Optical Flow Training under Limited Label Budget via Active Learning

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Introduction

“Accuracy-annotation cost” trade-off
- Optical flow: especially hard to label
- Supervised: better accuracy
- Unsupervised: lower annotation cost
- Semi-supervised: balancing both
- Draw “Error-label ratio” curves to visualize label efficiency
- Even a few labels help significantly

Active learning picks samples for labeling
- Given a label budget, which samples to label? Random Selection → Active Learning
- New problem setup: Semi-supervised optical flow estimation under certain label budget
- Active learning picks most effective samples to label → fully use label budget

Network Architecture

- Network: unsup SOTA: ARFlow[1]
- Unsup loss: multi-scale bidirectional photometric loss, smoothness loss, and augmentation loss as in ARFlow[1]
- Sup loss: multi-scale robust $L_1$ loss as in PWC-Net[2]
- Semi-sup loss: mixed supervised and unsupervised loss
- Code: https://github.com/duke-vision/optical-flow-active-learning-release

Active Learning Method

1. Training Stage 1: Train an unsup model $M_1$ on $D_1$
2. Active Learning: Use $M_1$ to infer flow on $D_2$ and evaluate uncertainty scores. Top samples query labels
3. Training Stage 2: Fine-tune $M_2$ on the partially labeled $D_2$ with semi-supervised training to get final model $M_2$

Uncertainty scores
- Photo loss: photometric loss
- Occ ratio: ratio of occluded pixels from consistency check
- Flow grad norm: estimated flow’s gradient magnitude

Semi-supervised Training Results

“Error-label ratio” curves: even a few labels help a lot

Validation: occ ratio works better than baseline

Benchmark test: occ ratio works (even w/ 5-20% labels)

Active Learning Results

Model Analysis

Active learning picks challenging samples to label

References


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