

Colloquium

ACMS and

Department of Mathematics

Sebastian Walcher - RWTH Aachen University

Speaker: Sebastian Walcher

RWTH Aachen University

Will give a lecture entitled

Reduction and critical parameters of reaction networks



Date: Wednesday, October 12, 2022

Time: 4:00 PM

Location: 117 Hayes-Healy Hall

Zoom URL: [notredame.zoom.us/j/94685316462?](https://notredame.zoom.us/j/94685316462?pwd=ZVFJbHRzRUYxZGoyZEIHN1VXVEdPQT09)

[pwd=ZVFJbHRzRUYxZGoyZEIHN1VXVEdPQT09](https://notredame.zoom.us/j/94685316462?pwd=ZVFJbHRzRUYxZGoyZEIHN1VXVEdPQT09)

Meeting ID: 946 8531 6462, Passcode: 511726



Pre-Colloquium Tea: Tea in Room 257 (lounge in Hurley Hall) at 3:30 p.m.

Abstract:

A comprehensive theoretical framework for the mathematical description and analysis of chemical and biochemical reaction networks has been developed since the 1970s, initiated principally by Horn, Jackson, and Feinberg. For homogeneous mass-action systems, this theory provides a concise description via polynomial parameter-dependent ordinary differential equations, as well as some fundamental results. From a practical perspective, there remains the determination of reaction parameters. To support this task, the reduction of dimension is a welcome (and sometimes indispensable) tool. Heuristics for dimension reduction have been introduced more than 100 years ago, with a mathematical foundation for many scenarios supplied only later by singular perturbation theory (Tikhonov and Fenichel). To determine possible singular perturbation reductions of a mass-action reaction network with a priori unknown parameters, the first task is to identify parameter regions where reduction is possible. This leads to the consideration of critical parameter values which we call Tikhonov-Fenichel parameter values (TFPV). To find such parameter values for arbitrary polynomial systems, standard methods from algorithmic algebra are readily applicable. (In chemically meaningful scenarios, the TFPV's form a semi-algebraic variety in parameter space.) Beyond a case-by-case analysis, one obtains natural classes of TFPV's via the structure theory by Horn, Jackson and Feinberg. Finally, recent work on quantitative problems and estimates will be briefly discussed.