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CORO Project Proposal

Hind4sight.net-Unsupervised learning model

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1 Introduction

- The ability to predict the dynamics of objects under applied forces is crucial for robotics
- Large labelled data is necessary for data-driven models like deep neural networks and human supervision is needed for the majority of real-world robot interaction learning techniques[2]
- “Hindsight for Foresight: Unsupervised Structured Dynamics Models from Physical Interaction” paper introduces Hind4sight-Net model which leverages unsupervised learning to model the dynamics of a robot’s interaction with objects (poking)
- By combining a forward and an inverse dynamics model, Hind4sight-Net learns to decomposes the scene into salient object parts and predict their 3D motion

2 Related Work

- The forward dynamics model is based on the SE3-Nets[1] but in the Hind4sight-Net the forward dynamics model does not require the ground-truth point-wise data associations

3 Problem Statement

- The primary objective of this project is to implement the joint forward and inverse network architecture introduced in the ”Hindsight for Foresight” paper
- The model aims to segment a scene into salient object parts and predict their motion with unlabeled data.
- In the paper the model is evaluated in both simulation and real-world implementation.

- This project will focus on the implementation of the model with simulation (Bullet Physics Engine simulation)
- The dataset is available here

4 Project Plan

4.1 Work Packages

The work packages of the project is listed bellow:

WP1 Data Prepossessing

WP2 Implementation of forward model

WP3 Implementation of loss functions : 3D point cloud alignment loss, Image reconstruction loss, edge-aware smoothness loss

WP4 Implementation of reverse model

WP5 Model training and evaluation

WP6 Project presentation

4.2 Deliverables

Minimum Viable

- Segmentation of the data
- Implementation of Forward and inverse dynamic models

Expected

- Implementation of the Hind4sight-Net model with the loss functions

Desired

- Hind4sight-Net model with performance evaluation

References

- [1] Arunkumar Byravan and Dieter Fox. Se3-nets: Learning rigid body motion using deep neural networks. In *2017 IEEE International Conference on Robotics and Automation (ICRA)*, pages 173–180. IEEE, 2017.
- [2] Iman Nematollahi, Oier Mees, Lukas Hermann, and Wolfram Burgard. Hind-sight for foresight: Unsupervised structured dynamics models from physical interaction. In *2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 5319–5326. IEEE, 2020.