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Machine learning for and from complex quantum dynamics

mardi 19 mars 2024 10:00 (30 minutes)

This talk is a tale of two halves. In the first part, we will discuss recent progress on the use of variational neural quantum states to describe the non-unitary and/or non-equilibrium dynamics of quantum many-body systems [1,2].

In the second part, we will show how the complex dynamics of quantum systems can be harnessed as a resource for machine learning and neuromorphic devices. In particular, we will discuss photonic kernel machines [3], noisy quantum kernel machines [4], reservoir computing based on relativity-inspired quantum dynamics [5] and an efficient scheme to estimate the trainability of large-size variational quantum circuits [6].

References:
[1] F. Vicentini, A. Biella, N. Regnault, and C. Ciuti, Variational Neural-Network Ansatz for Steady States in Open Quantum Systems, Phys. Rev. Lett. 122, 250503 (2019)

[2] K. Donatella, Z. Denis, A. Le Boité, and C. Ciuti, Dynamics with autoregressive neural quantum states: Application to critical quench dynamics, Phys. Rev. A 108, 022210 (2023)

[3] Z. Denis, I. Favero, C. Ciuti, Photonic kernel machine learning for ultrafast spectral analysis, Physical Review Applied 17, 034077 (2022).

[4] V. Heyraud, Z. Li, Z. Denis, A. Le Boité, and C. Ciuti, Noisy quantum kernel machines, Phys. Rev. A 106, 052421 (2022)

[5] Z. Li, V. Heyraud, K. Donatella, Z. Denis, and C. Ciuti, Machine learning via relativity-inspired quantum dynamics, Phys. Rev. A 106, 032413 (2022)

[6] V. Heyraud, Z. Li, K. Donatella, A. Le Boité, and C. Ciuti, Efficient Estimation of Trainability for Variational Quantum Circuits, PRX Quantum 4, 040335 (2023)

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