



University Medical Center Groningen

**University of Groningen****Modeling, analysis, and control of biological oscillators**

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Propositions  
belonging to the thesis entitled  
**Modeling, Analysis, and Control of Biological Oscillators**  
by  
Hadi Taghvafard

1. The Goodwin's oscillator is a simplified and cyclic model of endocrine regulation; a more complete model should have more feedback loops, leading to a non-cyclic feedback system. (Chapters 4 & 5)
2. Using an appropriate change of variables, a non-cyclic feedback system may be transformed to a cyclic one. (Chapter 5)
3. Bifurcation theory is a useful tool for predicting qualitative changes in the behavior of solutions of ordinary differential equations with respect to parameter variations. (Chapters 6 & 7)
4. A mathematical model which is correctly built based on underlying biology can compliment the corresponding experimental system. (Chapters 6 & 7)
5. Combination of geometric singular perturbation theory and the blow-up method is a powerful tool for the analysis of multiple-time-scale oscillators. (Chapter 7)
6. Carrying out research is similar to the blowing-up of a non-hyperbolic point as often a research problem has to be investigated from different angles, corresponding to defining different charts in the blow-up method.
7. Doing a PhD is an oscillatory process with a slow-fast nature.