

Machine-learning enhanced quantum state tomography, and its applications to gravitational wave detectors

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As a crucial diagnostic toolbox for applications with squeezed states, I will illustrate the implementation of our machine-learning (ML) enhanced quantum state tomography (QST) for continuous variables, through the experimentally measured data generated from squeezed vacuum states. Then, I will demonstrate the deployment of ML-based QST onto edge devices, specifically utilizing Field-Programmable Gate Arrays (FPGAs). This implementation was realized using the "Vitis AI" development environment provided by AMD Inc. The FPGA-based QST offers a highly efficient and precise tool for quantum noise reduction in advanced gravitational wave detectors.

Among various upgrade options, high-frequency (kHz) sensitivity is one of the candidates for KAGRA upgrade. With the cryogenic systems, and there are almost no mysterious noises in high-frequency, the only limitation is the shot noise. As the Chief, KAGRA Squeezing Subsystem, status about vOPO (vacuum optical parametric oscillator) test in NAOJ, and our plans to install KAGRA SQZ Subsystem will also be reported.