MIR MARINE & MARITIME INTELLIGENT ROBOTICS

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LLM-Nav: Enhanced Navigation with Large Language Models for Marine Vessels

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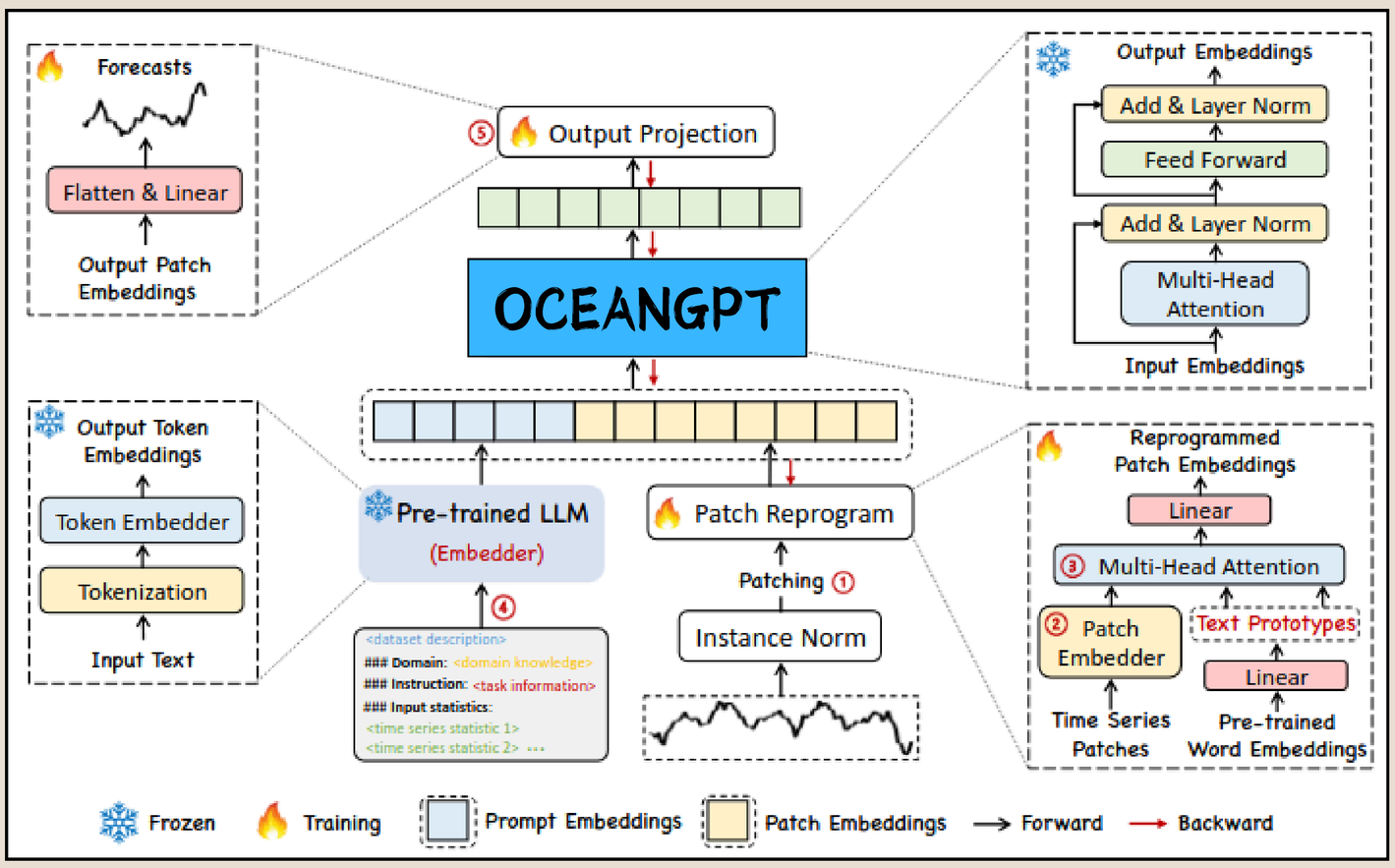
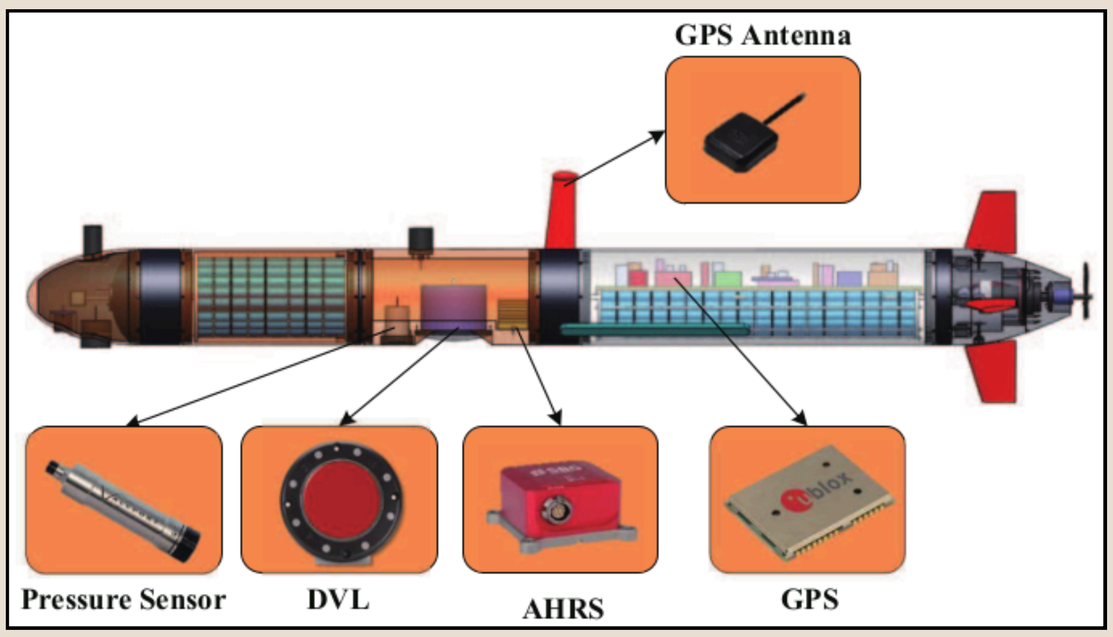
Context

