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Global Analysis of Oblique Convective Instabilities in Laminar Shock-Wave/Boundary-Layer Interactions[1] SEBASTIEN E.M. NIESSEN, University of Liege, KOEN J. GROOT, Texas A&M University, STEFAN HICKEL, Technische Universiteit Delft, VINCENT E. TERRAPON, University of Liege —

The stability of the interaction between a laminar boundary layer and an incident shock wave is investigated. In particular, we aim to represent convective instabilities with BiGlobal stability analysis. The convective nature of these instabilities causes BiGlobal stability analyses in a stationary frame of reference to be artificially affected by the finite size of the computational domain, because eigenmodes are non-localized in the streamwise direction in this case. Recent work on the incompressible boundary layer (Groot and Niessen, arXiv:2001.04124) and on shock-wave/boundary-layer interactions (Niessen et al., APS DFD G33.007, 2019) shows that two-dimensional convective instabilities can now be resolved with the stability equations formulated in a moving frame of reference. In the present work, we deploy this methodology to obtain localized wave packets for oblique convective modes, that are independent of domain size and truncation boundary conditions. The long-time behavior is subsequently determined by time integration, which results in the propagation of the localized wave packets in the flow. Finally, we highlight the physical mechanisms constituting the convective instabilities through a Reynolds-Orr energy budget analysis.

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