Detecting entanglement of unknown continuous variable states with random measurements

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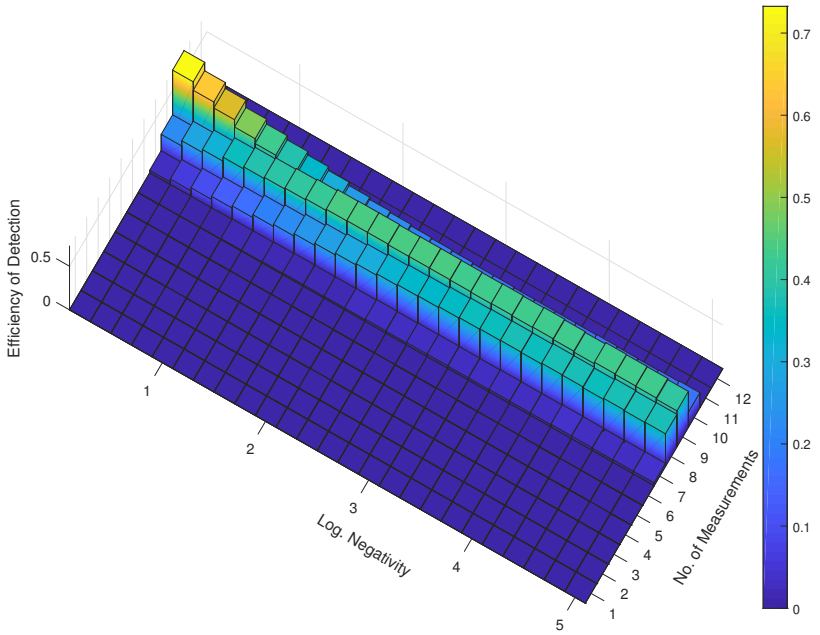
Abstract

We explore the possibility of the entanglement detection in continuous variable systems by entanglement witnesses based on covariance matrices (CMs), constructible from random homodyne measurements. We propose a set of stronger linear constraints characterising the entanglement witnesses, and use them in a semidefinite programme providing the optimal entanglement test for given random measurements.

For continuous variable systems it can be defined a special instance of entanglement witness, which embodies the entanglement criterion in terms of the variances of the canonical observables of the state [1, 2].

We study the efficiency of the entanglement detection for general random (unknown) two-mode CMs. The semidefinite optimization code using stronger constraints for the witness provides the optimal entanglement test for a given number of homodyne measurements. Starting with few random measurements, if the optimization does not confirm the presence of entanglement, then additional random measurements are performed. For every 10^5 random entangled CMs the number of measurements required for entanglement detection is recorded, and for every value of entanglement the data are binned such that they sum up to one (see the picture below). With low probability our method would require more than 10 measurements for entanglement detection in two-mode CMs.



[1] P. Hyllus, J. Eisert, New J. Phys. 8, 51 (2006).

[2] J. Anders, Diploma Thesis, Potsdam Univ. (2003).