Graduate School of Science and Technology Master's Thesis Abstract

Laboratory name (Supervisor)	Robot Learning (Takamitsu Matsubara (Professor))		
Student ID	2311420	Submission date	2025 / 7 / 24
Name	NGUYEN NGOC HUY		
Thesis title	Generalized Trajectory Prediction for Catching In-Flight Objects via Discriminative Feature Embedding		

Abstract

Robotic catching of flying objects demands accurate future trajectory prediction from the early stage due to limited flight time. Some objects exhibit complex aerodynamics, making it difficult to predict their future trajectories from short historical trajectories. Previous studies use recurrent neural networks (RNN) to predict the future trajectories of objects with complex dynamics. However, historical trajectories in the early stage often appear similar across multiple objects, making existing methods fail to differentiate between trajectories of different objects. Furthermore, when applied to unseen objects, these methods cannot match unseen object trajectories to similar seen trajectory features, resulting in inaccurate predictions. In this study, we propose a trajectory prediction method with discriminative feature embedding for catching diverse and unseen objects. The core idea is to project trajectories into a feature space that captures object-specific dynamics. This embedding enables the model to distinguish between objects from limited historical trajectories and accurately predict future motion for diverse and unseen objects. Experiments on 20 real-world aerial trajectories demonstrate that our method can clearly distinguish trajectory features across multiple objects and map the trajectories of unseen objects to similar seen objects. This capability improves prediction accuracy for diverse and unseen objects, resulting in higher catching success rates.