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A quantitative theory for the mean velocity distribution of compressible ramp flow WEI-TAO BI, BIN WU, HONG-YUE ZOU, Peking University, XIN-LIANG LI, Institute of Mechanics, CAS, FAZLE HUSSAIN, Texas Tech University, ZHEN-SU SHE, Peking University — The flow induced by a compression ramp is of practical importance as a typical flow in the intake of a scramjet engine, yet no quantitative theory is available. This study proposes a quantitative theory for the mean velocity profile (MVP) of the compression ramp flow, based on a multi-layer description of turbulent boundary layers. Application of the theory on the direct numerical simulation (DNS) data shows that the mixing length function in the boundary layer after the reattachment point has a five-layer structure. A formula is given for the streamwise MVP, in very good agreement with the DNS data. Variation of the parameters in the formula with the spatial position is measured and discussed. These results further support the validity of the Structural Ensemble Dynamics approach to a wide class of wall-bounded flows, and a new modeling strategy for engineering computation of complex supersonic flows.

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