Yuwen Heng, PhD

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Education

University of Southampton **Southampton, UK**
Doctor of Philosophy in Computer Science, Vision, Learning and Control Research Group 2021–2024

University of Edinburgh **Edinburgh, UK**
Master of Science in Data Science, Distinction degree 2020–2021

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

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, including material segmentation for immersive-sound rendering, vision-based autonomous driving, and panorama depth estimation.

Experience

Baidu **Shanghai, China**
Internship in Autonomous Driving Simulation Dec 2021–Now

- Constructed an autonomous driving (AD) platform based on the open-source simulator Carla and visualisation tool CarlaViz.
- Decoupled the AD algorithm from the simulator via Robot Operating System (ROS) communication tools.
- Implemented the perception algorithms (including drivable area segmentation, lane line detection, traffic object detection, pedestrian intention prediction *et al.*) with the OpenMMLab framework.
- Deployed simulation project and managed server resources with Docker.

Beijing Overleap technology Limited **Beijing, China**
co-founder and AR Engineer Jul 2017–May 2018

- Beijing Overleap was a start-up company founded by me and two of my classmates, aiming 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 phone 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.

Projects

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

- This project aims at producing dense material segmentation for 3D indoor scenes to synthesise spatial audio.
- Surveyed on material segmentation techniques with deep learning and proposed a hybrid network architecture to learn from full image and image patches jointly.
- Augmented coarse datasets with produce pseudo labels produced by semi-supervised learning techniques.
- Adopted boundary loss to stabilise the self-training procedure and achieve state-of-the-art on indoor test images.

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 on 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 vs over 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.

Point Cloud Registration for a Human Body Feb 2020–Apr 2022

- This project aims to reconstruct a 3D human body from a set of 3D point clouds acquired from an Intel RealSense depth sensor.
- Detected and matched the corresponding points from two consecutive frames with the Speeded Up Robust Features (SURF) algorithm.
- Estimated the transformation matrix with a randomly selected subset of matched 3D points using the Singular Value Decomposition method and calculated the distance between matched points after transformation. Chose the transformation matrix with the minimum total distance.
- Refined the transformation matrix by the iterative closest point (ICP) algorithm and fused all the frames into a single point cloud object.

Robot Control and Object Detection with ROS in the Gazebo simulation environment. Oct 2019–Dec 2019

- This project aims to control a simulated 4 degrees of freedom robot to grab a moving object using ROS in a 3D simulation scene.
- Detected and separated the moving object from the background with a colour threshold algorithm followed by a perimeter calculation algorithm using the OpenCV library in Python.
- Modelled the robot end-effector position as the DenavitHartenberg (DH) parameters and estimated the current robot joint angles with two images by solving the forward kinematics function.
- Controlled the robot to grab the object by calculating the joint angle velocity with the Jacobian matrix of the forward kinematics. The movement is stabilised with a closed-loop controller.

Publications

- 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, 2022
- 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

- Chen Kefeng, Li Shuowei, and Heng Yuwen. Head-mounted display device, 201830088225.6, 2018
- Chen Kefeng, Li Shuowei, and Heng Yuwen. Head-mounted display device, 201721775211.8, 2017
- Chen Kefeng, Li Shuowei, and Heng Yuwen. Head-mounted display device, 201711363613.1, 2017
- Li Shuowei and Heng Yuwen. Portable multi-functional intelligence comb, 201621143067.1, 2016

Awards

Overseas Students Pioneer Competition; 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