# Machine learning for turbulence modeling: A perspective

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## Abstract

In recent years there has been much optimism that machine learning (or more generally data-driven modeling) can solve many of the current intractable problems in science and engineering. This talk will address the impact of machine learning on the field of fluid turbulence which has been identified as the 'last unsolved problem of classical physics'. The term 'turbulence modeling' applies to a range of closure methods of different degrees of complexity. In applying machine learning (ML) techniques to turbulence modeling two important questions arise:

1. Will ML have a revolutionary or an evolutionary impact on turbulence modeling?

2. To what degree will ML depend on physics-based (PB) concepts for achieving success in turbulence applications?

Toward addressing these questions, we first identify the physical complexities underlying turbulence that render accurate modeling challenging at various levels of closure. Then, the challenges and opportunities for machine learning are identified at each level. At each level, the appropriate roles for ML techniques and PB theories are suggested. Some of the conclusions of this study can be extended to ML techniques for non-Newtonian and non-Fickian molecular transport.