Project title: Quantum reinforcement learning applied to autonomous navigation of swarms of underwater drones.

Modeling of collaborative and/or adversarial swarms of robots autonomously navigating an unknown dynamic environment with moving obstacles is extremely challenging within the framework of classical computing. Application of very recently developed classical deep reinforcement learning algorithms using tensorial representation has very significantly contributed to recent advances in this field, where individual behaviors are the background fabric from which the complex team-like behavior emerges.

Despite the recent progress, simulations of the behavior of large groups of robots in unknown environments are beyond the reach of classical computing. Application of quantum computing, which takes advantage of entanglement to implement motion rules, promises to revolutionize the field of collective behavior in general. Within this framework, we propose to investigate how development and application of quantum search algorithms, such as the Grover's algorithm, can accelerate decision and planning tasks in robot swarming and offer new solutions not tractable via classical computing.

We will mainly use Qiskit, which is an open-source framework for quantum computing supported by IBM, and cirq, which is supported by google. They are both using python for programing. We note that this project can find applications not only in drone navigation but also in seemingly unrelated fields such as morphogenesis in organisms, fetus development, and even in drug-delivery.

George Lykotrafitis
Professor
University of Connecticut
Mechanical Engineering
Biomedical Engineering
UTEB 374
196 Auditorium Road
Storrs, CT 06269
Phone: 860-486-2439
Email: george.lykotrafitis@uconn.edu
Website: https://cmlab.engr.uconn.edu/