Yuwen Heng, PhD

hengyuwen@outlook.com +86 18522708355 hengyuwen.com 123mutourener

Education

University of Southampton **Southampton, UK**
Doctor of Philosophy in Computer Science, Vision, Learning and Control Research Group 2020–Aug. 2023

University of Edinburgh **Edinburgh, UK**
Master of Science in Data Science, Distinction 2019–2020

University of Edinburgh **Edinburgh, UK**
Bachelor of Engineering with Honours in Electronics and Electrical Engineering, 2015–2017
Second Class, Division 1

North China Electric Power University **Beijing, China**
Bachelor of Engineering in Electrical Engineering and its Automation, GPA: 3.36 2013–2015

Research Interest

Computer Vision and its Applications, particularly perception in autonomous driving (with a focus on sensor-fusion solutions), and the caption-based image retrieval method for data mining.

Work Experience

Baidu AI Cloud Group **Shanghai, China**
Senior Computer Vision Engineer, Autonomous Driving Dec 2021–Now (Internship until August 2023)

- Job Summary: Responsible for developing and implementing 2D and 3D perception algorithms in a ground truth system. Also involved in developing various applications, including autonomous driving simulation, data mining, automated annotation, and automated quality assessment. Has served notable customers such as Qualcomm and Geely.
- 3D Lane Line Detection:
  1. Developed and implemented a novel BEV 3D lane line detection algorithm, LiLaDet. This algorithm effectively aggregates features extracted from pseudo 2D BEV images and 3D voxels.
  2. Improved the 3D lane line annotation pipeline by sampling smooth lane points from interpolated cubic curve functions in addition to the sparsely annotated 3D points.
  3. This contribution has been accepted by ICRA2024.
  4. Extended the LiLaDet to a sensor fusion solution by projecting 2D line segmentation into 3D space. This enhancement ensures better generalization performance.
- 3D Moving Object Detection:
  1. Designed and implemented a localisation-based 3D moving object detection pipeline that optimises detection results through time sequence tracking and localisation.
  2. Implemented a multi-step process within the pipeline: detection of moving objects in individual point clouds, tracking of objects between consecutive frames, assignment of locations to objects at specific timestamps, and smoothing of detected bounding boxes based on global localisation.
  3. Successfully deployed the pipeline in the ground truth system and adapted it for BEV parking area detection.
- Other Engineering Task: developed additional applications for the ground truth system, such as OpenScenario and OpenDrive transformation, overfitting-based annotation quality assessment, and data mining.

Research Projects

Dense Material Segmentation for Scene-Aware Spatial Audio Rendering Sep 2020–Now

- Research Description: This project aims to provide material labels for reconstructed 3D indoor scenes to synthesise spatial audio with multiple reflections and reverberation effects. Supervised by Dr. Hansung Kim and Dr. Srinandan Dasmahapatra at the University of Southampton.
- Research Background: Achieving accurate material segmentation for 3-channel RGB images is challenging due to the considerable variation in the appearance of a material. Moreover, the material datasets have sparse labels, where only a small region of the image is annotated. The sparse datasets present a significant challenge in recovering accurate material boundaries for lack of labelled samples near boundaries. To address these issues,

multiple neural networks are proposed to enhance segmentation accuracy by incorporating material features along with contextual features related to objects and scenes.

- Research Achievements:

  1. Proposed and implemented a material labelling enhancement method based on semi-supervised learning (self-training).
  2. Introduced a semi-global contextual feature learning method utilising boundary loss.
  3. Designed a dynamic cross-resolution feature learning method based on transformer architecture.
  4. Developed a material feature learning method based on a camera model and hyperspectral image reconstruction.

  These contributions have resulted in achieving the highest accuracy of 88.34% on the test data. Furthermore, six papers have been published in conferences such as EUSIPCO, ICASSP, BMVC, and IEEE VR, and one chapter in the Springer CCIS journal. Additionally, one journal paper has been submitted to IEEE Trans. Image Process. and another conference paper has been submitted to CVPR2024 (recommendations: 4, 4, 3, 2).

