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Phase portraits of planar piecewise linear refracting systems: Focus-saddle case

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ABSTRACT

This paper deals with planar piecewise linear refracting systems with a straight line of separation. Using the Poincaré compactification, we provide the classification of the phase portraits in the Poincaré disc of piecewise linear refracting systems with focus-saddle dynamics.

1. Introduction and statement of the main results

Global phase portraits are an invaluable tool in studying the long dynamical behaviour of differential systems. They reveals information such as whether an attractor, a repeller or a limit cycle is present for a given parameter value. Hence the global phase portraits analysis is the one of most important problems in the qualitative theory of differential systems.

The possibilities of topological distinct phase portraits for a general polynomial differential system are huge, it is expected that the quadratic polynomial differential systems have more than 2000 topological distinct phase portraits. As far as we know, most of known results about global phase portraits mainly deal with smooth differential systems, see for instance [1–10].

Many real-world systems involve a discontinuity or sudden change, such as friction in mechanical systems [11] and switching in electrical circuits [12]. Smooth differential systems generally do not provide ideal mathematical models for such situations. It becomes necessary to incorporate a non-smooth component into the model. Often this yields a piecewise smooth differential systems [13,14].

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