Yuwen Heng, PhD

y.heng@soton.ac.uk 18522708355 hengyuwen.com 123mutourener 0000-0003-3793-4811

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

Experience

Baidu ACG **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, both Logsim and Worldsim simulation modes are supported.
- Implemented the perception algorithms (including drivable area segmentation, lane line detection, traffic object detection, pedestrian intention prediction *et al.*) with the OpenMMLab framework, based on sensor fusion algorithms with camera, radar and lidar data.
- Deployed simulation project and managed server resources with Docker.

Sanjieke (Beijing) **Beijing, China**
Campus Product Manager May 2018–April 2019

- The campus team at Sanjieke aims to provide training courses for college students who are about to enter the workforce and want to find a position in Internet companies.
- Responsible for designing the campus end product, including the course management backend, web assignment submission page end and the applets course service end, communicating with the design and RD teams on the implementation plan, supervising the function development cycle and launching the online services.
- Produced courses in the form of dialogues to suit the learning needs using mobile phones.
- Deployed projects through WeChat applets to reduce development and maintenance costs.
- Simplified the process of assignment submission for students through the web assignment submission end.
- Created a data board in the background to display operational data in two dimensions: course/time.

Beijing Overleap technology Limited **Beijing, China**
co-founder and 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.

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 2020

- 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. Enhancing material features using dynamic backward attention on cross-resolution patches. In *2022 33rd British Machine Vision Conference (BMVC)*, under review
- Yihong Wu, Yuwen Heng, Mahesan Niranjan, and Hansung Kim. Depth estimation for a single omnidirectional image with reversed-gradient warming-up thresholds discriminator. In *2022 33rd British Machine Vision Conference (BMVC)*, under review
- 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 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

衡誉文，博士

y.heng@soton.ac.uk 18522708355 hengyuwen.com 123mutourener 0000-0003-3793-4811

教育经历

南安普顿大学（QS78） **南安普顿，英国**

计算机科学博士，Vision, Learning and Control Research Group 2020–2023.08

爱丁堡大学（QS15） **爱丁堡，英国**

数据科学硕士， Distinction 2019–2020

爱丁堡大学 **爱丁堡， 英国**

电子电气工程荣誉学士，Second Class, Division 1 2015–2017

华北电力大学 **北京，中国**

电气工程及其自动化学士, GPA: 3.36 2013–2015

研究方向

计算机视觉及其应用，包括沉浸式声音渲染的材料分割，基于视觉的自动驾驶（传感器融合），以及全景深度估计。

工作经历

百度 ACG **上海，中国**

自动驾驶仿真实习 2021.12–至今

- 工作简介：在开源模拟器 Carla 和可视化工具 CarlaViz 的基础上构建了一个自动驾驶平台，支持多场景自动化算法测评；
- 功能拆分：通过 ROS 通信工具将自动驾驶算法与模拟器解耦，支持 Logsim 与 Worldsim 两种仿真模式；
- 算法实现：用 OpenMMLab 框架实现了基于摄像头与毫米波、激光雷达的融合感知算法，包括可驾驶区域分割、车道线检测、交通对象检测与跟踪等；
- 项目部署：利用 Docker 部署了仿真项目并管理服务器资源。

三节课信息咨询 (北京) 有限公司 **北京，中国**

校园端产品经理 2018.5–2019.4

- 项目简介：三节课校园端旨在为即将步入社会的大学生提供产品、运营等互联网岗位培训课程；
- 工作简介：负责设计校园端产品，包括课程管理后台、web 作业提交端以及小程序课程服务端，与设计、研发团队沟通实现方案，监督功能开发周期并验收上线；
- 产品亮点：采用对话形式制作课程，适配手机端学习需求；通过微信小程序部署项目，降低开发、维护成本；通过 web 作业提交端简化学员提交作业的流程；后台制作数据看板，以课程/时间两个维度展示运营数据。

北京穿越科技有限责任公司 **北京，中国**

AR 技术联合创始人 2017.07–2018.05

- 公司简介：北京 Overleap 是一家由我和我的两个同学创立的初创公司，种子轮融资 100 万人民币，旨在开发低成本的增强现实（AR）硬件；
- 工作简介：负责使用开发工具包 Vuforia 在 Java 环境中中开发 AR 软件；
- 软件适配：修改了 Vuforia 的渲染相关的 Java 类，将仿射平移应用到渲染的每一帧中，这样为手机开发的应用程序就可以在我们的眼镜硬件上运行，而不需要修改 3D 资源和应用场景；
- 软件开发：参加比赛并撰写商业计划书，与我的团队一起为公司筹集资金，为一家科学博物馆用 3D 打印的结构建造了功能齐全的初代产品。

