Algebraic Analysis of Zero-Hopf Bifurcations of Polynomial Differential Systems

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The averaging method is a good tool to study limit cycles that can bifurcate from zero-Hopf equilibria of differential systems. In this talk, we will present an efficient symbolic program using Maple for computing the averaged functions of any order for continuous differential systems. The program allows us to systematically analyze zero-Hopf bifurcations of polynomial differential systems using symbolic computation methods. We show that for the first-order averaging, $\ell \in \{0, 1, \ldots, 2^{n-3}\}$ limit cycles can bifurcate from the zero-Hopf equilibrium for the general class of perturbed differential systems and up to the second-order averaging, the maximum number of limit cycles can be determined by computing the mixed volume of a polynomial system obtained from the averaged functions. A number of examples are presented to demonstrate the effectiveness of the proposed algorithmic approach.