Expressivity of linear optics for machine learning

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The training of classical machine learning is a resource-intensive process, where quantum machine learning can offer a benefit. In this work we aim to explore the expressivity of a linear optical circuit in mapping classical data into a higher dimension [1], taking into account its size and the number of indistinguishable photons involved. Specifically, we encode our data (corresponding to pixels of images belonging to two classes) into the phases of a universal interferometer [2], where we inject single photon states. To test the effectiveness of our encoding, we evaluate the separation between the two datasets on the feature Hilbert space (see FIG. 1). Furthermore, we enhance the complexity of the mapping by adding a random unitary after the encoding. This preliminary study constitutes a first step towards a linear optics-based quantum classification algorithm.

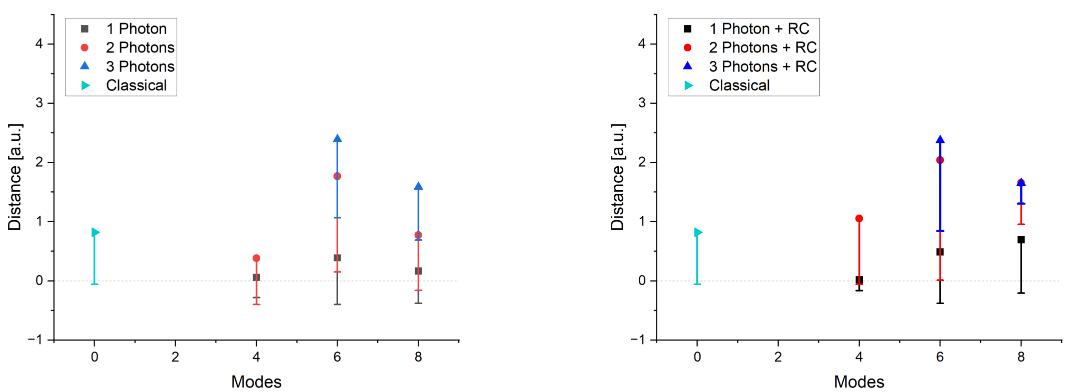

FIG. 1. Mean distance between two labelled datasets encoded through an optical circuit (left), followed by a random unitary (right). Error bars indicate lower values within 1 standard deviation.

[1] Schuld, M. & Killoran, N. Phys. Rev. Lett. 122, 040504 (2019).

[2] Clements, W. R.et al. Optica, OPTICA 3, 1460–1465 (2016).

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