A Novel Dynamic Movement Primitives Method for Robot Movement Generation

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Abstract

To learn from demonstration is an effective way for a robot motion generalization, especially when the robot is within a new spatial situation. However, as for learned skills, to generate humanoid and natural behaviour for a robot is a key challenge in robot skill learning. Dynamic movement primitive (DMP), a method of learning the humanoid action, is able to encode both rhythmic and discrete movement. Most researchers on DMPs can only obtain one demonstration to train the model, but the single demonstration is insufficient to extract the information of the movement generation. Dr.Yang proposed a method using Gaussian Mixture Model (GMM) to encoding the forcing term in DMPs with more than one demonstration, but it focused on the pre-processed data.

In this paper we try to extract the original data features. We focus on generalizing the robot trajectory from the database of the human demonstration (fig.1). For accurate learning, the raw data is pre-treated by dynamic time warping (DTW). And the underlying common features of different demonstrations are integrated by the Gaussian Mixture Model (GMM) - Gaussian Mixture Regression (GMR) method, and take the synthetic trajectory into DMP to model the dynamic system corresponding to the demonstration task. Then depending on the property of DMP, after changing the goal of the joints, the reproduced trajectory retains the shape of demonstration (fig2-fig4).

Using induction, summarizing demonstration data and generalizing skill, the results show that our method can achieve task-specific generalization with more smooth and human-like trajectory in comparison with Average method pre-treating data. And we are able to integrate demonstration into a distribution through unsupervised learning and extend to a new situation by dynamic movement primitives (DMPs).

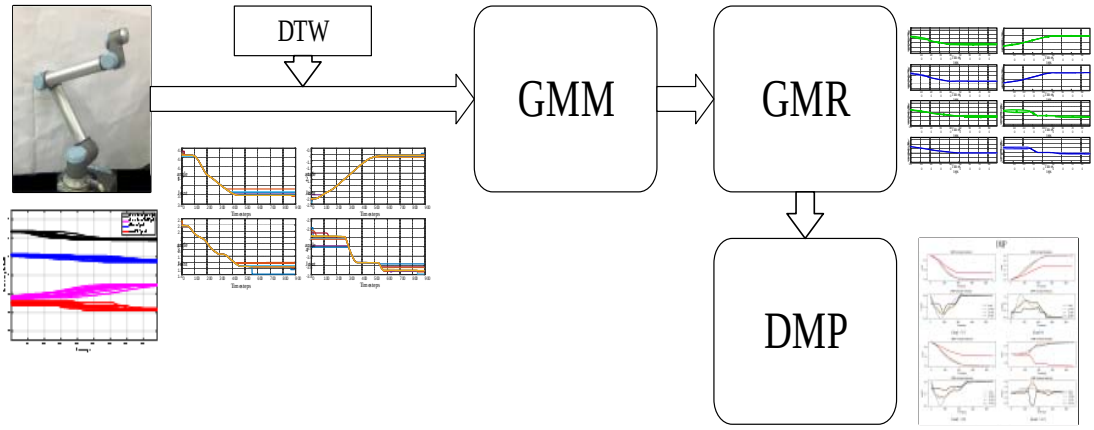

Fig.1 Approach used in movement Generalization

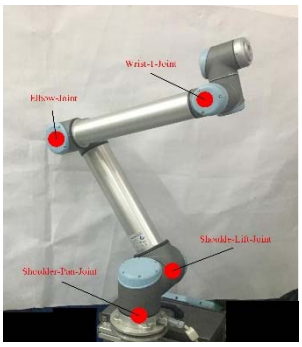

Fig.2 UR10 robot arm

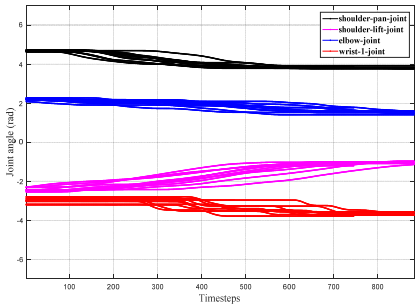

Fig.3 Ten demonstrations of the four joint position

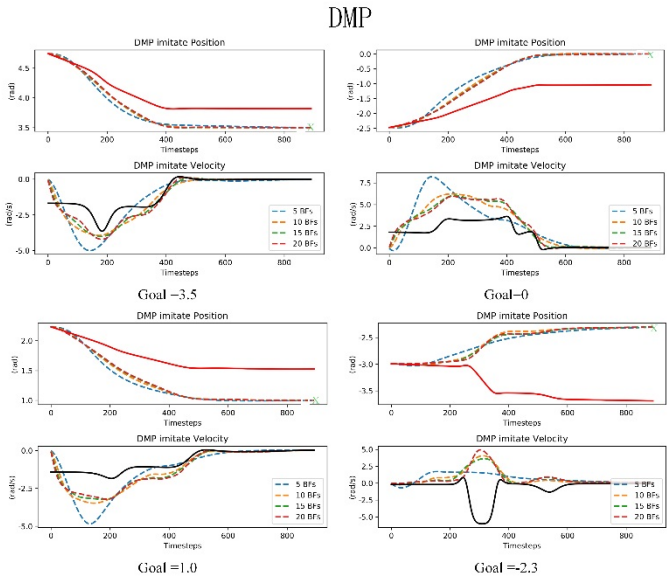

Fig.4 Generalize trajectory to the new goal by DMP

Keywords

Dynamic Movement Primitives (DMP), Gaussian Mixture Model (GMM), Gaussian Mixture Regression (GMR);

References

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