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Bifurcation and stability analysis of a jet in crossflow at low velocity ratios MILOŠ ILAK, PHILIPP SCHLATTER, SHERVIN BAGHERI, DAN HENNINGSON, Linne Flow Centre, Dept. of Mechanics, Royal Institute of Technology (KTH), SE-10044 Stockholm, Sweden — We study an incompressible jet in crossflow at low values of the jet-to-crossflow velocity ratio R using Direct Numerical Simulation and linear stability and sensitivity analysis. A Hopf bifurcation is found to occur slightly above R=0.75, and the frequency of the limit cycle oscillation is the frequency of the unstable linear global eigenmode. We find that the frequency of the limit cycle is the same as that of the most unstable eigenmode even for higher values of R, for which multiple unstable modes are found from the linear stability analysis. Using the leading adjoint global eigenmode near the first bifurcation point, we identify the location of the "wavemaker," i.e., the region in the flow most sensitive to localized feedback. This region, interpreted as the core of the first instability, is found to be in the shear layer that surrounds the counter-rotating vortex pair which is the dominating feature of the dynamics of the jet. Furthermore, we perform a sensitivity analysis of the most unstable eigenvalue near the bifurcation point using the first direct-adjoint eigenmode pair.

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