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Quantum Programming for the Study of Complex Systems, and possible applications in Biophysics

Quantum programming fundamentally differs from classical programming, as it is based on using the properties of quantum systems in computing. Nowadays, quantum algorithms have been developed to solve a variety of fundamental and applied problems. It is expected that, with the advancement of quantum computing, quantum algorithms will outperform classical ones for a wide range of tasks.
Quantum algorithms for studying the properties of networks using quantum computers will be presented. We investigate multi-qubit quantum states that can be represented as graphs, including bipartite graphs [1], weighted graphs [2], and one-layer variational quantum graph states [3]. The entanglement of these states and their quantum correlators are calculated. We identify relationships between quantum properties and the characteristics of the corresponding classical graphs, providing a framework to study network properties using quantum programming [1–3].
Potential applications of quantum computing in biophysics will also be discussed. In particular, applications of quantum optimization algorithms, quantum algorithms for studying the properties of complex systems, and quantum machine learning for solving problems in biophysics will be considered.

[1] Kh. Gnatenko, Phys. Lett. A 566, 131191 [7 p.] (2026)
[2] Kh. Gnatenko 2025 IEEE International Conference on Quantum Computing and Engineering (QCE), Albuquerque, NM, USA, 2025, 470–471 (2025)
[3] Kh. Gnatenko Eur. Phys. J. Plus 140(3), 241 [7 p.] (2025)

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