

Modeling the measurement problem of the sampling oscilloscope

- measurement data, uncertainty and reconstruction

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Oscilloscope measurements are never exact, they are subject to aleatoric and epistemic measurement uncertainties. An oscilloscope maps a time-varying voltage, which is assumed to exist and to be continuous, to a discrete measurement vector. We discuss approaches to model the measurement process, and in doing so, we provide an insight into the measurement problem of the sampling oscilloscope.

Because the real voltage is not available for comparison with the measured values, a high-fidelity (HiFi) measurement, that serves as a reference for the low-fidelity (LoFi) measurement of the sampling oscilloscope, is considered in modeling. A calibration operator is discussed based on the modeling of the HiFi and LoFi measurements.

Uncertainties in measurements and calibration lead to uncertainties in reconstructions, and it is necessary to quantify them. We evaluate and compare the uncertainties from a frequentist and a Bayesian point of view.