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Machine learning non-Markovian quantum dynamics

Machine learning methods have proved to be useful for the recognition of patterns in statistical data. The measurement outcomes are intrinsically random in quantum physics, however, they do have a pattern when the measurements are performed successively on an open quantum system. This pattern is due to the system-environment interaction and contains information about the relaxation rates as well as non-Markovian memory effects. Here we develop a method to extract the information about the unknown environment from a series of projective single-shot measurements on the system (without resorting to the process tomography). The method is based on embedding the non-Markovian system dynamics into a Markovian dynamics of the system and the effective reservoir of finite dimension. The generator of Markovian embedding is learned by the maximum likelihood estimation. We verify the method by comparing its prediction with an exactly solvable non-Markovian dynamics. The developed algorithm to learn unknown quantum environments enables one to efficiently control and manipulate quantum systems.

Presenter: Prof. FILIPPOV, Sergey (Moscow Institute of Physics and Technology, Steklov Mathematical Institute of Russian Academy of Sciences)

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