项目经历

基于场景感知的空间音频渲染的密集材料分割 2020.09–至今

- 研究描述：该项目旨在识别 3D 室内场景并提供材料标签，以合成空间音频。由南安普顿大学 Hansung Kim 博士指导；
- 研究内容：整理基于深度学习的语义分割技术，撰写了文献综述，并提出了一个混合网络架构，以便融合全局上下文信息以及局部材料特征。使用半监督学习技术产生的伪标签补充了粗略打标的数据集。采用边界损失函数来稳定 self-training 的过程；
- 研究成果：在室内测试图像上提高 3-20%的精确度，达到先进水平，并发布两篇论文。

监督学习的数据缩减 2020.02–2020.11

- 研究描述：本项目是我硕士论文的一部分，由爱丁堡大学计算机科学基础实验室（LFCS）的 Cao Yang 博士指导；
- 研究内容：调查了现有的机器学习的数据缩减技术，重点是实例选择算法和非均匀采样算法。在 Python 中用 scikit-learn 和 TensorFlow 实现了这些算法。从理论上和经验上评估了减少的数据集与原始数据集的训练的"相对准确性"；
- 研究成果：提出了一个新的工作流程，首先用预先训练的网络参数提取图像特征，使算法适用于图像数据集和卷积神经网络（CNN）。设计了一种新的实例选择算法，根据分类难度和提取的特征空间的决策边界对实例进行加权。在分类问题上，能够以 80%的数据实现原数据集 96%的精确度。

人体数据点云配准 2020.02–2020.04

- 研究描述：本项目旨在从一组从英特尔 RealSense 深度传感器获得的三维点云中重建一个三维人体；
- 研究内容：使用加速鲁棒特征（SURF）算法检测并匹配两个连续帧中的相应点。使用奇异值分解方法，用随机选择的匹配三维点子集估计变换矩阵，并计算变换后匹配点之间的距离。选择具有最小总距离的变换矩阵。通过迭代最接近点（ICP）算法重新定义转换矩阵，并将所有的帧融合为一个单一的点云对象；
- 研究成果：在 MATLAB 中完整实现全部代码，并能够稳定输出配准后的 3D 模型。

在 Gazebo 模拟环境中用 ROS 进行机器人控制 2019.10–2019.12

- 研究描述：这个项目旨在使用 ROS 控制一个模拟的四自由度机器人在三维模拟场景中抓取一个移动物体；
- 研究内容：通过颜色阈值算法和周长计算算法，利用 Python 中的 OpenCV 库，检测并将移动物体从背景中分离出来。将机器人末端执行器的位置建模为 Denavit-Hartenberg（DH）参数，并通过求解正向运动学函数来估计当前机器人的关节角度。通过计算前向运动学的雅各布矩阵的关节角速度来控制机器人抓取物体。用一个闭环控制器来稳定运动；
- 研究成果：模拟机器人能够稳定的抓取移动物体。

发表论文

- Yuwen Heng, Yihong Wu, Hansung Kim, and Srinandan Dasmahapatra. Enhancing material features using dynamic backward attention on cross-resolution patches. In *2022 33rd British Machine Vision Conference (BMVC)*, under review
- Yihong Wu, Yuwen Heng, Mahesan Niranjan, and Hansung Kim. Depth estimation for a single omnidirectional image with reversed-gradient warming-up thresholds discriminator. In *2022 33rd British Machine Vision Conference (BMVC)*, under review
- 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

专利

- 陈科枫; 李烁炜; 衡誉文. **头戴式显示器**, 201830088225.6, 2018
- 陈科枫; 李烁炜; 衡誉文. **一种头戴式显示装置**, 201721775211.8, 2017
- 陈科枫; 李烁炜; 衡誉文. **一种头戴式显示装置**, 201711363613.1, 2017
- 李烁炜; 衡誉文. **便携式多功能智能梳**, 201621143067.1, 2016

获奖经历

海淀创业园; 海淀创业潜力奖	2017
红谷滩杯 VR/AR 行业赛; 优胜奖	2017
杭州留学生创新创业大赛; 杰出归国青年奖	2016