Detection of Ammonia Slip Using NOx Sensor Signal Processing

GM Advanced Engineering

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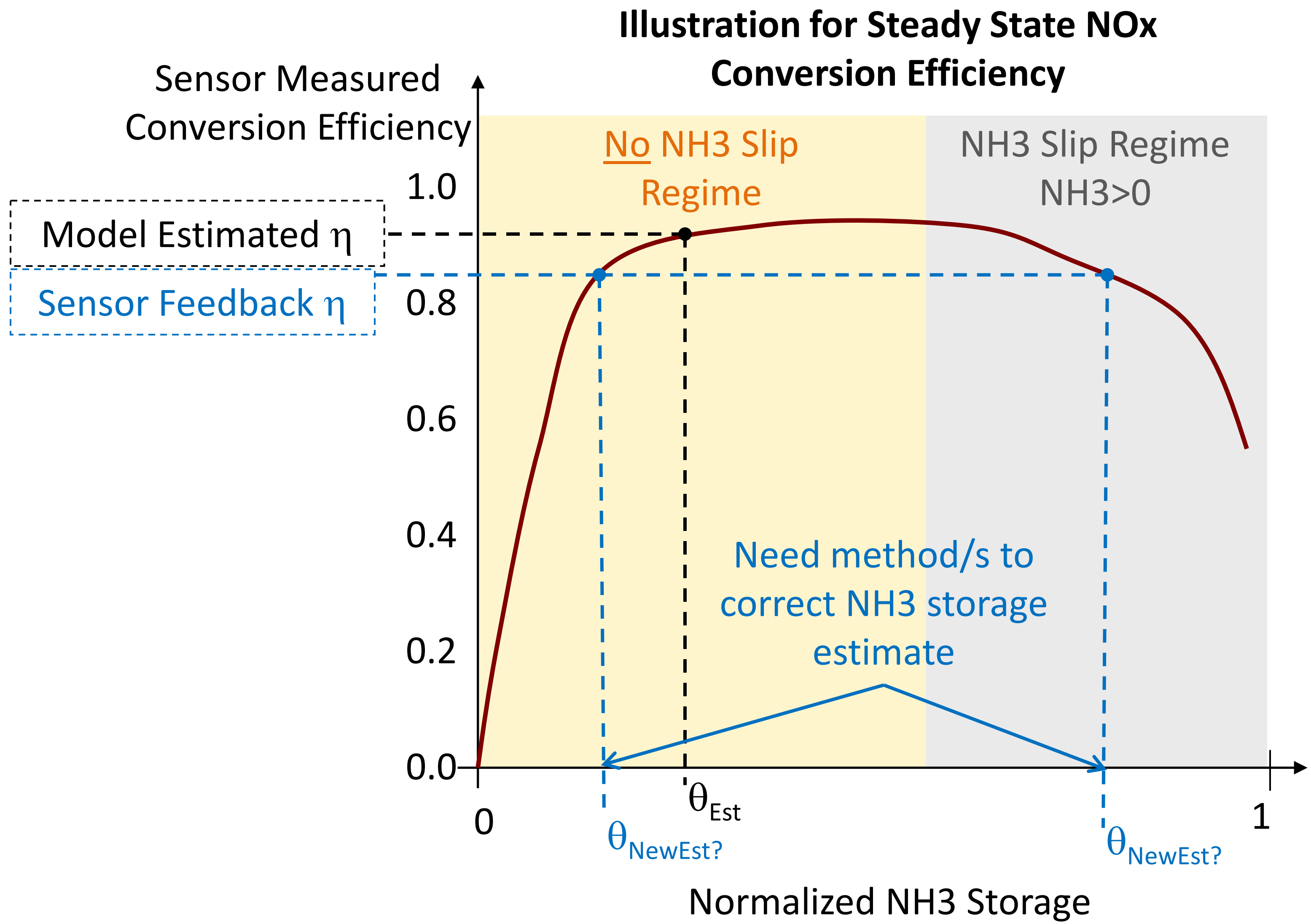
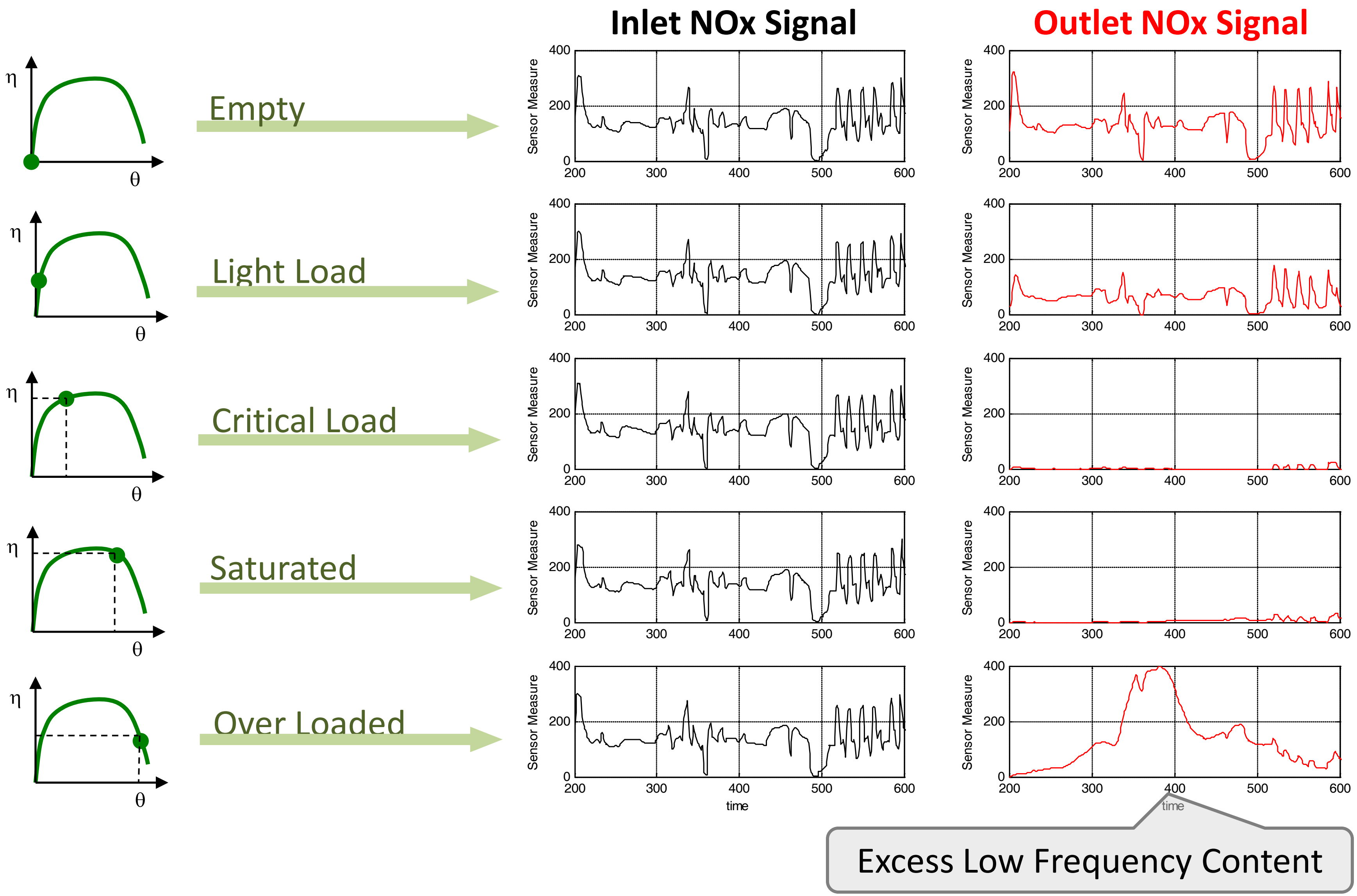
Need For NH3 Slip Detection



