

贺仁智

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教育背景 Education background

重庆大学，重庆

2020-至今

在读硕士研究生 机械与运载工程学院, 保送, TOEFL 109, 2023 年 6 月毕业

重庆邮电大学，重庆

2016-2020

机械电子工程，绩点排名 2/120，综测排名 1/120，四六级 579/531

科研经历 Research Experience

Multi-task learning for Single Image Depth and Defocus Estimation

2021.09-至今

- Submitted to <IEEE Transactions on Pattern Analysis and Machine Intelligence> IF. 24
- 提出一种基于多任务学习的结构同时学习深度地图以及离焦地图
- 制作数据集 All-in-3D。该数据集包含<全清晰图像，深度图，离焦图像以及对焦深度>包含了 500 个场景，10 万组数据，是目前与离焦图片, 深度图片相关的最大数据集。
- 完善硬件系统代码以及上位机处理程序 (PYQT, VIMBA SDK)

Precise Point Spread Function Estimation(离焦点扩散函数估计) [Arxiv](#)

2021.06-2022.03

- Submitted to <IEEE Transactions on Image Processing> IF. 11
- 提出一种新的测定图像离焦点扩散函数的方法。(非神经网络方法)
- 提出基于 CUDA 的离焦图像生成算法 ([GitHub](#) 2 star)
- 制作基于结构光系统以及自动对焦系统的硬件平台
- 提出一种新的衡量离焦图像相似度的损失函数

Shape from Focus using Gradient of Focus Measure Curve

2020.09-2021.05

- Submitted to <OPTICS AND LASERS IN ENGINEERING> (小修) IF. 5.66
- 学习结构光求解深度方法，学习 shape from focus 方法
- 制作自动对焦系统的硬件平台
- 提出一种衡量离焦图像清晰度的方法

与他人合作的工作

- 基于 phase-shifting 与神经网络的三维测量方法 (负责指导) 2021.05-至今
- 基于 PVDF/钛酸钡压电材料机器学习辅助的心音诊断系统(负责机器学习部分) 2021.05-至今
- 基于机器学习的石墨烯传感器信息加密方法 (负责机器学习部分 under review) 2021.03-2021.08

项目经历 Project Experience

研究生期间参与三项国家级军工项目(经费共 900 万)

2020.09-至今

制作魔方机器人 ([zhihu](#) 198 like, 242 favorite)

2017.10-2018.05

- 机器人结构的机械设计以及加工 (Solidworks)
- 视觉识别以及算法求解, (OpenCV, C++)
- 电机&舵机控制 (stm32, C)

制作单点平衡方块 ([zhihu](#) 77 like 154 favorite)

2019.10-2020.07

- 该方块能够通过内部搭载的三个动量轮实现单点平衡以及单边平衡。原型为 ETH 的 cubli。
- 机电一体化设计 (Solidworks、Adams)
- 控制算法，动力学仿真 (LQR, PID, Simulink & Adams)
- 电机控制 (stm32, C, Maxon)

制作五子棋机器人 ([zhihu](#) 19 like 19 favorite)

2020.06-2020.07

- 计算机视觉 (OpenCV & python)
- 五子棋机器人机构设计

获奖 Honors & Awards

- 2018-2019 学年国家奖学金(全校 40 人)
- 2019 年中国工程机器人大赛暨国际公开赛 一等奖
- 2019 年全国大学生数学建模竞赛 重庆赛区 一等奖
- 2018 年中国工程机器人大赛暨国际公开赛 一等奖(季军)
- 第十一届全国大学生先进成图与产品建模比赛 3D 打印 二等奖
- 2017 年全国大学生英语竞赛 二等奖
- 第十届全国大学生先进成图与产品建模大赛 尺规作图项目 二等奖
- 第十一届全国大学生机器人创意大赛 入围奖

其他经历 Project Experience

2021 年 担任重庆大学 RoboMaster 机器人战队视觉组组长。

2020 年 作为毕业生代表在毕业典礼发言

2019 年 担任机器人协会会长，

- 社团规模发展至 600 人以上，定期开展科技培训。
- 社团成员在 2019 年获得国家级奖项 20 余人次。社团获得精品社团称号(rank 4/90).

