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Simplest bifurcation diagrams for monotone families of vector fields on a torus

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We prove that the bifurcation diagram proposed in [1] as the simplest possibility for a monotone two-parameter family of vector fields on a torus is indeed representative of the simplest possible cases. To achieve this we define "simplest" by minimising sequentially the numbers of equilibria, Bogdanov-Takens points, closed curves of centre and of neutral saddle, Reeb components, arcs of rotational homoclinic bifurcation of horizontal homotopy type, necklace points, points of neutral horizontal homoclinic bifurcation, half-plane fan points, points of coexistence of centre and neutral saddle, and degenerate Hopf points. We obtain a variety of simplest cases, including that initially proposed. We provide an example of a family satisfying our definition of simplest. Fiedler's index plays a role in this analysis.

References

[1] Baesens C, Guckenheimer J, Kim S, MacKay RS, Three coupled oscillators: mode-locking, global bifurcations and toroidal chaos, Physica D 49 (1991) 387–475.