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Parallel Optimization with Large Eddy Simulations CHAITANYA TALNIKAR, PATRICK BLONIGAN, Massachusetts Inst of Tech-MIT, JULIEN BODART, University of Toulouse, ISAE, QIQI WANG, Massachusetts Inst of Tech-MIT, ALEX GORODETSKY COLLABORATION, JASPER SNOEK COLLABORATION — For design optimization results to be useful, the model used must be trustworthy. For turbulent flows, Large Eddy Simulations (LES) can capture separation and other phenomena that traditional models such as RANS struggle with. However, optimization with LES can be challenging because of noisy objective function evaluations. This noise is a consequence of the sampling error of turbulent statistics, or long time averaged quantities of interest, such as the drag of an airfoil or heat transfer to a turbine blade. The sampling error causes the objective function to vary noisily with respect to design parameters for finite time simulations. Furthermore, the noise decays very slowly as computational time increases. Therefore, robustness with noisy objective functions is a crucial prerequisite to optimization candidates for LES. One way of dealing with noisy objective functions is to filter the noise using a surrogate model. Bayesian optimization, which uses Gaussian processes as surrogates, has shown promise in optimizing expensive objective functions. The following talk presents a new approach for optimization with LES incorporating these ideas. Applications to flow control of a turbulent channel and the design of a turbine blade trailing edge are also discussed.

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