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Efficient Neutrino Oscillation Parameter Inference with Gaussian Process

Neutrinos are tiny sub-atomic particles that carry no electrical charge and interact with matter only through the weak nuclear force, which makes them extremely hard to detect. There are three distinct types of neutrinos, called "flavors": (ν_e, ν_μ, ν_τ), each of which can "oscillate" into the other with a detectable probability. Many experiments have been set-up to measure the parameters governing the oscillation probabilities accurately, with implications for the fundamental structure of the universe. Very often, this involves inferences from tiny samples of data which have complicated dependencies on multiple oscillation parameters simultaneously. This is typically carried out using the unified approach of Feldman and Cousins which is very computationally expensive, on the order of tens of millions of CPU hours. In this work, we propose an iterative method using Gaussian Process to efficiently find a confidence contour for the oscillation parameters and show that it produces the same results at a fraction of the computation cost.

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