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Masterarbeit

Camera-Uncertainty-Aware Metric Monocular Depth Estimation

Description

Monocular depth estimation aims to predict scene depth from a single RGB image. Recent methods have made substantial progress in relative and metric depth estimation. However, metric depth prediction depends strongly on camera parameters such as focal length, field of view and sensor characteristics. In many practical applications; including robotics, mobile vision, autonomous systems and web-scale imagery; these camera parameters are either unknown, estimated or uncertain.
The goal of this thesis is to develop a camera-uncertainty-aware metric monocular depth estimation method. Instead of treating camera parameters as exact deterministic inputs, the thesis models them as uncertain quantities and injects this uncertainty into the feature representation of a depth estimation network. The proposed direction is based on the uploaded thesis draft, where a probabilistic camera-conditioning mechanism and a feature modulation module are proposed for improving cross-camera and cross-dataset generalization.
A possible method is a Pose-Conditional Feature Modulation or Camera-Conditional Feature Modulation module, inspired by FiLM-style conditioning. The model should learn to predict robust metric depth even when camera parameters are noisy or only approximately known.

Tasks:

1. Review monocular metric depth estimation and camera-aware learning.
2. Analyze camera-parameter variations across depth datasets.
3. Define a noise model for uncertain camera parameters.
4. Develop a camera-conditioning module for depth estimation.
5. Evaluate in-distribution and cross-dataset settings.
6. Compare deterministic and uncertainty-aware conditioning.

The work can be done in German or English.

Prior knowledge

- Good programming skills in Python and PyTorch
- Background in machine learning and computer vision
- Basic understanding of camera geometry, projective geometry or 3D vision
- Interest in robust perception, 3D vision and real-world generalization.

Research area

- Computer Vision; 3D Vision
- Monocular Depth Estimation
- Robust Machine Learning
- Camera Geometry
- Metric Scene Understanding

Studiengang

- [x] Elektro- und Informationstechnik
- [x] Informatik
- [x] Mathematik
- [x] Physik

Alignment

- [x] Research
- [x] Implementation
- [x] Analysis and evaluation
- [x] Method development
- [ ] Simulation

Start

At any time

Links

Mitarbeiterseite

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