CDD - Abstract

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How to walk on a mountain in order to characterize gravitational waves ?

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Imagine you are blind and your task is to report the map of a complex shaped mountain. It has secondary peaks, steep slopes and plateaus, many bumps etc. Even though you cannot see, you are able to walk anywhere on that mountain and record the height of every point on your way. What would be the strategy to adopt in order to render a trustworthy picture of the mountain as quickly as possible?

In the context of gravitational waves data analysis, we are facing an ill-shaped mountain living in a 17 dimensional space. Indeed when such a ripple of space time has been detected by ground-based interferometers, the next step is to estimate the parameters of its source, in our case the coalescence of a compact binary system (eg an orbiting pair of neutron stars and/or black holes). Doing so requires having a deep knowledge of the posterior distribution of the parameters which is a function of 17 variables in the most complete model given by General Relativity.

The main purpose of my PhD is to develop an efficient algorithm, the Hamiltonian Monte Carlo (HMC), which should converge to a satisfactory picture of our mountain several times faster than currently used methods.

In this talk I will pursue the mountain metaphor to explain the reason behind the use of Markov Chain Monte Carlo algorithms, then describe their set-up, their relevance in the context of gravitational waves and finally explain why the HMC is a promising algorithm in this field.