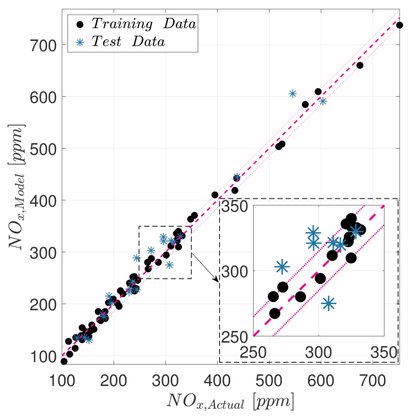


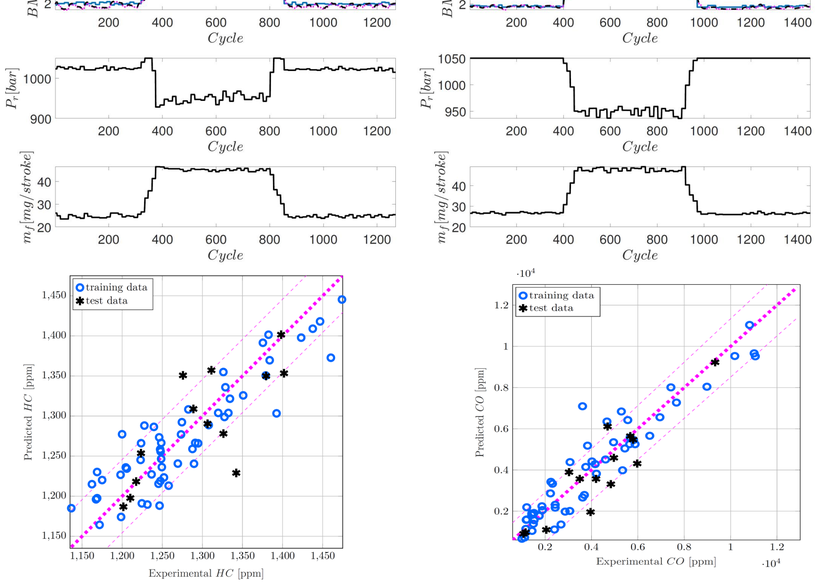


RESULTS

- The developed data-driven models are capable of predicting the main emission of diesel and HCCI engines.
- The developed grey-box models can accurately predict the performance of fast response electrochemical sensors.







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