MELNIKOV METHOD FOR SUBHARMONIC ORBITS AND HETEROCLINIC CONNECTIONS IN A NON-SMOOTH SYSTEM

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In this work we consider a two-dimensional piecewise smooth system, defined in two sets separated by the switching curve $x = 0$. We assume that there exists a piecewise-defined continuous Hamiltonian that is a first integral of the system. We also suppose that the system possesses an invisible fold-fold at the origin and two heteroclinic orbits connecting two critical saddle points located at each side of $x = 0$. Finally, we assume that the region closed by these heteroclinic connections is fully covered by periodic orbits surrounding the origin, whose periods monotonically increase as they approach the heteroclinic connection.

When considering a non-autonomous (T-periodic) Hamiltonian perturbation of amplitude eps, using an impact Poincaré map, we rigorously prove that, for every n and m relatively prime and eps > 0 small enough, there exists a nT-periodic orbit impacting 2m times with the switching curve at every period if a modified subharmonic Melnikov function possesses a simple zero. In addition, we also prove that, if the orbits are forced to undergo a discontinuity when they cross $x = 0$, which simulates a loss of energy, then all these orbits persist if the relative size of eps > 0 with respect to the magnitude of this jump is large enough.

We also obtain similar conditions for the splitting of the separatrices.