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Predicting the onset of shock-induced buffet using Dynamic Mode Decomposition[1] SATHSARA DIAS, MARKO BUDISIC, BRIAN HELENBROOK, PAT PIPERNI, Clarkson University — During transonic flight aircraft can experience a shock-induced buffet, an oscillation felt by the pilot and the aircraft structure which poses a significant constraint on the aircraft design. In idealized 2D flows buffet is linked to a Hopf-type bifurcation, although realistic flow configurations additionally contain a range of background flow features. In this talk we show how Koopman analysis and Dynamic Mode Decomposition (DMD) techniques can be used to predict the onset of the buffet by tracking decay of transients in pre-buffet simulations generated by a Reynolds-Averaged Navier–Stokes code on unstructured meshes. DMD algorithms decompose a sequence of snapshots into a sum of modes; to predict the buffet bifurcation we track the primary mode associated with the buffet across the threshold of stability. We demonstrate how the approach performs when applied to time-resolved simulations and simulations without physically-accurate timestepping. The results show that in the idealized time-resolved case the bifurcation could be predicted by tracking the change in time constants, although duration and resolution of input data affect the accuracy of the prediction. An additional challenge in realistic flows is identifying the primary mode among other components of the flow.

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