STABILITY ANALYSIS AND SYNCHRONIZATION OF CROSS-COUPLED OSCILLATOR CIRCUITS

By

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ABSTRACT

Nonlinear oscillations and bifurcations are ubiquitous. Recent years have witnessed increasing numbers of applications of nonlinear oscillators and their synchrony phenomena in biology, physics and electronics. In this thesis, we study the global stability of a particular class of cross-coupled oscillators which admit the representation of a dynamic system in feedback with a static nonlinearity. The nonlinearity is a combination of a parameterized negative slope k at the origin and a monotone increasing nonlinearity. We first review sufficient conditions for global convergence of the solutions to a limit cycle in the vicinity of the bifurcation point. Then we extend them to systems which are not passive but can be made passive with a Popov multiplier. Based on these results, we conclude that the cross-coupled oscillators experience a supercritical Hopf bifurcation.

Another major topic in this thesis is the synchronization of interconnected identical passive oscillators. The global stability analysis of a limit cycle existing for an isolated oscillator can be extended to the synchrony analysis of networks consisting of such identical oscillators. We apply this result to the synchronization of the interconnection of two identical cross-coupled oscillators.