Recurrences in Dynamics from Data

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Abstract: Understanding the hidden structures in observational or measured data from real-world systems like climate, astrophysical systems, or biological systems like brain, heart etc, is a challenge. Since such data varies over time in a complex manner, methods of nonlinear time series analysis can bring out the underlying dynamical details and characteristics that may not be apparent from purely statistical approaches. For this, we reconstruct the dynamics from data and analyze the patterns in their dynamics to extract quantitative measures to characterize the data.

I will present how the pattern of recurrences in the dynamics underlying the data, can be used effectively to estimate the complexity and classify the data. These methods can then be easily integrated with machine learning technics for many requirements in data analysis like diagnosis, classification, control and compression of data and signals. Interestingly, they can also be used to understand the transitions or shifts that happen in the system over time. I will illustrate these methods using data sets from astrophysics, ECG, finance and climate.

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