VOILA: Visual Observation-only Imitation Learning for Autonomous Navigation

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Abstract

- Imitation from Observation (IfO) methods typically assume observation-only demonstrations from the expert to match the viewpoint of the imitator. However, what if one would like to imitate a navigation demonstration from a physically different expert agent? Is imitation learning possible at all in such scenarios ?
- We introduce *VOILA* - an IfO algorithm that can learn to imitate from a single expert demonstration, even in the presence of egocentric viewpoint mismatch.
- VOILA utilizes off-the-shelf keypoint detection algorithms that are themselves designed to be robust to viewpoint mismatch. The keypoints detected are used within a novel reward function proposed in this work, for end-to-end Imitation Learning of expert driving behavior.
- We show both in simulation and on a real robot that VOILA is able to successfully imitate an expert demonstration even in the presence of significant egocentric viewpoint mismatch.

Method (Reward function)

$$R(O_t, a_t, O_{t+1}; \mathcal{D}^e) = \begin{cases} F + V - \lambda\|a_t^{steer}\|, & \text{alive} \\ -10, & \text{done} \end{cases}$$

$$F = d(O_{t+1}, O_{i_{t+1}}^e)$$

$$V = \gamma * d(O_{t+1}, \hat{O}_{i_t}^e) - d(O_t, \hat{O}_{i_t}^e)$$

VOILA is an Imitation from Observation algorithm that can imitate a physically different expert's video-only navigation demonstration, even in the presence of egocentric viewpoint mismatch

https://arxiv.org/abs/2105.09371

Method (Training)

- Given a single expert video-only demonstration sequence, we use *SAC* to learn an imitative policy, optimizing the proposed reward.
- We utilize an *RAE* for representation learning to efficiently learn end-to-end control policies from pixels.
- Additionally, we show that VOILA also supports vision-based training of navigation policies with inputs other than camera images

Physical experiments on Jackal
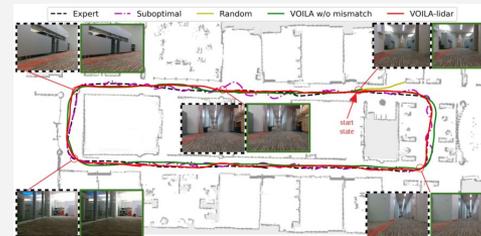
VOILA successfully imitates the expert even in the presence of egocentric viewpoint mismatch

Simulation Results on Airsim
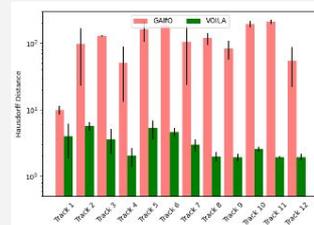
) With viewpoint mismatch between expert and imitator

Our method (*VOILA*) imitates the expert better compared to *GAIfO* and also generalizes to unseen environments