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Too big to grow: the saturation mechanism of the von Karman vortex street captured by a self-consistent model VLADISLAV MANTIC-LUGO, CRISTOBAL ARRATIA, FRANCOIS GALLAIRE, EPFL-LFMI — The supercritical instability leading to the Karman vortex street in a cylinder wake is a well studied problem: the steady solution becomes linearly unstable and saturates into a limit cycle. However a simple physical picture for understanding the saturation amplitude is still missing. We present a simple self-consistent model that captures the saturation mechanism. The model shows that the main nonlinear effects of the saturation process are retained by the coupling of the mean flow and perturbation equations through the Reynolds stress, which is built only with the first harmonic calculated as the most unstable eigenmode. A simple physical picture is revealed, wherein the perturbation amplitude is such that the modified mean flow is neutrally stable. The mean flow velocity field and the Reynolds stress spatial structure are thus well approximated in a self-consistent manner without any DNS data. Moreover, the results show an accurate vortex shedding frequency prediction when compared to experiments.

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