TANDEM3D

Active Tactile Exploration for 3D Object Recognition

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SCAN ME

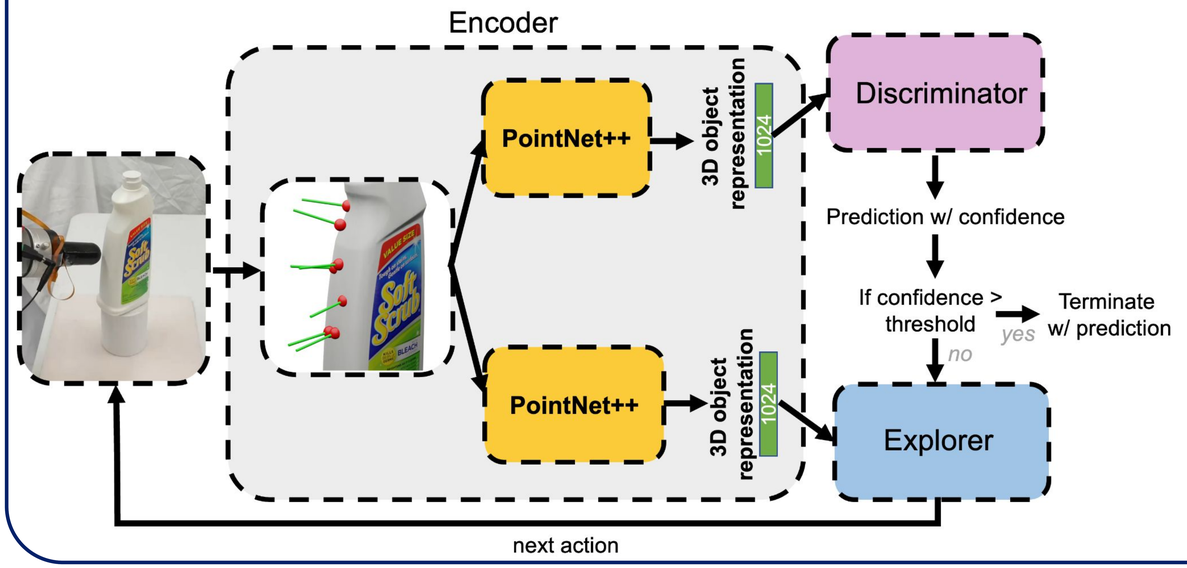
Task: Tactile Recognition of 3D Objects

The robot interacts with the object and needs to identify it by collecting a sequence of contact locations and normals.

Challenges

1. Active sensing modality
2. No simple heuristics
3. Requires advanced Encoding techniques
4. Requires more dexterous action space.

Methods



6DOF Action Space

We enable 6DOF movements for efficient exploration on 3D surfaces.

Encoder

Computes 3D representations from the sequence of sparse tactile information.

Discriminator

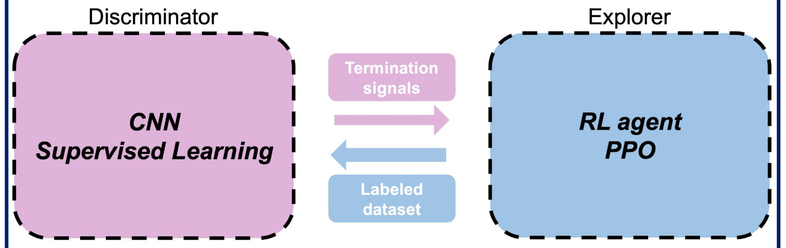
Looks at this representation and predicts the identity of this object.

Explorer

Generates the next action for the robot to take in order to collect more information.

Co-training

Despite that we have distinct decision-making and exploration policy modules, their training is highly interleaved.

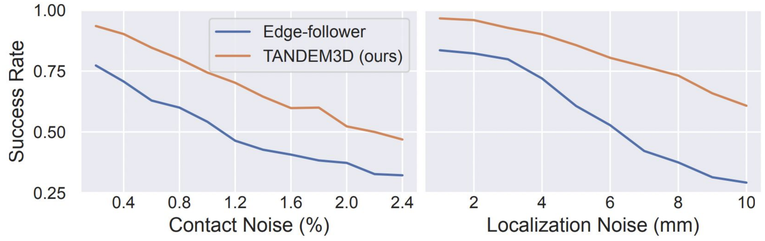


During the co-training process, the discriminator provides termination signals to the explorer and the explorer collects a labeled dataset for the discriminator. ***Each component affects the other, improves the other, co-evolves, and then converges.***

Through co-training, TANDEM3D recognizes 3D objects using ONLY touch sensing with very few actions.

Results and Discussion

***TANDEM3D* reacts to previous observations and takes moves to the most discriminative areas.** For example, it learns to collect a critical contact point on the pitcher handle by adjusting the angle, utilizing the all-around sensing coverage of the tactile finger.



We incorporate two types of noise during training: (1) contact noise and (2) localization noise. *TANDEM3D* retains a high success rate with higher noise than training