Data Reduction for Supervised Training Feb 2020–Nov 2020

- This project is part of my MSc dissertation, supervised by Dr Cao Yang, at the Laboratory for Foundations of Computer Science (LFCS), University of Edinburgh.
- Surveyed existing data reduction techniques for machine learning, focusing on instance selection algorithms and non-uniform sampling algorithms. Implemented the algorithms with scikit-learn and TensorFlow in Python.
- Analytically and empirically evaluated the relative accuracy of training over reduced datasets and original datasets.
- Proposed a new workflow to adapt the algorithms to work with image datasets and convolutional neural networks (CNN) by extracting image features first with pre-trained network parameters.
- Designed a new instance selection algorithm to weight the instances based on classification difficulty and the decision boundary in extracted feature space.

Publications

- Runkai Zhao, Yuwen Heng, Yuanda Gao, Shilei Liu, Heng Wang, Changhao Yao, Jiawen Chen, and Weidong Cai. Advancements in 3d lane detection using lidar point clouds: From data collection to model development. In *2024 IEEE International Conference on Robotics and Automation (ICRA 2024)*, 2024
- Yihong Wu, Yuwen Heng, Mahesan Niranjan, and Hansung Kim. Sliceformer: Deep dense depth estimation from a single indoor omnidirectional image using a slice-based transformer. In *2024 International Conference on Electronics, Information, and Communication (ICEIC)*. IEEE, 2024
- Yihong Wu, Yuwen Heng, Mahesan Niranjan, and Hansung Kim. Depth estimation for a single omnidirectional image with reversed-gradient warming-up thresholds discriminator. In *2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2023
- Yuwen Heng, Srinandan Dasmahapatra, and Hansung Kim. Material recognition for immersive interactions in virtual/augmented reality. In *2023 IEEE conference on virtual reality and 3D user interfaces abstracts and workshops (VRW)*, pages 577–578. IEEE, 2023
- Yuwen Heng, Yihong Wu, Srinandan Dasmahapatra, and Hansung Kim. Enhancing material features using dynamic backward attention on cross-resolution patches. In *33rd British Machine Vision Conference 2022, BMVC 2022, London, UK, November 21-24, 2022*. BMVA Press, 2022a
- Yuwen Heng, Yihong Wu, Hansung Kim, and Srinandan Dasmahapatra. Cam-segnet: A context-aware dense material segmentation network for sparsely labelled datasets. In *17th International Conference on Computer Vision Theory and Applications (VISAPP)*, volume 5, pages 190–201, 2022b
- Alawadh Mona, Wu Yihong, Heng Yuwen, Niranjan Mahesan, and Kim Hansung. Room acoustic properties estimation from a single 360° photo. In *2022 30th European Signal Processing Conference (EUSIPCO)*. IEEE, 2022
- Yihong Wu, Yuwen Heng, Mahesan Niranjan, and Hansung Kim. Depth estimation from a single omnidirectional image using domain adaptation. In *European Conference on Visual Media Production (CVMP)*, pages 1–9, 2021

Patents

Contributed to the development of 1 invention patent, 2 utility model patents, and 1 design patent.

Startup Experience

Beijing Overleap technology Limited **Beijing, China**

AR Engineer Jul 2017–May 2018

- Beijing Overleap was a start-up company founded by two of my classmates and me, aimed at developing cost-effective augmented reality (AR) hardware.
- Responsible for developing prototype AR software with the development toolkit, Vuforia in Java.
- Modified the render-related Java classes of Vuforia to apply affine translations to each frame so that the applications developed for mobile phones can run on our eyewear hardware without modifying the 3D resources and the application scene.
- Attended competitions and wrote the business plan to raise money for the company with my team. Successfully raised one million Chinese Yuan and built fully functional products for a science museum with 3D printed structures.

Awards

Overseas Students Pioneer Park; Creative Returnees Team	2017
2nd iCAN HongGuTan Cup VR/AR Innovation & Entrepreneurship Competition; Winning Team	2017
Hangzhou Overseas Returnees Innovation & Entrepreneurship Competition; Outstanding Young Returnees	2016