Observed Response of the SCR System



Components of NH_3 Slip Detection Logic

Frequency Analysis

- By observing the frequency content of the upstream and downstream NOx signals, there is potential to detect presence of NH_3 slip in the downstream signal.

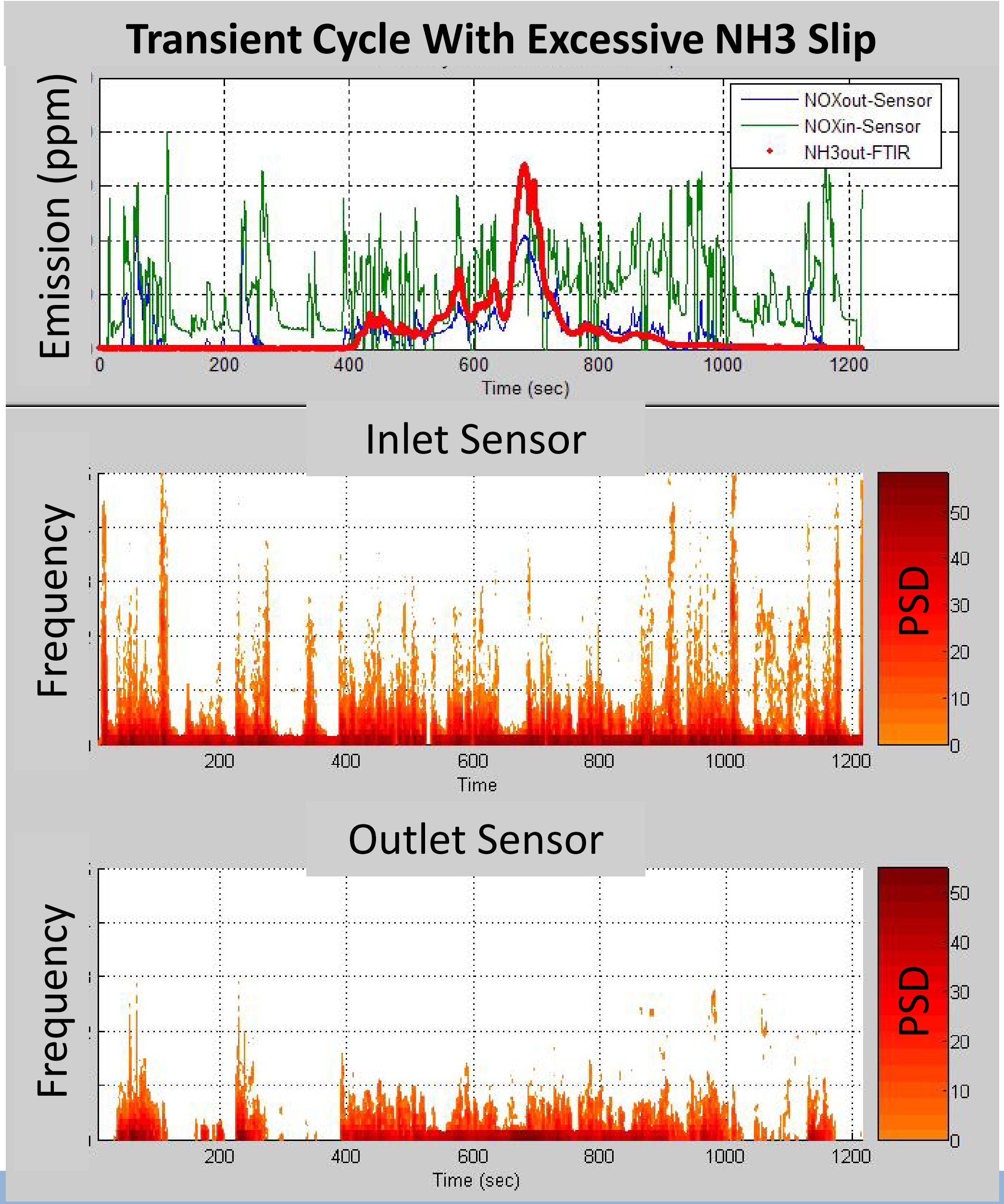
Statistical Analysis

- By observing how well the downstream NOx signal moves relative to the upstream signal, it is possible to determine when there is a low likelihood of NH_3 signal content within the downstream signal

Steady State Analysis

- By observing the response of the downstream signal to intrusive upstream inputs, it is possible to detect NH_3 slip

