Jan Škvrna

PhD student

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Research Interests

- 3D object detection
- Weakly-supervised and unsupervised training
- Autonomous Driving
- Monocular depth estimation
- 3D pose estimation

Skills

Python
- PyTorch, NumPy, OpenCV, Open3D, PyTorch3D, Faiss
- Creating pipelines and employing frameworks for deep learning.

LaTeX
- Writing scientific publications.

Git
- Using Git with GitHub.

Slurm
- Training deep learning models on a large scale.

C++
- Writing low-level code for real-time systems.

Linux

Java

About me

I am a second-year Informatics PhD student at the renowned Visual Recognition Group (led by Prof. Jiří Matas) at CTU Prague, supervised by Dr. Lukáš Neumann. Driven by a strong interest in advancing 3D perception, I am eager to deepen my understanding by learning from leading experts and engaging with diverse perspectives in the field.

My research focus lies in training both 3D Monocular and LiDAR object detectors, primarily for autonomous driving, in either weakly-supervised or unsupervised setups. Our pipelines mitigate the need for human annotators in the loop, reducing costs and significantly increasing scalability.

Education

PhD in Informatics   `Feb 2024 - now`
Czech Technical University

MSc in Cybernetics and Robotics   `Sep 2021 - Feb 2024`
Czech Technical University

Cybernetics and Robotics masters program further deepens the knowledge in computer vision, deep learning, combinatorial optimization, autonomous robotics and optimal control. I have finished this program **with honours**.

My Master's thesis focused on weakly-supervised training of 3D object detectors using temporarily consistent 2D cues. Its follow-up was published at ECCV 2024. My supervisor was Dr. Lukáš Neumann. I have received a **Dean's award** for my thesis.

Erasmus - Study abroad   `Sep 2022 - Feb 2023`
University of Southern Denmark

During my semester at the SDU, I have expanded my knowledge in data science, machine learning, statistical signal processing, drone technology and human-robot interaction

BSc in Cybernetics and Robotics   `Sep 2018 - Jun 2021`
Czech Technical University

Cybernetics and Robotics bachelor programme offers a wide variety of fields. It offers a strong mathematical and physics background and further focuses on robotics, automatic control, electrical circuits, sensors, measurements, programming, optimization, cybernetics and computer vision.

My Bachelor's thesis focused on designing and manufacturing a PCB, which controls the 3D printed 5-DOF robotic arm. The implementation was able to compute the inverse kinematic problem. My supervisor was Associate Professor Vojtěch Petrucha.

Publications

TCC-Det: Temporarily consistent cues for weakly-supervised 3D detection 🔗 `2024` `First Author`

European Conference on Computer Vision

TCC-det focuses on weakly-supervised training of a 3D object detector in LiDAR scans. Our pipeline uses Mask-RCNN, trained on a generic dataset such as MS-COCO, to detect objects in 2D. Those are further lifted into 3D based on given LiDAR scans. With temporal aggregation and direct optimization, 7-DOF bounding boxes are created as pseudo-labels. During training, we append two additional loss functions to achieve better alignment with the extracted information.
Results show that TCC-det achieves competitive performance to fully-supervised 3D object detectors while reducing the training costs significantly, as it doesn't use any domain-specific human labels.

MonoSOWA: Scalable monocular 3D Object detector Without human Annotations 🔗 `2025` `First Author`

ArXiv preprint - currently under review

MonoSOWA focuses on training 3D monocular object detector in a weakly-supervised manner. We employ Monocular Metric Depth Estimator to create pseudo-LiDAR and then detect objects in images via Mask-RCNN. Given the masks of each instance, we lift the instance into 3D and then perform aggregation of temporal consistent frames. Unlike our predecessors, our method distinguishes between moving and stationary instances and applies different priors to each category. Our method also improves the fitting speed of the 7-DOF bounding boxes. Given only images and ego-motion, our method generates high-quality pseudo-labels without any domain-specific human labels
Monocular 3D object detectors trained with our pseudo-labels achieve a competitive performance compared to the fully-supervised ones while keeping the cost for training significantly lower. Also, our method proves itself a powerful pretraining tool, as pretraining on a huge autolabeled dataset and then fine-tuning on the target dataset significantly improves the detector's performance.

Work Experience

Junior Embedded Software Developer `Jun 2020 - Jun 2023`

Poll s.r.o

- Developed and tested real-time firmware in C/C++ for ARM MCUs for HVAC systems and high-voltage DC/DC converters.
- Collaborated on hardware-level implementation for FPGAs in VHDL used in high-voltage DC/DC converters.
- Contributed to a Java-based diagnostics application, enhancing system monitoring capabilities.

Awards

Dean's award for exceptional master's thesis `2024`

Award given by Dean of Czech Technical University

6th best master's thesis on topic Industry 4.0 in Czech Republic `2024`

Award given by Ceny Wernera Von Simense