1. NeuronsGym: A Hybrid Framework and Benchmark for Robot Navigation With Sim2Real Policy Learning
    - Authors: Haoran Li, Guangzheng Hu, Mingjun Ma, Yaran Chen, Dongbin Zhao
    - Publication Year: 2024
    - Summary: This paper presents NeuronsGym, a hybrid framework and benchmark for studying Sim2Real policy learning in robot navigation. It combines a Unity3D-based simulator with a real-world testbed using RoboMaster EP robots to enable efficient training and direct policy deployment. The simulator models robot dynamics and sensor behavior (LiDAR, odometer, camera) with realistic noise and anomalies to better match physical environments. A novel metric, Safety-Weighted Path Length (SFPL), is introduced to evaluate navigation safety by penalizing collisions, improving upon traditional metrics like SPL.NeuronsGym supports tunable motion and sensor parameters to study the Sim2Real gap under varying conditions. Experiments show that domain randomization methods like UDR and SimOpt improve real-world performance, especially under the PointGoal navigation task. LiDAR fidelity has a greater impact on navigation transfer than dynamics modeling, and increased robot speed worsens Sim2Real performance. The simulator is highly efficient, supporting fast, headless-mode training for large-scale experiments. While the framework emphasizes physical safety during navigation, it does not explore ethical issues like robot autonomy or privacy. A key limitation is the use of fixed environments. Our work will use this to help us know how to simulate an environment in Unity, and have the robot path around objects, and we can add onto this by adding dynamic pathing aspects using the quantum AI to allow for our robot to be able to move around dynamic objects (for more adaptability in real world applications).
    - Link: https://ieeexplore.ieee.org/abstract/document/10750009
2. Learning Attribute Attention and Retrospect Location for Instance Object Navigation
    - Authors: Yanwei Zheng, Yaling Li, Changrui Li, Taiqi Zhang, Yifei Zou, Dongxiao Yu
    - Publication Year: 2025
    - Summary: This paper presents a novel cascade architecture to improve instance-level object navigation (ION), where agents must locate specific objects using fine-grained attributes like color, material, and reference cues. Current ION approaches often struggle with attribute confusion and weak memory of explored areas. To address these limitations, the authors introduce two main components: the Object-Attribute Attention Graph (OAAG) and the Objective Retrospect and Location Module (ORLM). OAAG enhances object discrimination through two sub-graphs: the Object-Aware Graph (OAG), which dynamically learns relationships among observed

objects, and the Attribute-Attention Graph (AAG), which uses attention to focus on key distinguishing attributes. This helps the agent identify specific instances, even within the same category. ORLM improves memory and spatial reasoning through a Back-tracker, which retains temporal and spatial object memory, and a Locator, which maps where targets were seen during exploration. Together, OAAG and ORLM provide stronger perception and memory capabilities.Integrated with an A3C reinforcement learning framework and tested in the AI2-THOR simulator, the model achieves state-of-the-art performance on Instance-Localization, Instance-Navigation, and Category-Localization tasks. The approach nearly doubles success rates over baseline methods. This will be useful to our project because we can use their improved ideas of ION to help us navigate dynamic simulated environments.

- Link: https://dl.acm.org/doi/10.1145/3706423

3. Personalized Instance-based Navigation Toward User-Specific Objects in Realistic Environments
   - Authors: Luca Barsellotti, Roberto Bigazzi, Marcella Cornia, Lorenzo Baraldi, Rita Cucchiara
   - Publication Year: 2024
   - Summary: This paper introduces Personalized Instance-based Navigation (PIN), a task where agents must locate a specific object instance (e.g., a child's favorite teddy bear) among similar items, without relying on contextual cues. Unlike traditional navigation tasks, PIN emphasizes fine-grained object recognition and personalized retrieval in complex, realistic environments.To support this, the authors present PInNED, a dataset built from Habitat-Matterport3D scenes augmented with photo-realistic 3D objects from Objaverse-XL. Each episode provides the agent with reference images on neutral backgrounds and textual descriptions, without environmental context. Objects are procedurally placed on furniture like beds and tables, and same-category distractors are included to increase difficulty. The dataset includes 338 unique instances across 18 categories, with over 865k training and 1.2k validation episodes. Target objects used in validation are unseen during training, requiring zero-shot generalization. PIN differs from existing tasks by focusing on movable, injected objects and emphasizing instance-level recognition rather than category-based search. Experiments show that modular navigation approaches outperform end-to-end models, which struggle with distinguishing similar objects and recovering from mistakes. Despite improvements, the task remains challenging, especially when distractors are present. This benchmark establishes a foundation for future work on personalized embodied navigation.This will help us with our project because we can use their ideas of how to identify specific objects, make it better (maybe through the use of upgraded knowledge graphs and quantum AI) and then apply it to our robot.
   - Link: https://arxiv.org/abs/2410.18195