RENZHI HE

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EDUCATION

Chongqing University (GPA 3.56, TOEFL 109, GRE 322)

Master of Science in Mechanical Engineering

Chongqing, China

Sept 2020 – June 2023

Chongqing University of Posts and Telecommunications (GPA 3.5, Rank=2/120)

Bachelor of Science in Mechatronic Engineering

Chongqing, China

Sept 2016 – June 2020

- Selected coursework: C Language Programming (98/100), Applied Statistics (92/100), Engineering Graphics (96/100), Robot Technology (91/100), Robot Design Practice (91/100), Electronics (90/100), Speech Eloquence and Public Expression (95/100), College Physics B (1) (90/100)
- Awards and Honors: China National Scholarship, Sep 2019; First Prize of Contemporary Undergraduate Mathematical Contest in Modeling – Chongqing District (CUMCM), May 2019; First Prize of RoboWork *2, June 2018~2019; Second Prize of National University Students Advanced Mapping and Product Modeling Competition *2, May 2017~2018; Second Prize of National English Competition for College Students (NECCS), April 2017; University First Class Scholarship, Oct 2020


PUBLICATIONS & PATENTS

1. **He, R.**, Hualing H., & Liu, F. (2022). Multi-task Learning for Monocular Depth and Defocus Estimation. (Submitted to Transactions on Pattern Analysis and Machine Intelligence - **Impact Factor=16.3**)
2. **He, R.**, Zhuang, Y., Fu, B., & Liu, F. (2022). Precise Point Spread Function Estimation. [arXiv preprint arXiv:2203.02953](#). (Submitted to IEEE Transactions on Image Processing – **Impact Factor=10.8**)
3. Fu, B., **He, R.**, & Liu, F. (2021) Shape from Focus using Gradient of Focus Measure Curve (Submitted to OLEN)
4. Hao, S., Tao, L., **He, R.**, Sang, T., Xia, S., Wang, G., Guo, L., & Ren, T. (2022). Machine learning assisted human-computer interaction for ultrasound information encryption based on graphene. (Submitted to Chemical Engineering Journal - **Impact Factor=13.2**)

RESEARCH EXPERIENCES

Chongqing University, School of Mechanical and Vehicle Engineering

Chongqing, China

Topic: Multi-task Learning for Monocular Depth and Defocus Estimations 

Mar 2021 - June 2022

Research Assistant to Prof. Fei Liu

- **Motivation: Explored the inverse process of the Point Spread Function (PSF) to decode the defocused and depth maps from focused images**
- Designed a multi-task learning network to simultaneously estimate defocus maps as well as depth maps based on the physical properties, which is the first multitask-based method to estimate the two maps
- Created a dataset including all-in-focus images, focused images, depth maps, and defocus maps called all-in-3D. The data consists of 100k sets of data in more than 500 scenes, and is the only and largest dataset that includes depth and focused images
- Created the high-resolution RGB images and depth maps with the size of 2452 × 2056. Our depth maps require no additional alignment or interpolation with the RGB images. The published dataset achieved pixel-level annotated defocus maps where the defocus level is calculated by the Circle of Confusion (CoC) size
- Achieved a 10% and 5% accuracy improvement of processing depth maps and defocus maps compared to networks that address them separately. The proposed multitask network structure was proved to mutually facilitate depth estimation and defocus estimation

Chongqing University, School of Mechanical and Vehicle Engineering

Chongqing, China

Topic: Precise Point Spread Function (PSF) Estimation  ★ 2

June 2021 - Mar 2022

Research Assistant to Prof. Fei Liu

- **Motivation: Investigated the process of generating focused image and proposed a new method to determine PSF, from the perspective of computational photography**
- Developed a precise mathematical model of the camera's point spread function to describe the defocus process and solved the parameters which cannot be solved by the optimization algorithm, including one optical composite parameter and one mechanical parameter
- Built a hardware system consisting of a focusing system and a structured light system to acquire the all-in-focus image, the focused image with corresponding focus depth, and the depth map in the same view
- Designed experiments on both standard planes with synthetic patterns and actual objects to solve and evaluate the efficiency and effectiveness of the proposed algorithm. Implemented the model using the open-source PyTorch framework and the CUDA toolkits with an Nvidia Titan RTX 24G
- Optimized focused image generation algorithms. Utilized CUDA toolkit instead of SCIPY tool library on CPU to synthesize the focused images. Improved image processing speed from 5s to 1ms
- Designed a novel metric based on the defocus histogram to evaluate the difference between the simulated focused image and the actual focused image to obtain 40% higher accuracy than the previous blurred image generation method

Chongqing University, School of Mechanical and Vehicle Engineering

Chongqing, China

Topic: Robust Image Focus for Shape from Focus using Gradient of Focus Measure Curve

