Project Proposal : Rigid Scene Flow Estimation on 3D Point Clouds

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Abstract

We work on improving and extending the Weakly Supervised Learning of Rigid 3D Scene Flow based algorithm [3] for our ADL4CV project. Within the scope of the project, we plant to look into modifying scene flow refinement, improving estimation of ego motion error and supplementary segmentation methods.

1. Introduction

The 2D optical flow approach is a method that uses the change of pixels in the image sequence in the time domain and the correlation between adjacent frames to find the correspondence that exists between the previous frame and the current frame, so as to calculate the motion information of objects between adjacent frames [1]. The 3D scene flow is a generalization of the 2D optical flow, which can help us understand and estimate dynamic 3D scenes, and has an important role in the field of computer vision and robotics [4]. But dynamic scenes contain a lot of rigid body motion, such as autonomous driving Scenario. And point flow will not work well without the restriction of rigid body motion conditions [2]. At the same time, direct learning of scene flow requires a large amount of detailed data annotation, which is also impractical. Therefore this paper proposes a method for weakly supervised learning of scene flow. Specifically, the scene stream estimation task is divided into 3 parts, foreground-background segmentation, background ego rigid body motion estimation, and foreground multi-rigid body motion estimation [3].

2. Objective

We would like to improve and extend the algorithm based on Weakly Supervised Learning of Rigid 3D Scene Flow in the following possible directions:

- Looking closely into scene flow head refinement module and exploring other algorithms for smoothing out the noisy initial vector field.
- Exploring other algorithms for the correspondence point search algorithm ego motion error, testing and documenting their effects.
- Simplifying the complex loss function of the algorithm while ensuring competitive performance.
- Applying supplementary segmentation methods like hypercolumns to improve the quality of the latent representations in the U-Net backbone.
- Exploring other inference methods to improve the performance of the algorithm without retraining.

3. Technical outline

The existing code base of the paper : https://github.com/zgojcic/Rigid3DSceneFlow.

The project milestones are as follows :

First presentation milestones:

- Thoroughly understand the details of the paper and be able to rerun the code.
- Set algorithm baseline on a partial dataset.
- Complete one of the above directions and get the initial result.

Second presentation milestones:

- Research in depth or change research direction based on the results of experiments.
- Pursue another direction simultaneously if feasible within the time frame.
- Make comparative experiments.

Final presentation milestones:

- Do ablation studies and create visual representations of experiment outcomes.
- Clean up code repository, make documentations and prepare final report.

References

[1] Steven Beauchemin and John Barron. The computation of optical flow. *ACM Computing Surveys (CSUR)*, 27:433–466, 09 1995. 1

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[3] Zan Gojcic, Or Litany, Andreas Wieser, Leonidas J Guibas, and Tolga Birdal. Weakly Supervised Learning of Rigid 3D Scene Flow, 2021. 1

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