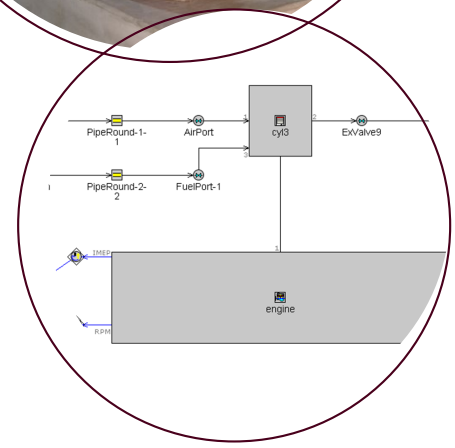
ADVANCED ENGINE RESEARCH LABORATORY



Residual Gas Fraction Estimation Based on Measured In-Cylinder Pressure

Abdullah Umair Bajwa

Motivation and Background

Large bore two stroke engines have been around for over a century and are the prime movers of choice for natural gas compressor stations in North America. Developments in control system technology since the pre emissions regulation days, when many of these engines were designed, can significantly improve operational and emissions performance. Owing to the complicated nature of the gas exchange process in two stroke engines i.e. scavenging, it is difficult to have reliable metrics to use in control applications.

Reliable real time trapped residual gas fraction (TRF) knowledge can help bridge this gap as it is a good measure of the overall effectiveness of the gas exchange process. This study is an exercise in identifying easily and economically measureable operational parameters (e.g. speed, load, AMP, ignition timing, and perhaps even fuel composition) that can be used in predicting the TRF and consequently the trapped equivalence ratio (TER).

Approach and Expected Outcomes

A one dimensional GT-Power based model will be developed for an AJAX E-565 single cylinder, two-stroke engine. The model will be validated against experimental cylinder pressure and trapped residual fraction data measured from the in-house research engine using pressure transducers and fast -response CO and CO2 probes, respectively. Once validated, the model will be used to probe various engine operational parameters for their effects (if any) on TRF and trends will be identified. Mathematical correlations expressing these trends will be developed. Initially all of the correlations would only be applicable to the AJAX E-565. Later on these correlations will be made engine independent by normalizing them appropriately.

Acknowledgements

The Pipeline Research Council International (PRCI) is acknowledged for providing financial and technical support for the project. Dr. Mark Patterson from General Electric and Mr. Greg Beshouri from Hoerbiger are specially thanked for their continued support in troubleshooting problems.

Abdullah Umair Bajwa

Ph.D. Student

Research Assistant

abdullahbajwa@tamu.edu

ENGINEERING
TEXAS A&M UNIVERSITY