MnRI Research Showcase

Visuo-Tactile Policy Learning for Robot Manipulation

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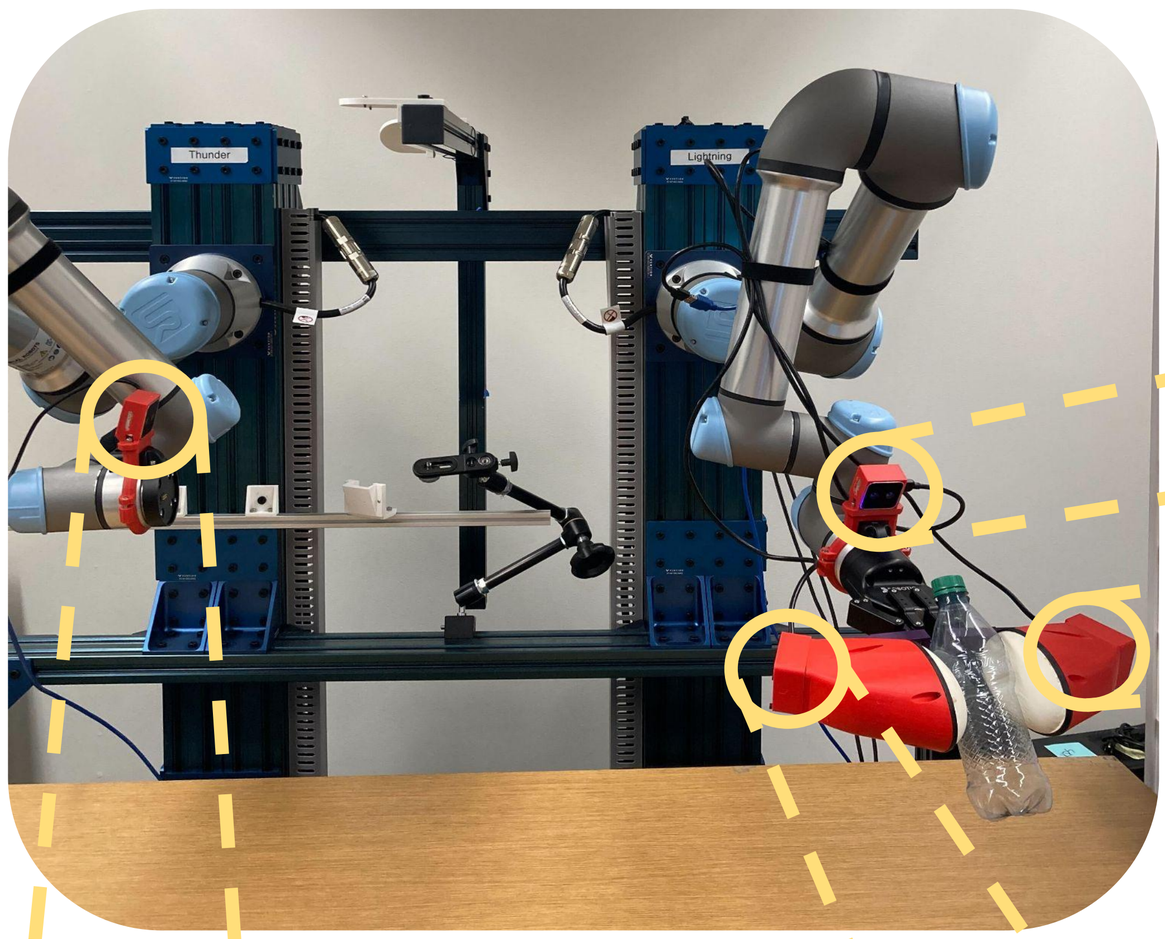
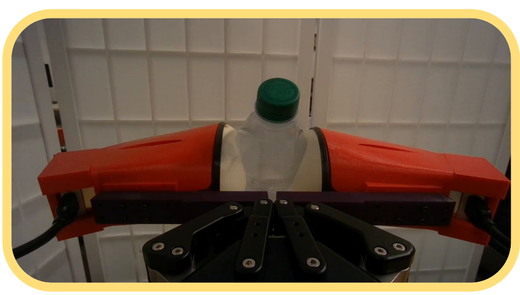
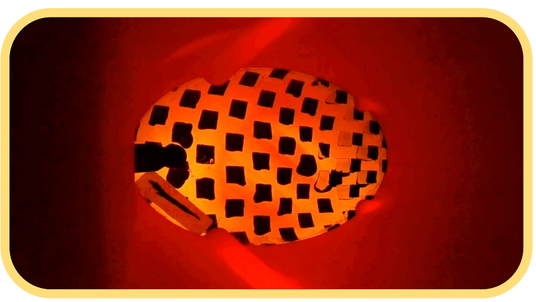
Visuo-Tactile Data Increases Task Capability for Diffusion-based Visuomotor Policy Learning



