NRI: INT: Self-Assembly of Modular Robots Constructed using DNA: Modeling and Manufacturing Nanostructures with Graph Neural Networks and DNA Origami

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Award Number:2132886, http://biorobotics.org, https://www.andrew.cmu.edu/user/bex/

Challenge:

- Future micro-scale robotic devices will be integrated in broad applications (e.g., non-invasive surgical procedures to advanced electronics manufacturing)
- At micro- and nano-scale effectively impossible to physically manipulate components necessary to form integrated systems (e.g., robots)
- Very difficult to observe with fidelity mechanisms at extremely small scales

Solution: Develop a synergistic framework that combines ideas related to contemporary top-down and bottom-up manufacturing processes with those from ML, AI, and robotics to

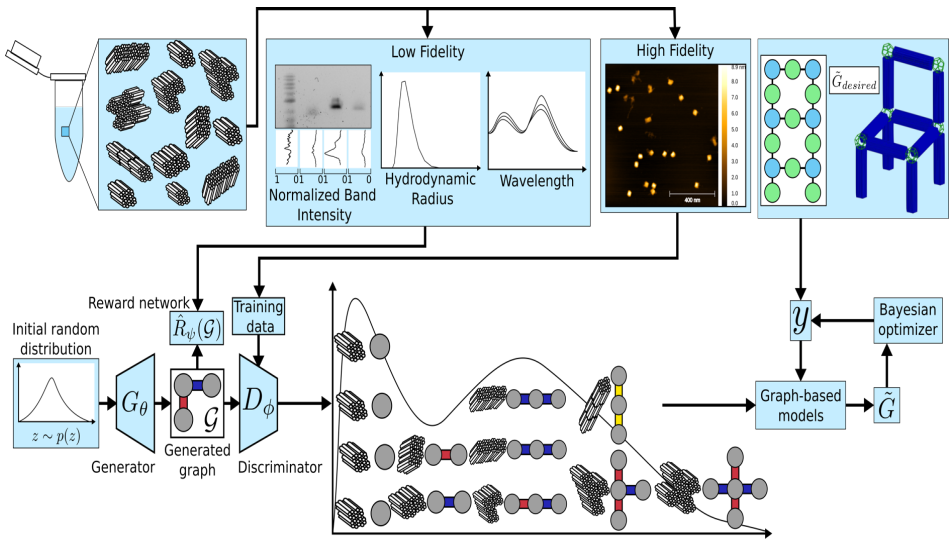
1) Effectively "manipulate" micro and nano components for assembly

2) Utilize low-cost, readily available sensing for small-scale mechanisms

Self-Assembly:

Skylar Tibbits, Baily Zuniga, Carrie McKnelly, and Athina Papadopoulou. Fluid-Assembly Chair — Self-Assembly Lab.

Systems Diagram:



Scientific Impact:

- Use low dimensional data to approximate distributions over nanoscale structures
- Probabilistic graph model generates distribution over structures conditioned on manufacturing parameters
- Optimizer learns ideal manufacturing conditions

Broader Impact:

- Nanotechnology community -- novel approach for building complex systems at high yield
- Useful to researchers in molecular biology, swarm robotics, micro medical devices, etc.
- Educate middle schoolers about artificial intelligence and DNA nanotechnology