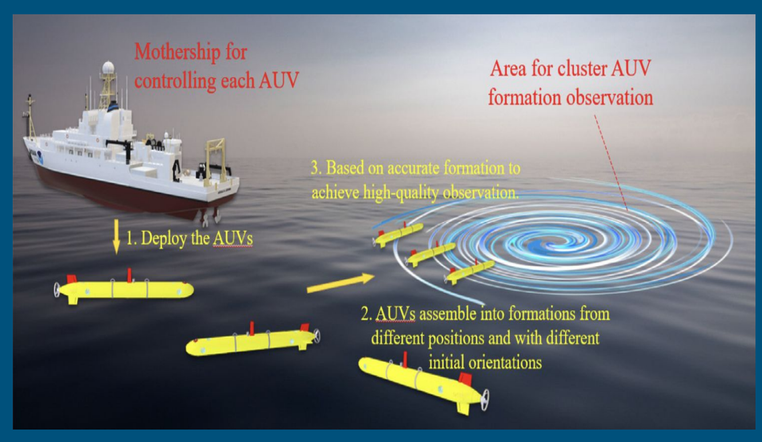
Enhancing Performance with Graph Neural Networks for Multi-Cooperative AUVs Flow Control and Obstacle Avoidance

Context & Motivation:

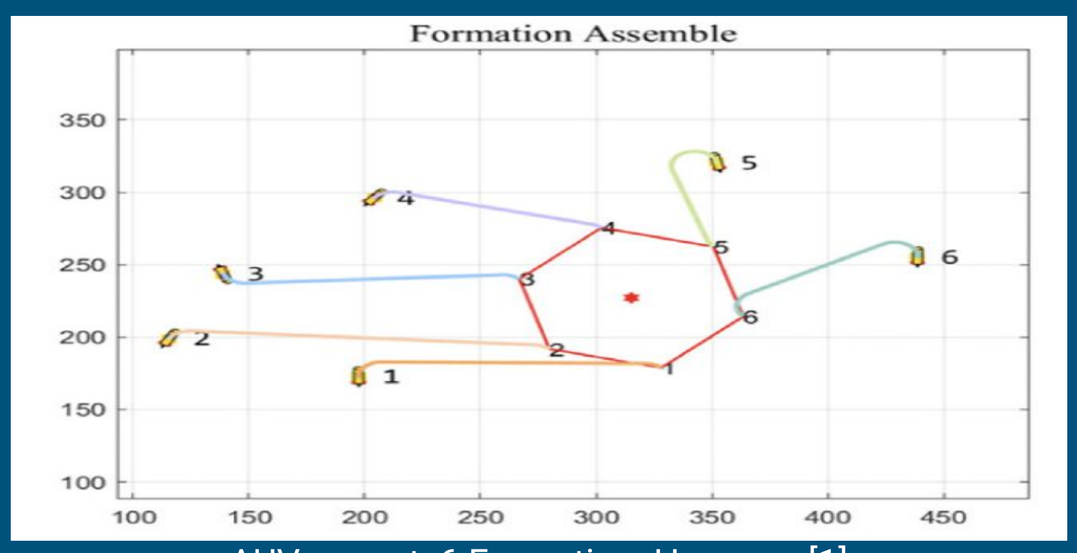
- AUV -> short endurance and restricted mission range [3].
- Multi AUVs -> information fusion-> large-scale operations [4]
- Communication Delays [5].
- Intricate & dynamic environment [1].



Multi-AUV formation cooperative operation [1].

State-of-the-art:

Formation Assembly: (FNDP) methods.
Dynamic Cooperative Control: hybrid control strategy (LFVS) combining leader-follower and virtual structure approaches [1].



AUVs count: 6 Formation: Hexagon [1]

Obstacle Avoidance: the Intelligent Adaptive Artificial Potential Field (IA2PF) method [1].

