Mikihiro Ikura

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PROFILE

- Introduction

Mikihiro Ikura is a Ph.D student in Graduate School of Engineering, Department of Precision Engineering, The University of Tokyo. My major is high-speed image processing, 3D sensing, and Robotics at Asama Yamashita Laboratory.

- Current research and interesting research area

My research topic is an adaptive 3D sensing with adjustable spatio-temporal resolution and measurement range. The adaptive 3D sensing system realizes not only 360◦ 3D sensing but also local 3D sensing at high spatio-temporal resolution for a focused measurement range. Moreover, the adaptive 3D sensing system detects an object and keep tracking it at high spatio-temporal resolution. The advantage of the proposed 3D sensing system is that only a single 3D sensing system realizes multiple measurement tasks.

Another research topic is to develop a real-time landing gear control system for a safe landing of UAV. The background of the research is that NASA will send a drone to Mars as a flight experiment. The motivation of the research is to develop a safe landing system on an unknown and rough ground especially in Mars. A first approach is to measure the ground shape on landing points with high spatio-temporal resolution by the adaptive 3D sensing system. Next, lengths of four landing leg robots are automatically changed according to the measurement result of the ground. Finally, the UAV lands horizontally on unknown and rough ground, even on rocky ground and slopes.

My interesting research area is efficient environment recognition of high-speed robots such as UAV by image processing. For example, visual SLAM obtains a position of a robot and a map simultaneously. However, if the robot moves faster, the accuracy of the position and the map is worse. My motivation is to improve the efficiency of environment recognition by adaptive sensing. This improvement makes the estimation of the position and the map more accurate. Another interesting research area is guidance, navigation, and control (GNC) system of high-speed robots.

- My PR

My strength is that I had many experiences in which I developed small mobile robots, systems, and software. From these experiences, I obtained practical software development skills, C++, Python, MATLAB and so on.

One of the most impressing robots developed was a small two-wheel autonomous rover at the 3rd year bachelor. My role was to develop the control algorithm of the rover in software. After developing the rover, my team attended an aerospace mission competition, in which rovers were launched at 4000 feet high, fell down with parachutes, landed on the ground, and ran automatically to the goal.

After entering Nakasuka Funase laboratory at the 4th year bachelor, we developed nano spacecraft EQUULEUS, which will be launched to space by a new rocket of NASA, which is called SLS. Especially, I was in charge of the development of high-speed camera which captured images of Lunar Impact Flash from the back of the moon.

In the research of the undergraduate school, a new rendezvous and docking system of

multiple spacecraft using Ultra Wide Band devices was proposed and the research got an award in an international conference.

I delayed my graduation by one year and participated in a long-term internship at ispace inc., in which I contributed to the development of a lunar lander. In the internship, I analyzed the structure of the interface between payloads and the lunar lander. I discussed this task many times by English.

In Ishikawa Senoo laboratory at Master course in The University of Tokyo, I developed a high-speed motion detector for autonomous driving cars with high-speed image processing. I engaged in a research of real-time landing gear control system for safe landing of UAV and in developing software of spacecraft as part-time job. During the master course, I engaged in car driver's pose estimation by machine learning and Genetic Algorithm and Drone-to-drone detection & tracking algorithm using machine learning and optical flow as internships.

In Asama Yamashita laboratory at Ph.D course in the University of Tokyo, I developed an adaptive 3D sensing system. The system can adaptively change the spatio-temporal resolution and the measurement range according to the measured surrounding environment. Moreover, in Ishikawa group laboratory, I developed a UAV-UGV cooperative superimposed image generation system with multi-thread programming. In the system, 3D point clouds in the shielded area, which cannot be obtained by the UGV, are acquired by the UAV. Then, the relative pose between the UAV and the UGV is obtained by the high-speed camera. Finally, the point clouds from the UAV and the UGV are superimposed and presented as a video.

EDUCATION

2020 - Now	Ph.D of Engineering in Graduate School of Engineering, Department of Precision Engineering, The University of Tokyo
2018 - 2020	Master of Informatics in Graduate School of Information Science and Technology, Department of Creative Informatics, The University of Tokyo, Japan
2013 - 2018	Bachelor of Engineering in Department of Aeronautics and Astronautics, The University of Tokyo, Japan

PUBLICATION AND PRESENTATION

Journal Papers

- **Mikihiro Ikura**, Leo Miyashita, and Masatoshi Ishikawa, "Stabilization System for UAV Landing on Rough Ground by Adaptive 3D Sensing and High-speed Landing Gear Adjustment", Journal of Robotics and Mechatronics, Vol. 33, No. 1, pp.108-118, 2021.
- **Mikihiro Ikura,** Satoshi Ikari, Atushi Tomiki, Ryu Funase, Shinichi Nakasuka, "Estimation Algorithm of Relative Position and Attitude during Proximity Rendezvous and Docking Using Multiple Ultra-Wide-Band Devices", ISTS Special Issue of Transactions of JSASS, Vol. 17, No. 1, pp.43-50, 2019.

Conference Papers & Presentations

- **Mikihiro Ikura**, Leo Miyashita, Masatoshi Ishikawa: Real-time Landing Gear Control System Based on Adaptive 3D Sensing for Safe Landing of UAV, 2020 IEEE/SICE International Symposium on System Integration (SII2020), Honolulu, Hawaii, USA, 12-15 Jan 2020. Received **Best Student Paper Award**
- **Mikihiro Ikura**, Leo Miyashita, Masatoshi Ishikawa: High-speed Adjustment of UAV Landing Gear with Adaptive 3D Sensing for Landing on Rough Ground, in Proceedings of 20th The Society of Instrument and Control Engineers System Integration Division (SI2019), 2E5-02, pp.1881-1886 (2019).
- **Mikihiro Ikura**, Leo Miyashita, Masatoshi Ishikawa, "Improvement of Spatio-temporal Resolution by Adaptive 3D Sensing for Safe Landing of UAV", Robomech 2019, Hiroshima Japan, June 2019.
- **Mikihiro Ikura**, "Estimation Algorithm of Relative Position and Attitude during Proximity

Rendezvous and Docking Using Multiple Ultra-Wide-Band Devices", 31st ISTS (International Symposium on Space Technology and Science), Matsuyama Japan, June 2017, ISTS 2017-s-08-d.
Selected as a Finalist of Student Session.
Received **Society for Promotion of Space Science (SPSS) President Award**.

QUALIFICATIONS

Programming

C++
- Developed an adaptive 3D sensing system with high-speed image processing with multi-thread programming.
- Developed an UAV-UGV cooperative real-time superimposed image generation system with multi-thread programming and GPU.
- Developed a software to control the attitude of spacecraft

Python
- Developed car driver's pose estimation by SVM and Genetic Algorithm
- Developed drone-to-drone detection & tracking algorithm by ML and Optical flow
- Developed image recognition system by CNN, using GPU

MATLAB
- Developed a camera calibration software.
- Developed a rendezvous simulator in my bachelor's research

Software: OpenCV, OpenGL, CUDA, Linux (Ubuntu), ROS, PyTorch, Chainer, Inventor, Adobe Illustrator, AfterEffects

Hardware: High-speed camera, Event-based camera, GPU, RealSense, MBED, rasberry pi

English: Intermediate (TOEIC: 800)