-> Accurate navigation and localization are vital for AUVs. Traditional methods like EKF and UKF rely on system and measurement models, which can introduce errors affecting precision.

-> LLMs are proficient in handling sequential data and understanding the temporal dependencies in sensor data similar to LSTM RNNs. LLM-Nav can learn to predict the AUV's displacement and trajectory over time.

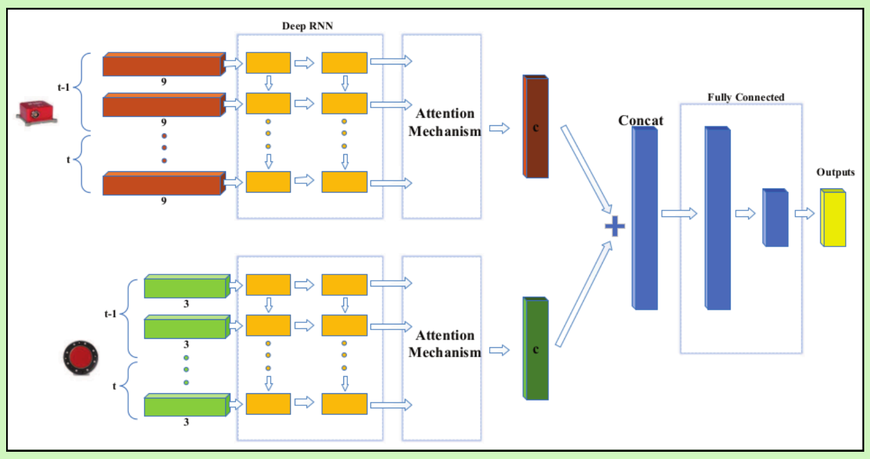




Motivation

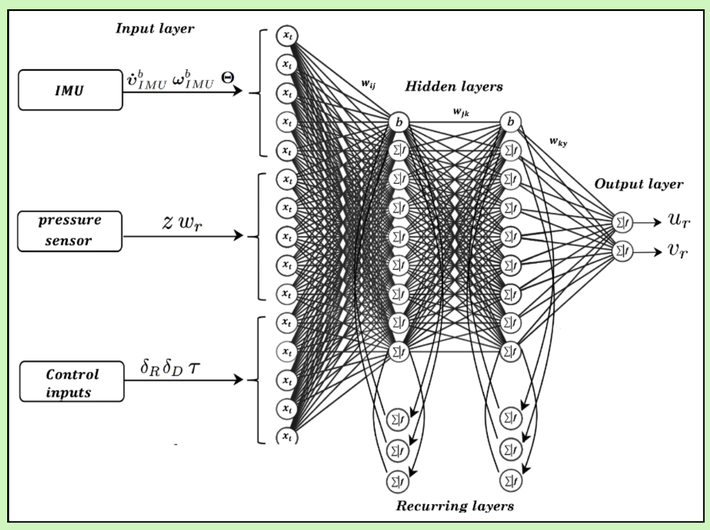
-> This can enhance the performance of the navigation system by better capturing the relationships between past and current sensor readings. Also, eliminates the need for traditional model building and state estimation, reducing potential errors.

