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A Rigorous Approach to Stochastic Dynamics Inference from Tracked Data

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Advances in experimental biology increasingly provide time-resolved data that capture essential aspects of complex biological dynamics. Yet, uncovering how the underlying components interact remains a challenging inverse problem, requiring the separation of systematic behavior from stochastic fluctuations and measurement noise.

Among existing approaches, the method of Brückner et al. (2020) offers a way to work with smaller datasets. In this work, we present our ongoing work that builds on and extends this approach. Our method rigorously addresses the theoretical gaps and ad hoc assumptions of the original formulation by achieving a higher degree of accuracy, identifying the correct small parameters, and clarifying the conditions for validity. The result is a more efficient and broadly applicable framework for analyzing stochastic dynamics from limited, sparsely sampled data. This is joint work with Richard Kollár.

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