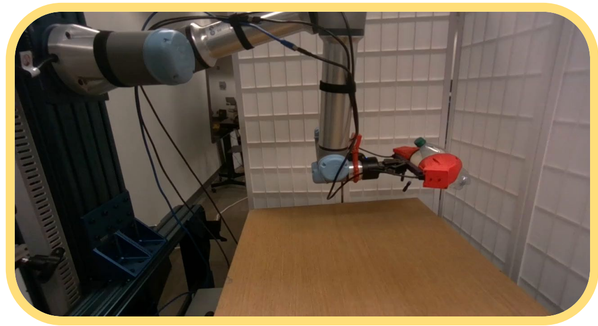


Wrist View

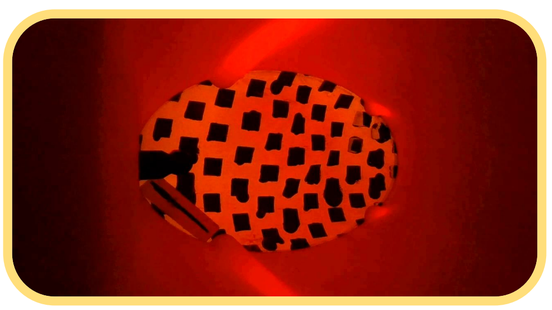
Bubble View 2



Side View



Bubble View 1



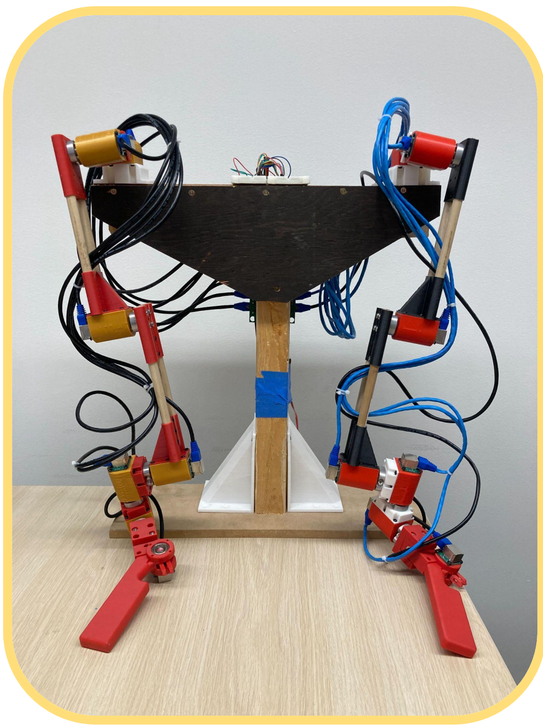
Introduction:

The objective of this work is to explore how visuo-tactile data improves real-world performance of robot policy learning. The visuo-tactile sensor presented is a redesigned version of the Soft Bubble Gripper from Punyo at Toyota Research Institute (TRI)[1]. We also present a re-implementation of a visuomotor policy learning method via action diffusion, called Diffusion Policy[2]. We leverage Diffusion Policy's robustness to multimodal inputs to improve success rate in a manipulation task.

Input-output:

The input to the framework is a series of RGB images (side, wrist, and bubbles) and end-effector poses (with gripper state), also known as observations. The output of the framework is a series of end-effector poses and gripper states, also known as actions.

Soft Bubble Part Designs



Custom Teleoperation Setup. 0.5 scale of UR5e

Network details:

