

Systems with fast limit cycles and slow interaction

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Abstract: Systems with fast limit cycles and slow interaction We will review the theory of slow-fast systems that started with papers by Tykhonov, Pontryagin, Levinson, Anosov, Fenichel and other scientists. After this review we focus on systems with limit cycles. The Pontryagin-Rodygin theorem for slow-fast systems has an ingenious proof, it has as advantage that it can be applied if the slow manifolds of the slow-fast system are all unstable. A serious disadvantage is that for application we have to know the fast solutions explicitly with the slow part in the form of parameters. Another disadvantage is the relatively short timescale where the results are valid. In practice there are very few cases where the theorem applies. However, the Pontryagin-Rodygin idea can be used again on assuming that the fast limit cycle arises in higher order approximation; this allows an approximation approach to study the slow motion. At this point we have still a restricted timescale but extension is then possible by looking for continuation on stable, in particular slow manifolds. We will demonstrate this extension of the theory by studying various types of self-excited, coupled slow and fast Van der Pol oscillators.

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