Quantum Physics

Bayesian estimation in homodyne interferometry

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We address phase-shift estimation by means of squeezed vacuum probe and homodyne detection. We analyze Bayesian estimator, which is known to asymptotically saturate the classical Cramer-Rao bound to the variance, and discuss convergence looking at the a posteriori distribution as the number of measurements increases. We also suggest two feasible adaptive methods, acting on the squeezing parameter and/or the homodyne local oscillator phase, which allow to optimize homodyne detection and approach the ultimate bound to precision imposed by the quantum Cramer-Rao theorem. The performances of our two-step methods are investigated by means of Monte Carlo simulated experiments with a small number of homodyne data, thus giving a quantitative meaning to the notion of asymptotic optimality.

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