Analysis of nonlinear interactions among instability mechanisms in a jet in crossflow MILOŠ ILAK, PHILIPP SCHLATTER, SHERVIN BAGHERI, DAN HENNINGSON, Linne Flow Centre and Swedish e-Science Research Centre, KTH Mechanics, SE-100 44 Stockholm, Sweden — We undertake an analysis of datasets from direct numerical simulation of a jet in crossflow, using the method of Dynamic Mode Decomposition (DMD). The procedure reveals coherent structures in the flow known as Koopman modes, which oscillate at frequencies that are also computed by the method. Both the crossflow and the jet inflow profile are laminar. As the jet-to-crossflow velocity R is increased, we observe the breakdown of hairpin vortices characteristic for low values of R. Near-wall structures corresponding to low-frequency oscillations are revealed above $R = 1.5$ by the DMD analysis, and their interaction with modes on the jet trajectory results in complex flow patterns, which however retain spanwise symmetry. At $R = 2.5$ and higher, spanwise symmetry is broken, and the flow exhibits the complex dynamics typically observed in literature. Furthermore, we study the effects of crossflow unsteadiness on jets at low R, showing that the hairpin vortices are able to persist under noise of moderate amplitude introduced upstream of the jet orifice.

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