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Quantitative description of non-equilibrium turbulent phenomena in compressors

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Abstract A description of non-equilibrium turbulence in compressors is introduced by using the equation of Lagrangian velocity gradient correlation. This description is consistent to other traditional definitions in homogeneous isotropic turbulence and can be easily extended to complex anisotropic flows in compressors. We then show by post-processing in a linear cascade, that the non-equilibrium phenomena are obvious in the regions of corner separation, wake and boundary layer. Theoretical predictions show good agreement in magnitude with numerical results. We also show that the non-equilibrium phenomena cannot be eliminated even when the flow is far downstream, which indicates the importance of non-equilibrium phenomena in compressors. The aim of the present contribution is to provide a method to quantitatively describe the non-equilibrium phenomena in compressors, and to inspire future improvement on turbulence models by considering these non-negligible non-equilibrium properties in the future.

Keywords: Non-equilibrium turbulence; compressors; turbulence models; linear cascade.

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