Numerical Study of Cyclic Variation in a Large Bore 2-Stroke Natural Gas Engine – Timothy Jacobs, et al.
Cyclic variation (CV), may lead to increased or unexpected (and thus difficult to control for) emissions.

CFD simulations can help diagnose the CV problem inherent in 2-stroke engines.

Fluid flow characteristics and development have been shown to influence the combustion performance.

Factors local to the spark plug, such as turbulent kinetic energy, and local equivalence ratio can affect the development of the initial flame kernel into a fully developed flame front.
The animations show the development of the flame front. The difference in shape of the flame front and speed of its growth is obvious comparing the good and bad cycles.
The difference in fluid flow characteristics in the combustion chamber for a good and bad cycle can be observed in this animation. This difference in flow development can be one of the reasons for having cyclic variation.
Based on our simulation results, the flow development is the main culprit for the observed cyclic variation.

These results can be later used to modify the design of relevant parts, in order to maintain the combustion performance from cycle to cycle (reduce cyclic variation).
Numerical Tools

- Software used: CONVERGE CFD
- Cluster used: ADA
- Typical job size
  - #cores: 2 nodes = 40 cores
  - Memory: 10GB/core
  - Walltime: 150 hours for one cycle of the engine!
    - To get useful information to study the cyclic variation we need at least 8-9 cycles of the engine ≈ 1400 hours ≈ 2 months!
Advanced Engine Research Lab (AERL)

- PI: Dr. Timothy Jacobs
- Students:
  - 3 PhD students
  - 5 MSc students
  - 3 BSc students
- Research topics:
  - In-cylinder combustion processes
  - The coupling to advanced concepts
  - The use of alternative fuels
  - The integration of exhaust after treatment systems
- Website: [http://aerl.tamu.edu/](http://aerl.tamu.edu/)