# Schrödinger bridge problem

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## 1 Abstract

The field of computational Schrödinger Bridges (SB) has seen significant advances, yet existing solvers remain computationally intensive, typically requiring the optimization of multiple neural networks and extensive hyperparameter tuning. This complexity reveals a critical gap: the absence of a simple, efficient baseline solver for SB analogous to k-means in clustering, logistic regression in classification, or the Sinkhorn algorithm in discrete optimal transport.

Paper [1] introduces a novel lightweight SB solver that integrates two key innovations: (1) parameterization of Schrödinger potentials using sum-exp quadratic functions and (2) interpretation of log-Schrödinger potentials as energy functions. The resulting simulation-free solver features a theoretically sound, straightforward optimization objective that enables efficient solutions for moderate-dimensional problems in minutes on standard CPUs, eliminating the need for complex hyperparameter tuning.

Light SB solver resembles the Gaussian mixture model, a widely used tool for density estimation, and the work demonstrates its universality as an SB approximator. Furthermore, there were provides a theoretical analysis of the solver's generalization error. The method's simplicity and efficiency make it particularly suitable for moderate-dimensional data applications, such as biological datasets, where heavy neural network-based approaches prove impractical. This solution effectively bridges the gap between theoretical SB formulations and practical, scalable implementations.

## References

[1] Alexander Korotin, Nikita Gushchin, Evgeny Burnaev. "Light Schrödinger Bridge," ICLR. 2024.