Publ. Math. Debrecen
107/1-2 (2025), 1–32
DOI: 10.5486/PMD.2025.9867

Melnikov functions of first and second order for 2-dimensional piecewise non-Hamiltonian systems with n regions

By DURVAL JOSÉ TONON (Goiânia), MAYK JOAQUIM DOS SANTOS (Goiânia) and RONY CRISTIANO (Goiânia)

Abstract. In this paper, we examine piecewise non-Hamiltonian systems where the switching manifold consists of n half straight lines r_i originating from the origin, and each domain D_i is bounded by two consecutive half straight lines r_i and r_{i+1}. Our main goal is to derive the expressions of the first- and second-order Melnikov functions. We address the question of the bifurcation of limit cycles in several interesting models by performing a first-order Melnikov analysis on (1) a buck power converter, (2) a Lotka–Volterra model, and (3) a piecewise smooth system with cubic vector fields. Additionally, we conduct a second-order Melnikov analysis on (4) a piecewise linear vector field with heteroclinic connections.

DURVAL JOSÉ TONON &
MAYK JOAQUIM DOS SANTOS &
RONY CRISTIANO
INSTITUTE OF MATHEMATICS
AND STATISTICS
FEDERAL UNIVERSITY OF GOIÁS
AVENIDA ESPERANÇA S/N
CAMPUS SAMAMBAIA
CEP 74690-900, GOIÂNIA, GOIÁS
BRAZIL

Mathematics Subject Classification: 34A36, 34C05, 34C07, 34C23, 34C60, 37G15, 70K05.
Key words and phrases: piecewise smooth vector fields, non-Hamiltonian systems, limit cycle, Melnikov method.