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Direct and adjoint analysis of turbomachinery aeroacoustics[1] ANTON GLAZKOV, University of Oxford , MIGUEL FOSAS DE PANDO, University of Cadiz, PETER SCHMID, Imperial College London, LI HE, University of Oxford
— With ever more stringent efficiency, emission and noise regulations, much interest and efforts are presently directed towards the analysis and eventual performance optimization of turbomachinery. In these applications the flow domain geometries typically consist of identical airfoils arranged in annular rows, with alternating stationary and rotating components making up the working sections of the device. With the large numbers of blades, traditional modal, non-modal and sensitivity analyses focusing on isolated single passages are incapable of modelling the large-scale synchronization effects in the unsteady flow field and an alternative approach must be utilized. In this work we present a novel computational framework for the direct and adjoint analysis of unsteady turbomachinery flows. By modelling an idealized compressor geometry, we investigate the roles played by self-excited aerodynamic instabilities and the effects of aerodynamic mistuning though an n-periodic mean flow stability analysis. We then augment this by applying a high-order time-domain nonlinear-adjoint sliding plane approach for identifying flow sensitivities in the rotor-stator interaction problem - a configuration where mean flow analysis is no longer suitable.

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