Invariant manifolds in some three dimensional piecewise smooth differential systems

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We report the existence of some bi-dimensional manifolds in three dimensional piecewise smooth differential systems separated by a plane of discontinuity.

We consider the differential system

$$
\begin{aligned}
\dot{x} &= -y, \\
\dot{y} &= x, \\
\dot{z} &= h(x, y),
\end{aligned}
\tag{1}
$$

and note that the cylinders $C_\rho = \{(x, y, z) \in \mathbb{R}^3 : x^2 + y^2 = \sqrt{\rho}\}$ are invariant sets for system (1) for all positive values of ρ, once the origin is a global linear center for the projection of the trajectories into the xy-plane.

By performing a small perturbation of system (1) we verify the existence of cylinder, cones, as well as some compact bi-dimensional manifolds as spheres and torus. The results are obtained using the averaging theory.

[1] C. A. Buzi, R. D. Euzébio and A. C. Mereu, *Bifurcation of limit cycles from a non-smooth perturbation of a two-dimensional isochronous cylinder.* Preprint (arxiv link: http://arxiv.org/pdf/1404.2630.pdf).

[2] C. A. Buzi, R. D. Euzébio and A. C. Mereu, *Birth of bi-dimension invariant manifolds for piecewise smooth vector fields in $\mathbb{R}^3$.* Work in progress.