ID de Contribution: **52** Type: **MÉTHODES D'ANALYSE DES DONNÉES**

DeepHMC: a deep neural network enhanced Hamiltonian Monte Carlo algorithm for accelerated Bayesian inference of binary neutron star parameters

mardi 30 mars 2021 14:15 (15 minutes)

A major activity of the LIGO-Virgo-KAGRA collaboration is to build algorithms able to infer from the detected gravitational wave signals the posterior distributions of the parameters defining their sources: angles in the sky, distance from us, masses etc. Current algorithms like MCMC and Nested Sampling have already demonstrated with success their ability to do so during the first three runs of observations of the detectors.

Nonetheless the latter remain computationally expensive as they require from weeks to months of CPU time when analyzing long duration signals, typically BNS ones, and when using advanced waveform models.
As the sensitivity of GW interferometers is being improved years after years, the duration of exploitable signal and rate of detection increase ($10^{+52}_{-10}\,\mathrm{y}^{-1}$ BNS expected during O4), requiring more and longer analysis which creates an important tension with the time required to perform each of them.

To respond to this challenge we will present DeepHMC, a Hamiltonian Monte Carlo (HMC) algorithm boosted by a Deep Neural Network (DNN).
Contrary to currently used algorithms, the HMC is a non random-walk sampler as it uses the gradient of the posterior distribution to make new chain proposals, making it more efficient than MCMC or Nested Sampling.
To circumvent the computational bottleneck of numerical gradients which require many waveform generations and prevented an earlier use of the HMC, we train a DNN to predict gradients at new points in parameter space.
Tested on the BNS GW170817, we compare DeepHMC's results with those produced by LALInferenceMCMC and show that DeepHMC is ~80 times faster.

Auteurs principaux: ARÈNE, Marc (APC); Dr PORTER, Ed (APC)

Orateur: ARÈNE, Marc (APC)

Classification de Session: Contributed talks: Data analysis methods