IOP Publishing | London Mathematical Society Nonlinearity

Nonlinearity **35** (2022) 3883–3906 https://doi.org/10.1088/1361-6544/ac7691

Lower bounds for the number of limit cycles in a generalised Rayleigh–Liénard oscillator

Rodrigo D Euzébio[1], Jaume Llibre[2] and Durval J Tonon[1,*]

[1] Institute of Mathematics and Statistics of Federal University of Goiás, Avenida Esperança s/n, Campus Samambaia, 74690-900, Goiânia, Goiás, Brazil
[2] Departament de Matemàtiques, Universitat Autònoma de Barcelona, 08193 Bellaterra, Catalunya-Barcelona, Spain

E-mail: euzebio@ufg.br, jllibre@mat.uab.cat and djtonon@ufg.br

Received 8 September 2020, revised 1 May 2022
Accepted for publication 7 June 2022
Published 22 June 2022

Abstract

In this paper a generalised Rayleigh–Liénard oscillator is consider and lower bounds for the number of limit cycles bifurcating from weak focus equilibria and saddle connections are provided. By assuming some open conditions on the parameters of the considered system the existence of up to twelve limit cycles is provided. More precisely, the approach consists in perform suitable changes in the sign of some specific parameters and apply Poincaré–Bendixson theorem for assure the existence of limit cycles. In particular, the algorithm for obtaining the limit cycles through the referred approach is explicitly exhibited. The main techniques applied in this study are the Lyapunov constants and the Melnikov method. The obtained results contemplate the simultaneity of limit cycles of small amplitude and medium amplitude, the former emerging from a weak focus equilibrium and the latter from homoclinic or heteroclinic saddle connections.

Keywords: Rayleigh Liénard oscillator, limit cycles, Lyapunov constants, Melnikov function
Mathematics Subject Classification numbers: 34C23, 34C25, 37G15.

*Author to whom any correspondence should be addressed.
Recommended by Dr Reiner Lauterbach.

