Foreword

Stochastic effects in nonlinear dynamical systems are an important field of state-of-the-art research. The interplay of noise, nonlinearity, and time-delayed feedback leads to a wealth of novel, unexpected phenomena, such as stochastic bifurcations, coherence resonance, etc. Stochastic bifurcation denotes the transition from a monomodal to a bimodal stationary probability distribution, and coherence resonance is a counterintuitive effect which describes the nonmonotonic dependence of the coherence of noise-induced oscillations upon noise strength, resulting in an optimum coherence at non-zero noise strength.

This Master Thesis focusses on these effects in a simple paradigmatic model, i.e., the Stuart-Landau oscillator. The model variant which is considered in this thesis arises from the generic expansion of an oscillator system near a subcritical Hopf bifurcation in terms of a fifth-order polynomial in the complex variable z. While the third-order, supercritical form of the Stuart-Landau oscillator has been well studied, much less is known about the effect of noise near a subcritical Hopf bifurcation which creates an unstable limit cycle in the deterministic system. This thesis considers the regime of bistability between the trivial zero steady state and a stable limit cycle which arises from the saddle-node bifurcation of the unstable limit cycle. Originally, the term coherence resonance has been restricted to excitable systems, but this thesis extends the notion to non-excitable systems with a subcritical Hopf bifurcation, where coherence resonance is due to a novel mechanism.

The thesis demonstrates that coherence resonance can be modulated by time-delayed feedback or coupling, i.e., enhanced or suppressed depending upon the delay time. Analytical methods are developed and detailed numerical simulations for various ranges of the noise intensity, bifurcation parameter, delay time and feedback strength are presented for a single and for two coupled systems.

This thesis presents novel results on the interplay of noise and delay in nonlinear systems, and in particular offers new insights into the modulation of coherence resonance by time-delayed feedback.

Eckehard Schöll

http://www.springer.com/978-3-658-09294-8

Stochastic Non-Excitable Systems with Time Delay
Modulation of Noise Effects by Time-Delayed Feedback
Geffert, P.M.
2015, XIV, 84 p. 41 illus., Softcover
ISBN: 978-3-658-09294-8