State-of-the-Art



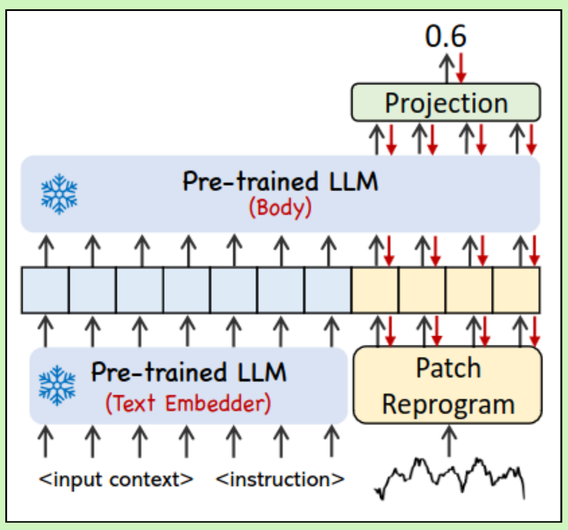
NavNet [1]

- LSTM Based
- Input AHRS and DVL
- Output AUV displacement



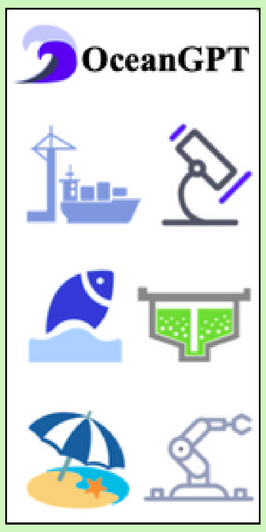
Deep Learning Approach to Dead-Reckoning Navigation [2]

- RNN Based
- Input IMU, Pressure and Control
- Output AUV relative velocities



Time-LLM [3]

- Patch Reprogramming
- Patch-as-Prefix
- Prompt-as-Prefix

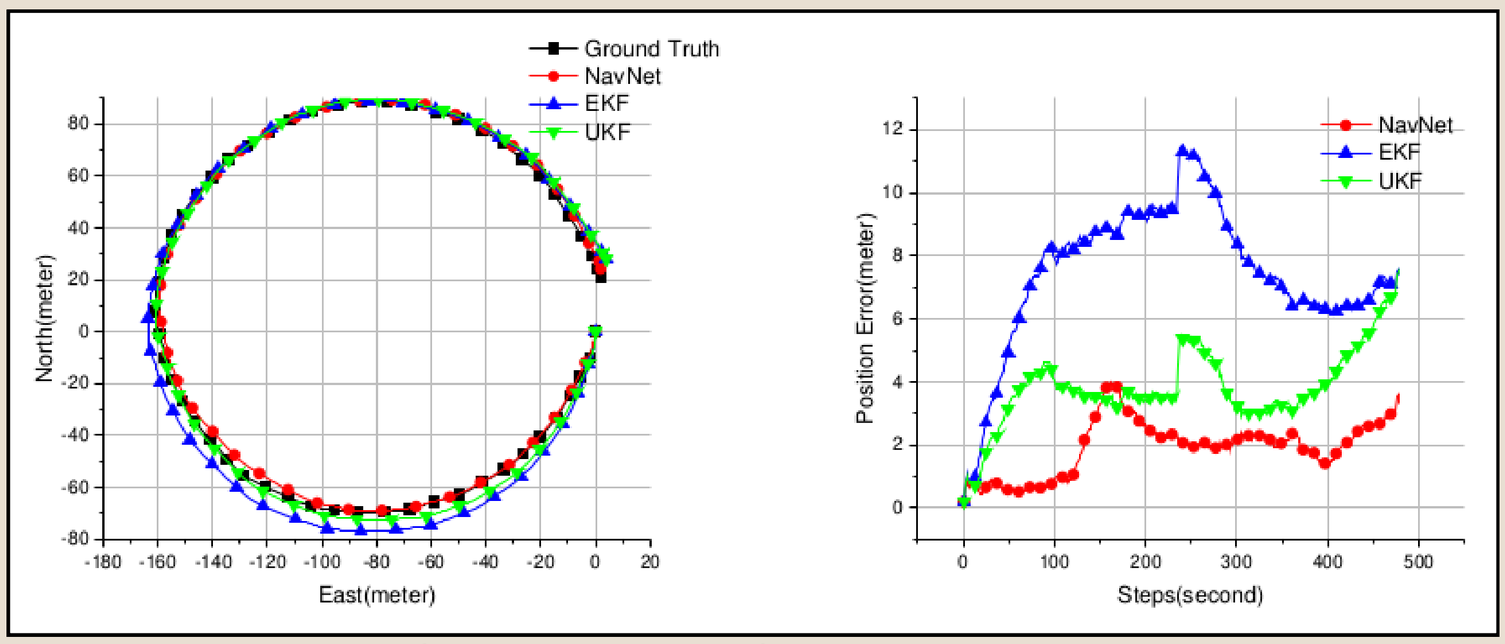


OceanGPT [4]

- Llama-2 based
- Pretrained on Ocean Science Corpus
- Finetuned with instructions

Objectives and Contributions

1. Data Preparation and Input Handling: Collect and preprocess underwater sensor data from various AUV missions. Transform the sensor data using the reprogramming approach.
2. Model FineTuning: Fine-tune the model to optimize performance for underwater navigation tasks.
3. Integration with Existing Systems
4. Performance Evaluation: Test the trained LLM-Nav model in both simulated and real-world environments.



Trajectories (left) and Position Errors of tested Navigation Techniques (right)