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THREE NESTED LIMIT CYCLES IN DISCONTINUOUS PIECEWISE LINEAR DIFFERENTIAL SYSTEMS WITH TWO ZONES

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Abstract. In this paper we study a planar piecewise linear differential system formed by two regions separated by a straight line so that one system has a real unstable focus and the other a virtual stable focus which coincides with the real one. This system was introduced in a very recent paper (On the number of limit cycles in general planar piecewise linear systems, *Discrete and Continuous Dynamical Systems-A* **32**, 2012, pp. 2147–2164) by S.-M. Huan and X.-S. Yang, who numerically showed that it can exhibit 3 limit cycles surrounding the real focus. This is the first example that a non-smooth piecewise linear differential system with two zones can have 3 nested limit cycles of crossing type surrounding a unique equilibrium. We provide a rigorous computer assisted proof of the quoted numerical result.

Keywords. non–smooth differential system, limit cycle, piecewise linear differential system.

AMS (MOS) subject classification: 34C05, 34C07, 37G15.

1 Introduction

The analysis of piecewise linear differential systems can be traced back to Andronov and coworkers [1] and still continues to receive attention by researchers. Effectively, in recent years there has been an upsurge of interest from the mathematical community in understanding their dynamical richness, as such systems are widely used to model many real processes and different modern devices, see for instance [4] and references therein. Recently, they have been shown to be also relevant as idealized models of cell activity, see [3, 15, 16].

The case of continuous piecewise linear systems, when they have only two linearity regions separated by a straight line is the simplest possible configuration in piecewise linear systems. We remark that even in this seemingly simple case, only after a thorough analysis it was possible to establish the existence at most of one limit cycle for such systems, see [7]. The reason for