Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Receptivity of a precessing vortex core to open-loop forcing in a swirling jet and its predictability by linear stability adjoint theory JENS MÜLLER, FINN LÜCKOFF, KILIAN OBERLEITHNER, Technische Universität Berlin — The precessing vortex core (PVC) is a dominant coherent structure which occurs in swirling jets such as in swirl-stabilised gas turbine combustors. It stems from a global hydrodynamic instability caused by an internal feedback mechanism within the jet core. In this work, open-loop forcing is applied to a generic non-reacting swirling jet to investigate its receptivity to external actuation regarding lock-in behaviour of the PVC for different streamwise positions and Reynolds numbers. The forcing is periodically exerted by zero net mass flux synthetic jets which are introduced radially through slits inside the duct walls upstream of the swirling jet's exit plane. Time-resolved pressure measurements are conducted to identify the PVC frequency and stereo PIV combined with proper orthogonal decomposition in the duct and free field is used to extract the mean flow and the PVC mode. The data is used in a global linear stability framework to gain the adjoint of the PVC which reveals the regions of highest receptivity to periodic forcing based on mean flow input only. This theoretical receptivity model is compared with the experimentally obtained receptivity results and the validity and applicability of the adjoint model for the prediction of optimal forcing positions is discussed.

Jens Müller
Technische Universität Berlin

Date submitted: 30 Jul 2017 Electronic form version 1.4