

Global Dynamics of Ordinary Differential Equations: Ramp Systems, Rook Fields, and Connection Matrices

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Abstract

Given a nonlinear system of differential equations insights into its dynamics usually come about via numerical simulations. This suggests the following goal: *Given a parameterized system of ordinary differential equations develop an algorithm that identifies the global dynamics over all parameters.*

If one uses classical ideas of what it means to identify nonlinear dynamics, e.g. invariant sets, then it is not possible to achieve this goal. With this in mind I will discuss three topics:

1. An alternative framework based on combinatorial topology that characterizes global dynamics (connection matrices).
2. I will introduce a rather general class of differential equations for which we are making significant progress towards the goal (ramp systems).
3. I will discuss a means by which we can transition from the analytic setting of differential equations to the combinatorial framework (rook fields).

The focus of the talk will be on providing a perspective of this approach rather than on particular details or results.