UnDeepVO: Monocular Visual Odometry through Unsupervised Deep Learning

Bolaños T.
Kilkkilä M.
Kurki L.
Rehn A.
Zaka A.
Zhao Z.

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Outline

Introduction

UnDeepVO

- A monocular visual odometry system
- Based on deep learning
- Unsupervised
  - No need for labeled training data
- Pose estimation
- Depth estimation

Introduction

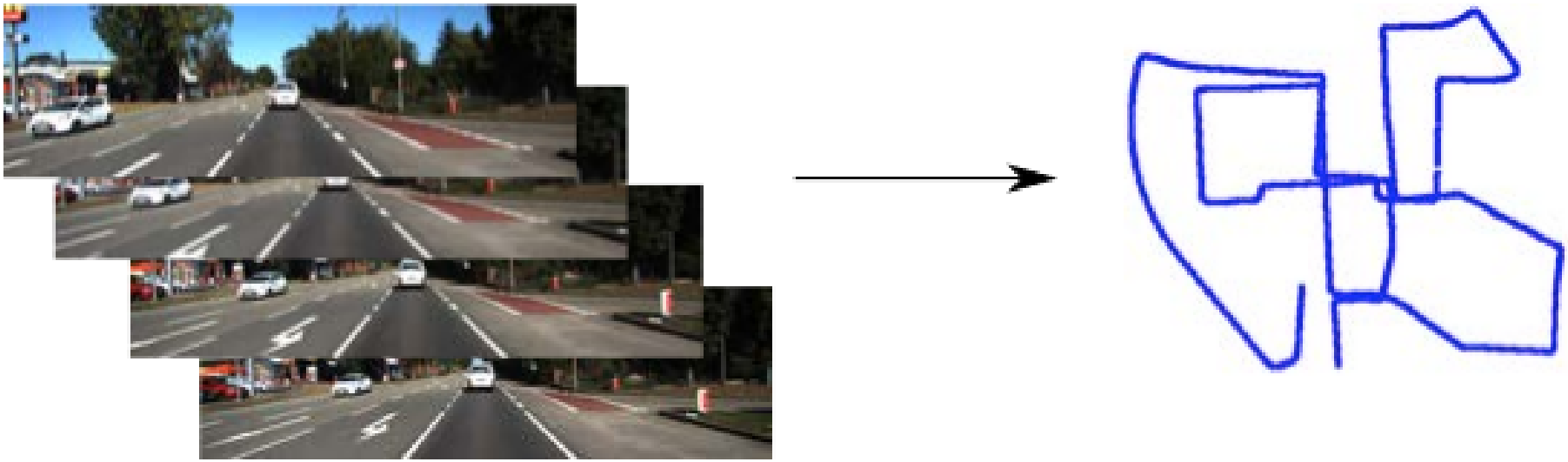
Visual odometry

- Goal
  - Robot localization using only visual information

Introduction

Visual odometry

- Goal
  - Use consecutive monocular images to construct a path of robot movement



System Overview

Architecture

- Maybe that figure on the paper ...

System Overview

Training Scheme

- ...

Objective Losses

Spatial Losses

The spatial losses are based on the fact that, given the structure of stereo cameras, for a pixel $p_l(u_l, v_l)$ on the left image and $p_r(u_r, v_r)$ on the left image:

$$u_l = u_r \quad \text{and} \quad v_l = v_r + D_p$$

- Photometric Consistency Loss (Image reconstruction)

$$L_{pho} = \lambda_s L^{SSIM}(I, I') + (1 - \lambda_s) L^{l_1}(I, I')$$

- Disparity Consistency Loss (Depth)

$$L_{dis} = L^{l_1}(D_{dis}, D'_{dis})$$

- Pose Consistency Loss (Camera orientation)

$$L_{pos} = \lambda_p L^{l_1}(t_l, t_r) + \lambda_o L^{l_1}(R_l, R_r)$$

Objective Losses

Temporal Losses

This is based on the reconstruction of pixels on time k and $(k+1)$ as

$$p_{k+1} = KT_{k,k+1}D_{dep}K^{-1}p_k$$

- Photometric Consistency Loss (Image reconstruction)

$$L_{pho} = \lambda_s L^{SSIM}(I, I') + (1 - \lambda_s)L^{l_1}(I, I')$$

- 3D Geometric Registration Loss (Adding depth with $P(x, y, z)$)

$$L_{geo} = L^{l_1}(P, P')$$

Evaluation

Trajectory

- ...

Evaluation

Depth

- ...

Conclusions

- UnDeepVo ...

Contributors

- Bolaños Tlahui
  - Objective Losses
- Kilkkilä Miikka
  - ...
- Kurki Lauri
  - ...
- Rehn Aki
  - Introduction to Visual Odometry
  - Conclusions
- Zaka Ayesha
  - UnDeep VO Key Contributions
- Zhao Zhao
  - System Overview