

# How non-generic coincidences of local bifurcations can occur in fluid mechanics

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**Abstract.** Generically, a local bifurcation only affects a single solution branch. Surprisingly, two supercritical pitchfork bifurcations, of the equilibrium and the periodic solutions, were observed to occur at nearly the same value of the Reynolds number in the “fluidic pinball” configuration. The mechanism of this non-generic coincidence is modelled and explained.

## Introduction

It was recently discovered that in the “fluidic pinball” configuration, two supercritical pitchfork bifurcations are almost coincident at a value of the Reynolds number around 70, one affecting the steady solution of higher symmetry, the other a vortex shedding periodic regime in the wake of the three cylinders, as shown in Fig. 1 [1]. Generically, local bifurcations only affect single solution branches, e.g. either the steady solution or the periodic limit cycle, but not both simultaneously.

## Results and discussion

We investigated the reasons for this unexpected coincidence. The two branches involved, although very different, share certain eigenvectors and eigenvalues which can explain the coincidence of the two bifurcations. The mechanisms involved in this non-generic coincidence, modelled and explained, suggests that non-generic coincident local bifurcations should be found in many other instances in fluid mechanics [1].

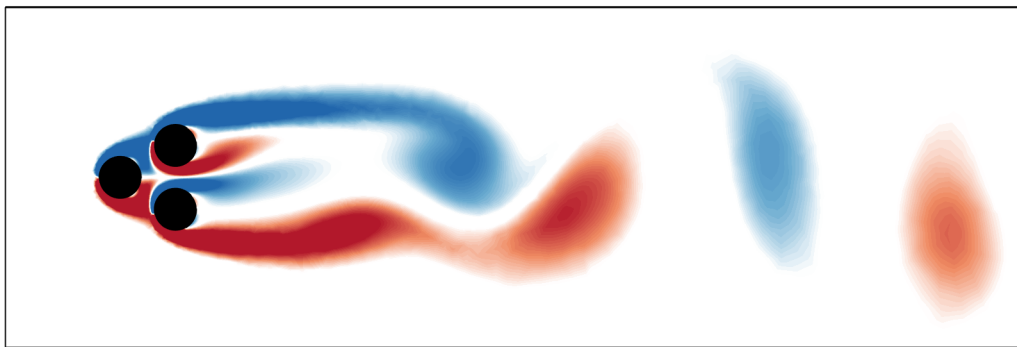


Figure 1: Snapshot of the vorticity field in a vortex shedding periodic regime of the fluidic pinball configuration at Reynolds 80. The three cylinders are mounted on the vertices of an equilateral triangle in a transverse flow coming from the left.

## References

- [1] N. Deng, L.R. Pastur, L.S. Tuckerman, & B.R. Noack. Coinciding local bifurcations in the Navier-Stokes equations. *Europhysics Letters*, Vol. **135**(2), p. 24002, 2021.