



JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

FALL 2020 CEAFM VIRTUAL SEMINAR

“Toward Predictive yet Affordable Computations of Practical Wall-Bounded Turbulent Flows”

Presented by Prof. George Ilhwan Park

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Hosted by Tamer Zaki (JHU - MechE)

Kinetic energy of turbulence is generated at large scales controlled by boundary conditions, but it is dissipated into heat at the smallest scales. The ratio of these two length scales increases rapidly with Reynolds number. Solid walls add another dimension in this scale landscape, where the scale separation gets progressively less pronounced toward the wall. This has significant ramifications on the cost of scale-resolving simulation of practical engineering flows, such as those found in aircraft, wind turbines, and ship hydrodynamics. Direct approaches with full resolution of length and times scales close to the wall are still infeasible with current computing power. The demand for superior designs at reduced cost has led researchers to explore alternative computational approaches that have potential to be predictive yet affordable. Large-eddy simulation (LES) is one such approach where only the energy-containing scales are resolved directly, and the effect of the unresolved motions are modeled. In practical LES calculations, subgrid-scale (SGS) models are used in conjunction with wall models to augment the turbulent shear stress, which otherwise is underpredicted on coarse grids and leads to inaccurate prediction of mean and turbulence quantities.



In this talk, I will discuss the research in my group on this wall-modeled LES approach. Widely-used wall-modeling techniques will be discussed with their applications to canonical and complex wall-bounded flows. Challenges in robust and efficient implementation of the models in flow solvers for handling practical geometries will be discussed. I will also highlight recent work to predict flow over realistic aircraft geometries at flight conditions and a boundary layer with mean three dimensionality.

Friday, December 4, 2020 at 3:00 PM
<https://wse.zoom.us/j/93762992307>