Frequency Content of NOx Sensor Signals

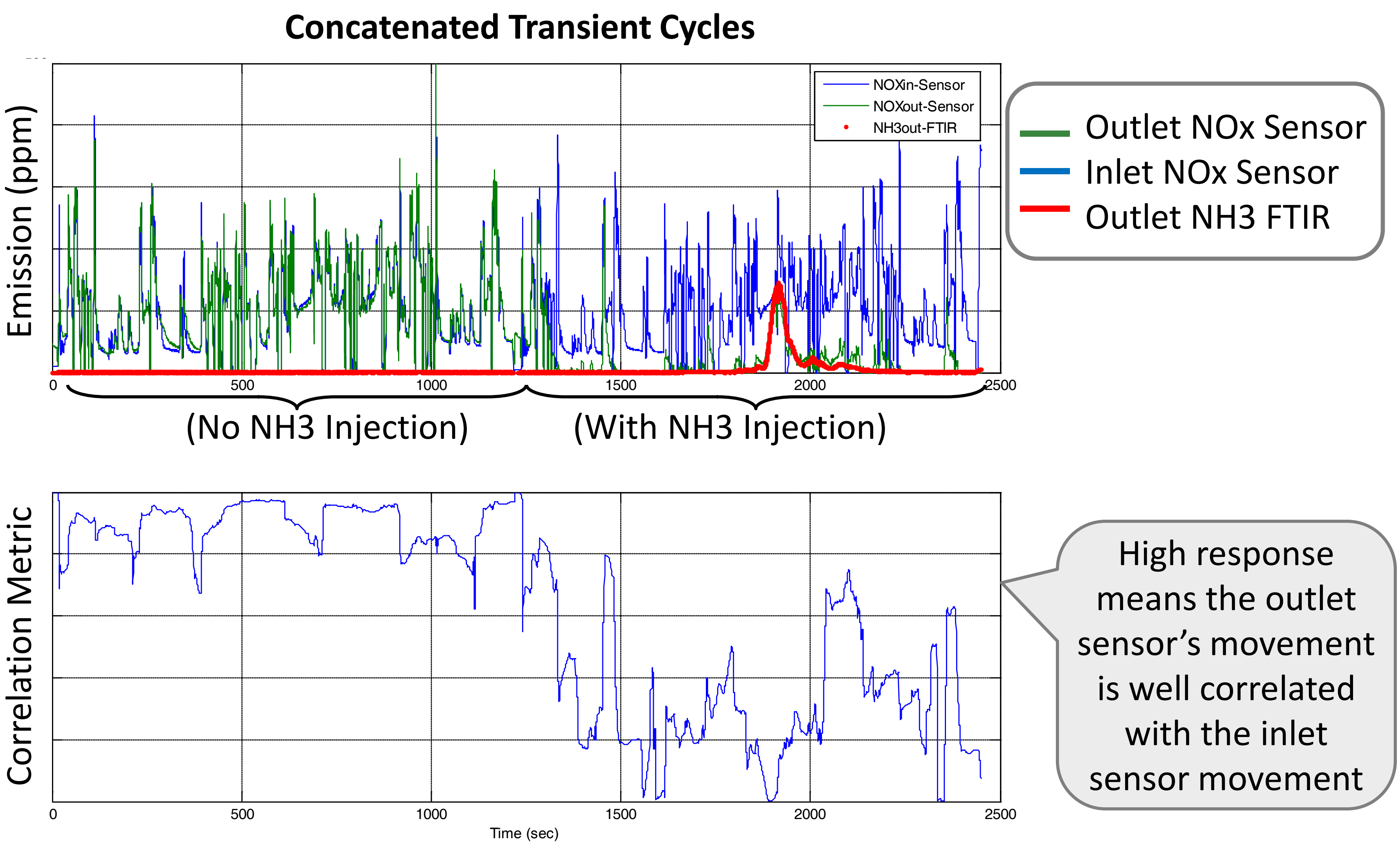


- Outlet NOx Sensor
- Inlet NOx Sensor
- Outlet NH3 FTIR

Less low frequency content then outlet sensor

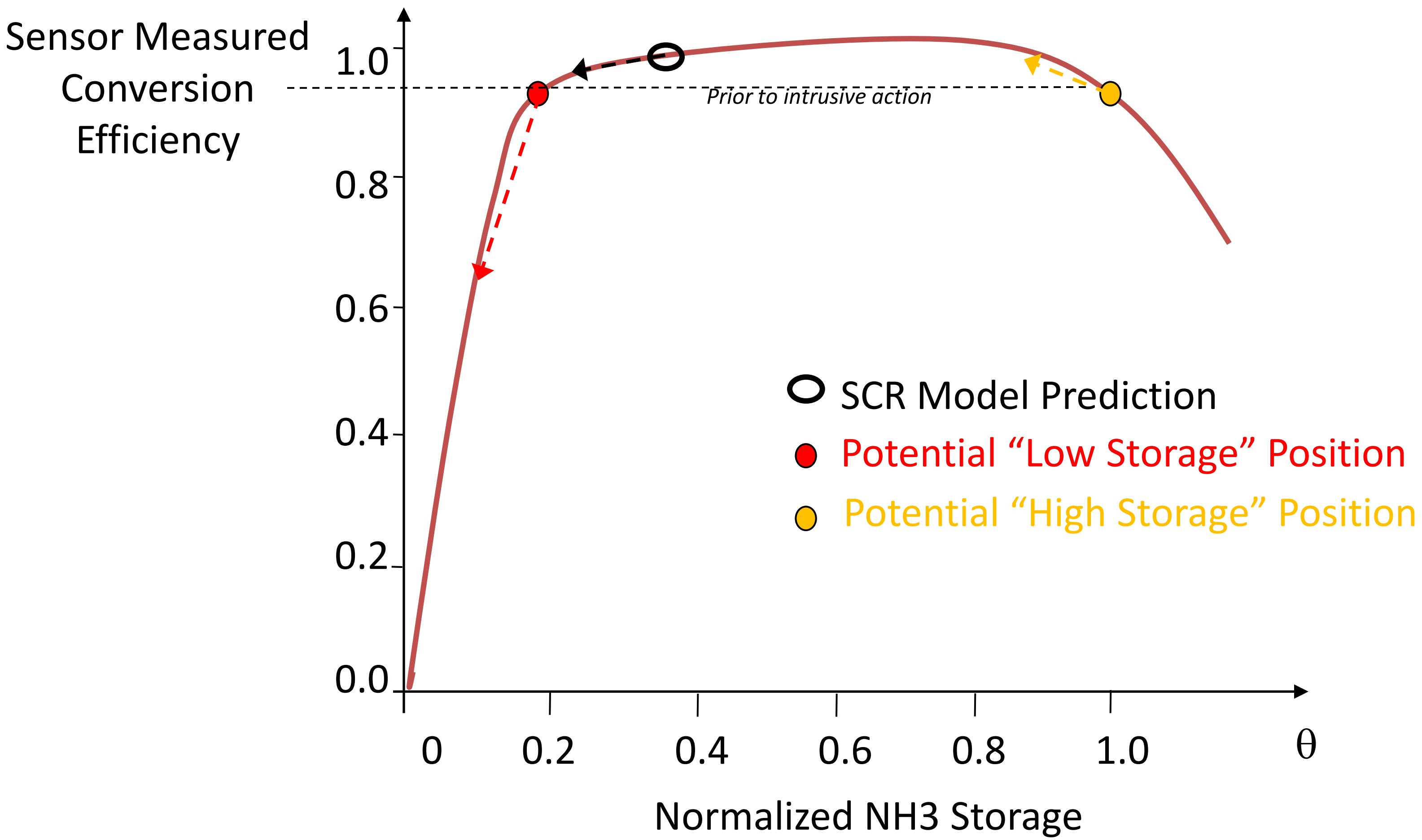
Less high frequency content then inlet sensor

Statistical Correlation of Signals



NH3 Slip Detection During Quasi-Steady Conditions

The response of the downstream NOx sensor is analyzed relative to the model prediction after an intrusive action has been taken



