Learning Transfer Operators by Kernel Density Estimation

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Abstract

To infer transfer operators from data is usually take as a classical problem that hinges on the Ulam method. The usual description is in terms of projection onto basis functions that are characteristic functions supported over a fine grid of rectangles, that we have previously called the Ulam-Galerkin method when taken in terms of finite time. Here, we present that the same problem can be understood by statistical density estimation formalism. In these terms, the usual Ulam-Galerkin approach is a density estimation by the histogram method. This perspective allows us other methods such as spectral density estimation, Kernel density estimation, etc. However, this is not the only popular method of density estimation, and we point out inherent efficiencies available by the popular kernel density estimation method, and this general phrasing of the problem allows for analysis of bias and variance, toward a discussion of the mean square error for example.

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