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GWTBoost: Modernizing Unmodeled Gravitational-Wave Analysis from cWB to PycWB in the High-Performance Computing Era

Unmodeled search methods play a crucial role in detecting generic gravitational-wave transients (GWTs), especially in the case of signals without precise theoretical predictions. Coherent WaveBurst (cWB) is one of the primary data-analysis pipelines used for the detection and coherent reconstruction of such signals. Within the GWTBoost non-flagship use case, we focus on developing and optimizing algorithms for unmodeled gravitational-wave analyses on the LEONARDO high-performance computing (HPC) platform. To this end, we are developing PycWB, a modern Python-based reimplementation of the cWB algorithm. By exploiting HPC infrastructures, PycWB aims to enhance scalability, flexibility, and computational efficiency—key requirements for handling the ever-increasing data volumes produced by current and future gravitational-wave observatories. The framework is designed to integrate seamlessly with contemporary scientific software ecosystems, fostering extensibility, reproducibility, and collaborative development. Here, we present the motivation, design, and implementation strategies behind PycWB, as well as the broader perspectives it opens for next-generation gravitational-wave signal analysis.

INFN OpenAccess Repository link

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