Slip Detection Process Flow

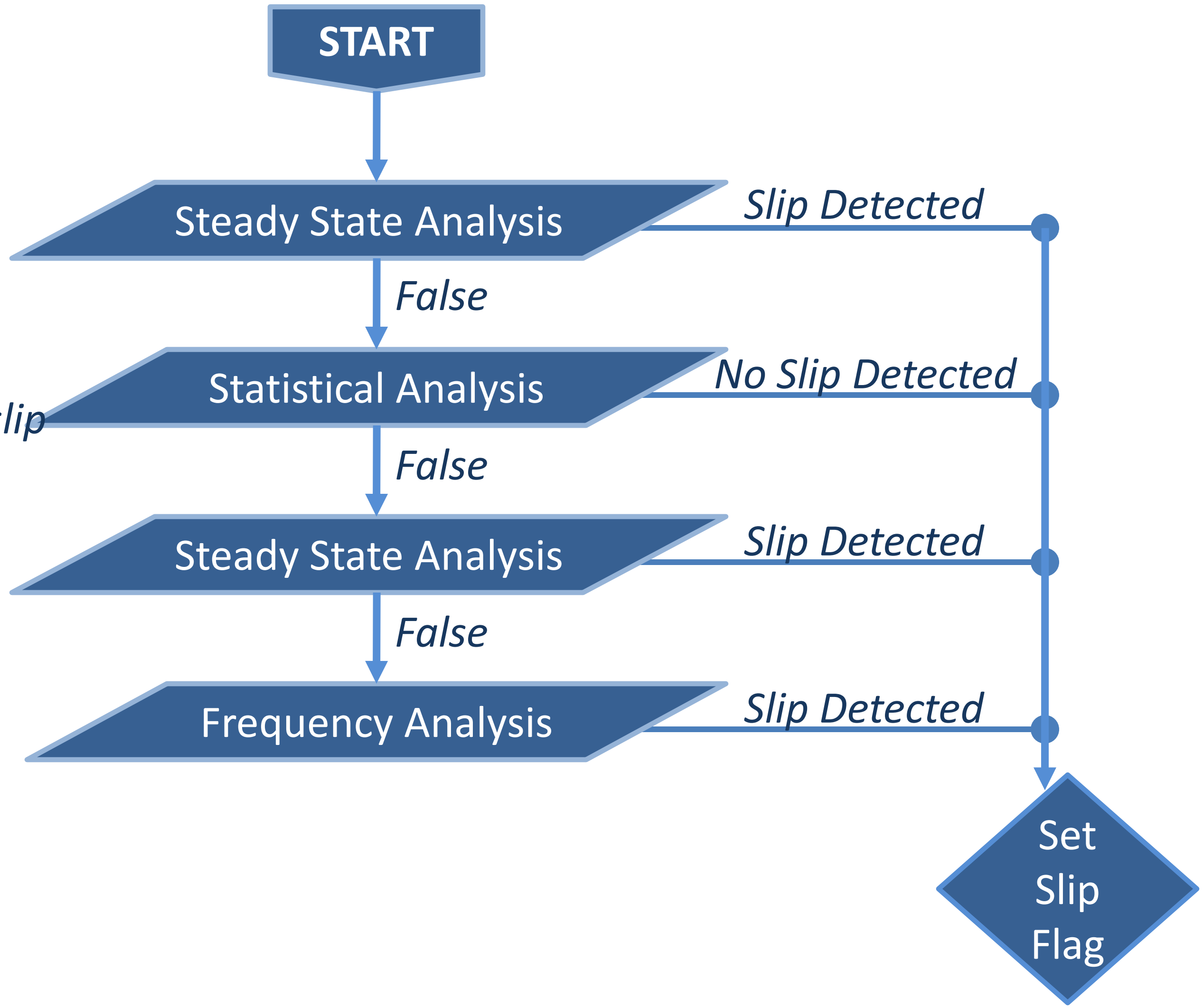
Model prediction disagrees with feedback sensor