Sept 2020 - May 2021

Research Assistant to Prof. Fei Liu

- **Course Learning:** (1) Learned the structured light depth estimation method to find the depth of an object by projecting a stripe onto the object and then photographing it with a camera. (2) Studied the shape from focus method to solve for object depth by using defocus information. Built the hardware system for the method and wrote the corresponding code
- **Hardware System Building:** (1) Built focus system with Arduino, stepper motor, industrial infrared sensor, industrial camera. (2) Used Arduino to control the motor to drive the camera and trigger the camera to take pictures. (3) Utilized Arduino to connect with IR sensor through TTL to RS485 adapter to trigger sensor measurement and get measured data. (4) Deployed the camera to connect to the computer via RJ-45 to transfer the image data. (5) Implemented Arduino to connect to computer via USB to transfer sensor measurement data and obtained distance data on computer
- **Software Building:** (1) Built a development environment for Arduino using C/C++. (2) Used Python and OpenCV to process the focal length and captured images. (3) Proposed a novel algorithm to improve the Shape from Focus accuracy using gradient of focus measure curve (4) Wrote a computer software based on multi-threaded technology and PYQT

Chongqing University, School of Mechanical and Vehicle Engineering

Chongqing, China

Topic: Three-dimensional measurement method based on phase-shifting and neural networks

June 2022 - Present

Research Assistant to Prof. Fei Liu

- Built a dataset of structured light images and depths. It is being prepared for publishing on GitHub
- Implemented a transformer-based neural network in Python to solve for the structured light images and depths

Chongqing University, School of Mechanical and Vehicle Engineering

Chongqing, China

Topic: Machine learning assisted human-computer interaction for ultrasound information encryption based on graphene

Research Assistant to Prof. Luqi Tao

Apr 2020 - Nov 2021

- Built an ultrasound encrypted wireless control system for Ultrasound Remote-Control Robot (URCR).
- Initialized the collected ultrasound signals. After the fast Fourier transform, filtered ultrasound signals in the frequency domain to analyze the target frequency domain, and then further transformed it into the operation instruction of URCR
- Built C++ code on Raspberry Pi to recognize variety of instruction signals including 'forward', 'left', 'right', 'back', 'accelerate', and 'decelerate'. Drove the motor according to the signals by the PWM to control the motion of URCR

PROFESSIONAL EXPERIENCE

China Aerodynamics Research and Development Center (CARD C)

Sichuan, China

Mechanical Engineer in Aspirated Hypersonic Research Center

Sept 2020 - June 2021

- Learned about the dual-channel variable geometry intake tract adjustment system used to simulate the ignition process of a combination engine
- Recorded the displacement of the intake tract adjustment mechanism and other data in real time during the test. The intake adjustment mechanism has a small range of motion and requires a high degree of accuracy and load carrying capacity. This test requires the mechanism to be able to reach the specified position at the specified point in time
- Optimized the mechanical structure of the air inlet adjustment mechanism

Chongqing University of Posts and Telecommunications Capstone Project ([Project Link](#))

Chongqing, China

Project Leader

Oct 2019 - Aug 2020

- Completed the mechatronic design of Cubli, a cube with three reaction wheels mounted on the orthogonal plane, which becomes a 3D inverted pendulum based on the reaction wheels when placed at one of its vertices
- Placed the momentum wheel, motor, and electronic components such as motor driver, inertial sensing unit, and main control board inside a square body with a side length of 180 mm
- Simulated and analyzed the Cubli to rationalize the internal space of the system. Performed a joint simulation with MATLAB-Simulink and Adams for the block single-sided equilibrium mode and the single-point equilibrium mode
- Built the physical experimental platform and used the STM32F103 microcontroller (MCU) to apply the control algorithm

RoboWork Competition ([Project Link](#)) 🏆★6

Chongqing, China

Team Leader

Oct 2017 - May 2018

- **Hardware Setup:** (1) Used SolidWorks to design and machine the robot frame and connectors. (2) Utilized 3D printing to make the fingertips of the robot. (3) Applied for patent protection for the design of the clamping part
- **Electronics Setup:** (1) Selected 57 stepper motors to drive the robot manipulator. (2) Installed the Arduino mega 2560 to receive signals from the host computer and drive the motors.
- **Algorithm Deployment:** (1) Implemented the Kociemba algorithm to solve the Rubik's Cube in about 20 steps, which involves knowledge of group theory and data knots. (2) Used camera to load the image and perform Gaussian blur, white balance and histogram equalization on the received image. (3) Divided the processed image into nine regions and obtained the average of the six RGBHSV values for each region. (4) Put the RGBHSV information into the Support Vector Machines (SVM) and trained the SVM classifier.