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Prediction of transonic buffeting based on aeroelastic global stability analysis

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Recent studies of transonic flows around airfoil have shown, that shock unsteadiness at low frequencies is significantly influenced by the presence of laminar flow regions. The low frequency shock motion called buffet is particularly dangerous, since it induces large lift oscillations, which can provoke an aeroelastic buffeting instability. The present work aims at investigating the onset of aeroelastic buffeting for the free-transitional flow around an OALT25 airfoil by a fluid-structure linear global stability approach within a RANS framework. To that aim, we consider a one equation γ transition model, coupled to the Spalart-Allmaras (Sa-neg) turbulence model and formulate the system of equations in a non-inertial moving reference frame following the airfoil structure.

Following, the discretized fluid-structure system is linearized including all model contributions and a normal mode decomposition is injected, leading to a generalized eigenvalue problem. A parametric study will be performed for the OALT25 case to characterize the onset of transonic aeroelastic instabilities by varying structural as well as flow parameters.

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