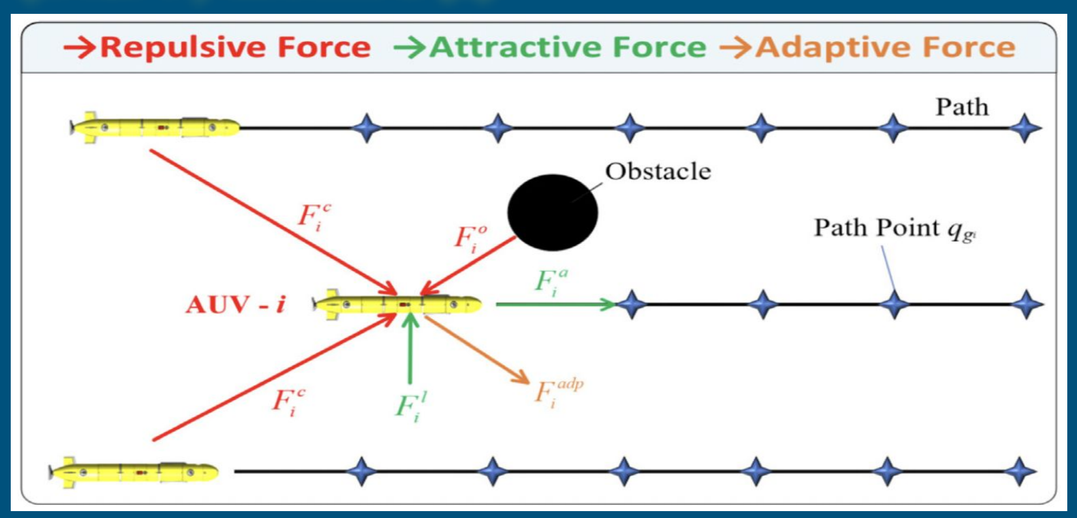
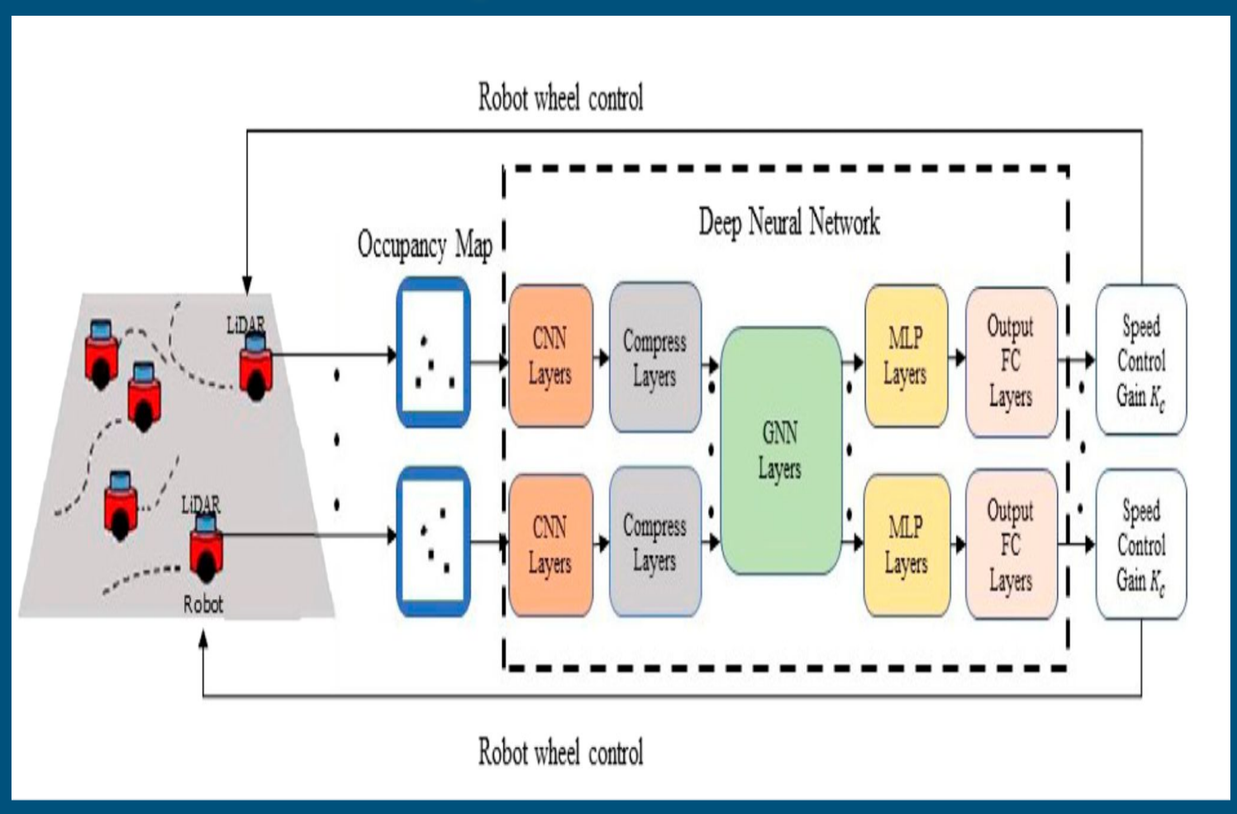


Illustration of forces acting on AUV. [1]

Proposal:

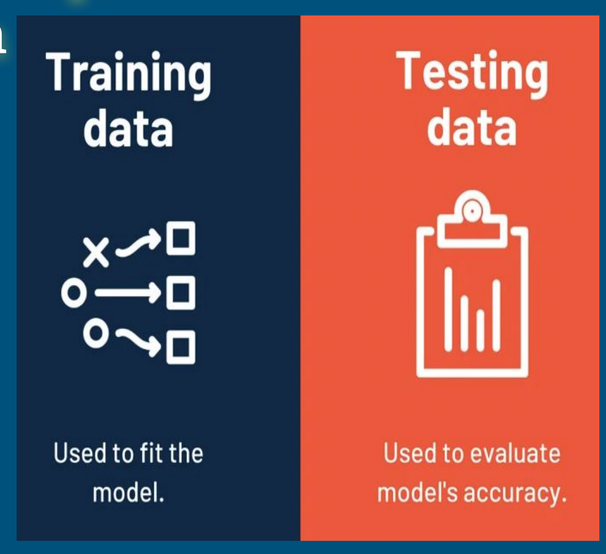
1- Switch between different communication tech
2- Utilizes GNNs to facilitate decentralized decision-making and mitigating delays.
Combines CNNs and GNNs for direct sensor data processing and robust formation maintenance in dynamic environments.



An overall diagram of end-to-end GNN-based decentralized formation control [2].

Implementation Steps:

- Expert demonstration data Collection.
- Train the GNN-based decentralized control Policy
- validate the trained model in simulations and real-world



References:
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2024 MIR Symposium

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Co-funded by the Erasmus+ Programme of the European Union