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Machine Learning Implementation on Reynold Average Navier-Stoke Equations: A Review

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The Reynolds-Averaged Navier-Stokes (RANS) equations, crucial in predicting turbulent flows through computational fluid dynamics (CFD), involve the decomposition of flow variables into time-averaged and fluctuating components using Reynolds decomposition applied to the Navier-Stokes equations. Predicting turbulent stresses accurately necessitates turbulence models due to flow complexity, which are mathematical or empirically based. Commonly used models include k –□ and k –□ , focused on turbulent kinetic energy and dissipation rate, and turbulent kinetic energy and specific dissipation rate, respectively. These models offer strengths and weaknesses, and their selection is dependent on simulation specifics and result accuracy. The first review section delves into model variations, discussing closure term functions and constants. Machine learning (ML) enhances turbulent models by enabling data-driven closures and rapid precise predictions. The second part explores ML's role in enhancing turbulent models—predicting quantities, optimizing models, and creating efficient reduced-order models. This ML integration in modelling holds the potential for improved accuracy, efficiency, and cost reduction. Challenges and prospects in this field are also addressed in this review.

Speaker Bio

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