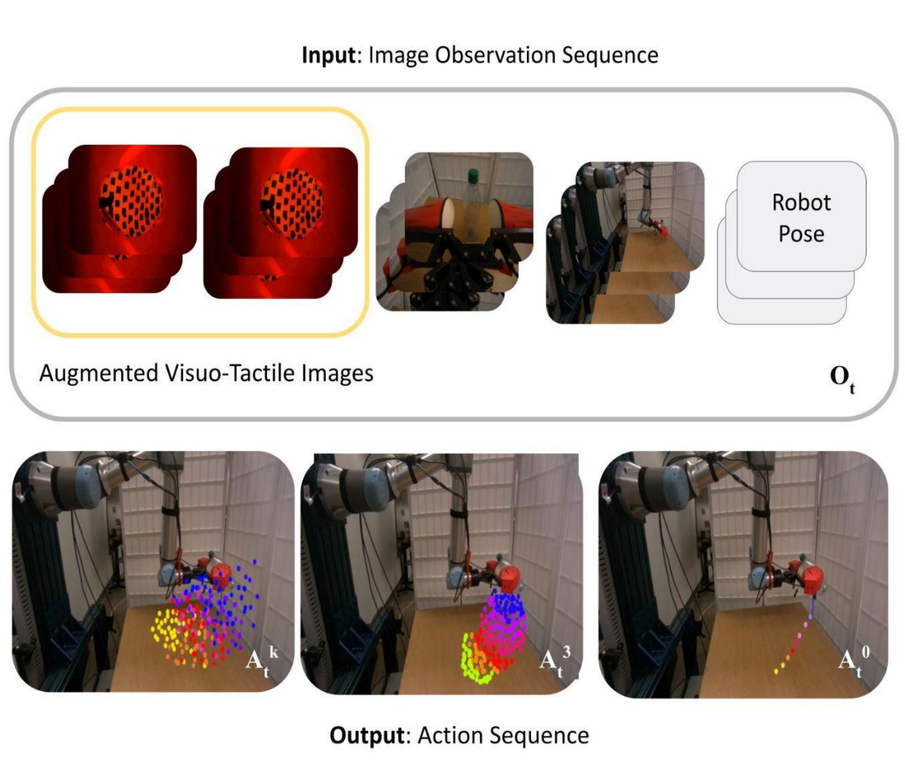
Here we use the CNN-based Diffusion Policy. Resnet 18's are used as the vision encoders for each individual camera view. Feature-wise Linear Modulation (FiLM) conditioning of the observations is applied to every convolution layer. Square Cosine Schedule is used as the noise scheduler for the DDPM. Training time is around 6 hrs on an NVIDIA RTX A5500.

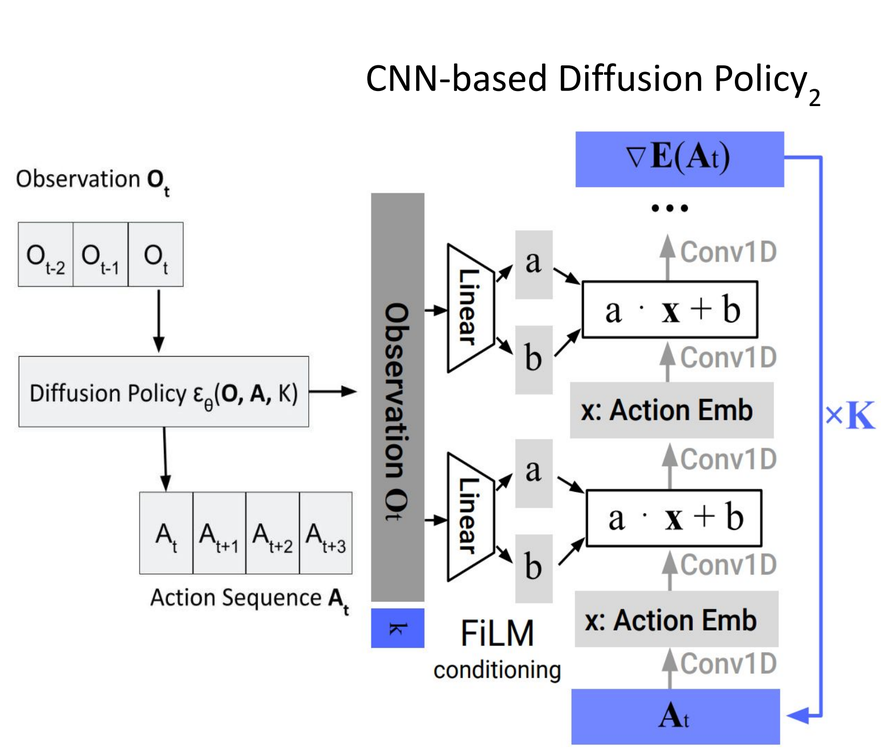
Dataset information:

50 demonstrations were collected on the custom teleoperation setup pictured.

What did you experiment on:

We examined the performance of Diffusion Policy with and without visuo-tactile data, evaluated on our Rotate Bottle task. This task requires the robot to upright a transparent bottle and place it on the table.





1. https://punyo.tech/#history
2. https://diffusion-policy.cs.columbia.edu/

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