

Towards Developing Cleaner & More Efficient Engines with Predictive Simulations

Tuesday, Nov. 6th, 1:00 pm-2:00 pm; Dean's Conf. E-203E

Abstract: An overview of the research activities in the Computational Multi-Physics (CMP) section at Argonne National Laboratory will be presented. The focus areas of the research in CMP include developing high-fidelity submodels and efficient numerical algorithms and utilizing high performance computing (HPC) resources with the ultimate objective of designing cleaner and more efficient internal combustion and gas turbine engines. This presentation will focus mostly on the combustion modeling research with a brief overview of the other research activities in CMP. In the first part of the talk, an overview of the turbulent combustion model development efforts in our group will be presented. The use of detailed chemistry mechanisms, fast and accurate chemistry solvers, accurate tabulated combustion models, and artificial neural networks to enable fast and accurate combustion models will be discussed. In the second part of the talk, the use of numerical simulations to predict and understand the phenomenon of cyclic variability in spark ignition engines will be discussed. A strategy to use HPC to considerably reduce the computational time without sacrificing the fidelity of the simulations will be presented. Machine learning techniques as a postprocessing technique to analyze the causes of cyclic variability will also be explored. In the third part of the talk, the development of a highly scalable, highorder spectral element method-based code as a platform for simulating internal combustion engines on future exascale computing platforms will be presented.



Dr. Muhsin Ameen



BIO: Dr. Muhsin Ameen is a staff mechanical engineer in the Center for Transportation Research in Argonne's Energy Systems division, where his work focuses on developing techniques to improve the accuracy and turnaround time of computational fluid dynamics (CFD) simulations of automotive engines. His research interests include developing high-order computational codes for CFD, high performance computing, combustion modeling and machine learning. At Argonne, Dr. Ameen has been a recipient of several awards including the 2018 FLC Technology Transfer award, the 2017 postdoctoral performance award and the 2016 Pacesetter award. Dr. Ameen received his PhD from Purdue University (2014) in Mechanical Engineering, with specialization in computational fluid dynamics for engines with a specific focus on turbulence chemistry interaction modeling and high-performance computing. He also holds a Master of Engineering degree in Mechanical Engineering from Indian Institute of Science (2010) and a Bachelor of Technology in Mechanical Engineering from National Institute of Technology Calicut (India) (2008). He joined Argonne as a postdoctoral fellow in 2015, and was subsequently converted to staff in 2017.

San Diego State University 5500 Campanile Drive San Diego , CA 92182 Phone: 619-594-6067 <u>Contact:</u> Julie Smitherman Administrative Support Coordinator Department of Mechanical Engineering