If steady state conditions, then check for obvious NH3 slip occurrence

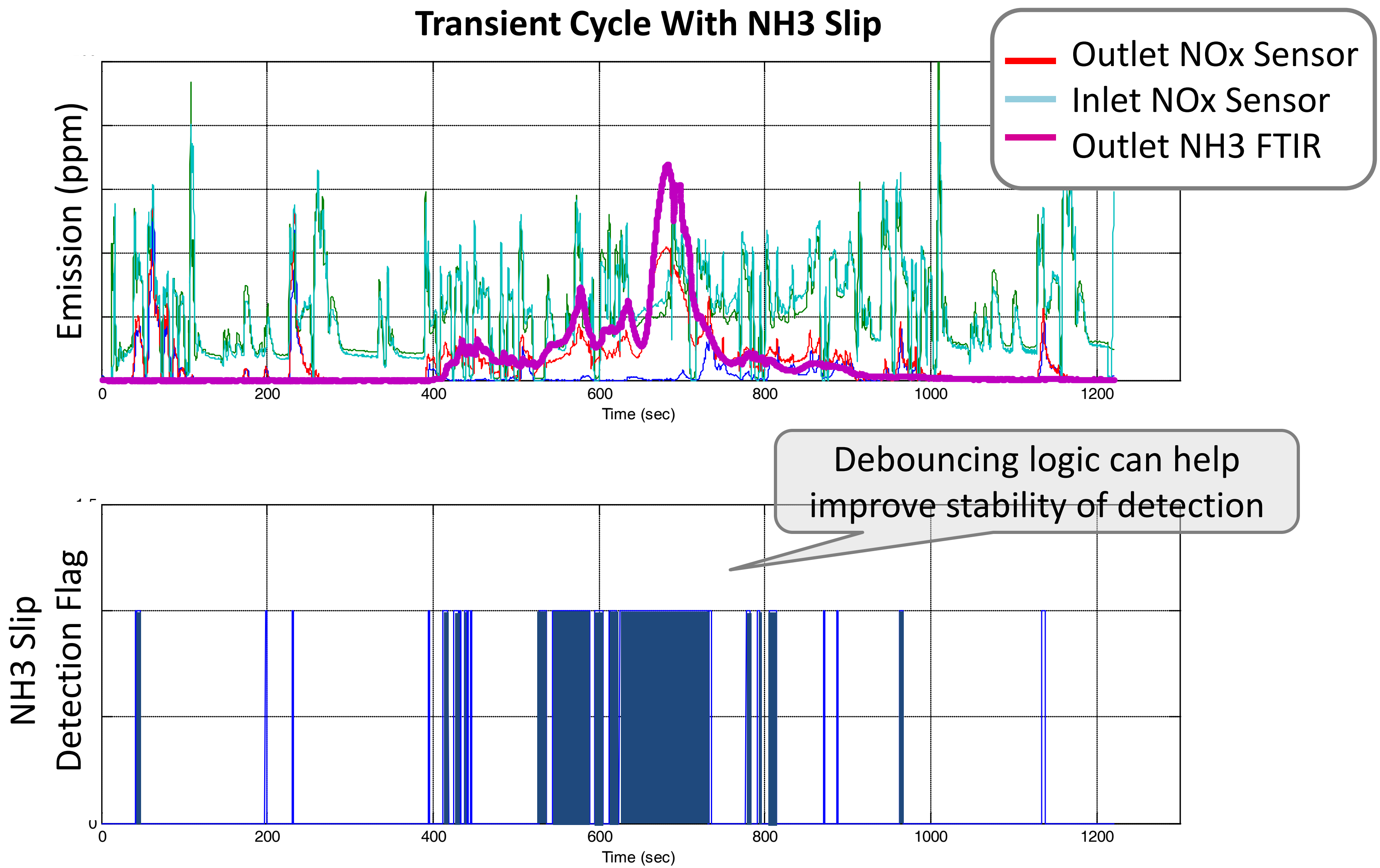
If transient conditions, then check if there is likely no NH3 slip

If steady state conditions, then complete intrusive diagnostic

Check if transient conditions suggest there is NH3 slip



NH3 Slip Detection Logic in Action



Conclusions/Recommendations

For robust SCR control, it is useful to know the SCR outlet NOX & NH3 emissions such that the control model can be accurately corrected.

The current production NOx sensor is cross-sensitive to NH3. Therefore, it provides noisy feedback to the control algorithm.

Presented are some signal processing observations which can help to provide insight to the true nature of the exhaust downstream the catalyst. However, there is some inherent noise to these methods.

As future emission regulation become more stringent, the accuracy of the feedback sensor will become more important.

It is recommended that there be further development in a sensor that provides a combination of NOx and NH3 feedback.

THE END