Abstract Submitted
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Large Eddy Simulations of Internal Combustion Engines to Understand the Origins of CCV[1] SAUMIL PATEL, MUHSIN AMEEN, Argonne National Laboratory, TANMOY CHATTERJEE, GE, SICONG WU, Argonne National Laboratory — Mitigating cycle-to-cycle variability (CCV) can improve the performance of an engine. This requires an in-depth understanding of the stochastic in-cylinder processes. The objective of this research is to understand the causes of CCV. Nek5000, a leading high-order spectral element, open source code was used to simulate turbulent flow in the engine combustion chamber. Multi-cycle, wall resolved large-eddy simulations (LES) were performed for the General Motors (GM), Transparent Combustion Chamber (TCC-III) optical engine. In this talk, we highlight the mechanisms that contribute to large-scale turbulent flow structures during the intake and compression strokes. In particular, we investigate the interaction of the fast-moving intake jet with the spark plug which enables vortex shedding and turbulent flow structures at the start of the intake stroke. Large-scale motion is characterized by integral quantities, i.e. tumble and swirl ratios, which were calculated during each state of the engine cycle. We attempt to quantify the tumble breakdown process during compression by investigating the evolution of kinetic energy. We also present statistical analysis, including mean and root mean-squared (rms) phased average velocity fields. Results are compared with experimental PIV data.

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