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Control of vortex breakdown in a contracting pipe FRANCOIS GALLAIRE, PHILIPPE MELIGA, Ecole Polytechnique Federale de Lausanne- Lab. of Fluid Mechanics and Instabilities — We investigate numerically the vortex breakdown of a viscous, swirling jet developing in an axisymmetric contracting pipe. When the swirl number, i.e. the ratio of the maximum azimuthal to streamwise velocity, exceeds a certain threshold value, such flows are known to undergo a violent transition from the so-called columnar state to the breakdown state, the latter being characterized by a large recirculation region. We show first that breakdown occurs through a saddle-node bifurcation, owing to the destabilization of an axisymmetric global mode. We also address the question of control by means of a small annular jet, whose position is allowed to vary at the pipe wall. Such a control technique can be easily implemented in practice and is originally designed to restore the linear stability of the bifurcating mode close to threshold. Results issuing from fully nonlinear simulations will be presented. In particular, it will be shown that vortex breakdown can be suppressed over a large range of swirl numbers, even for low-flow-rate jets representing only a few per cent of the flow rate in the inlet section.

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