RESEARCH INSTITUTE FOR SUSTAINABLE URBAN DEVELOPMENT (RISUD)

News Article for RISUD Emerging Frontier Area (EFA) Scheme

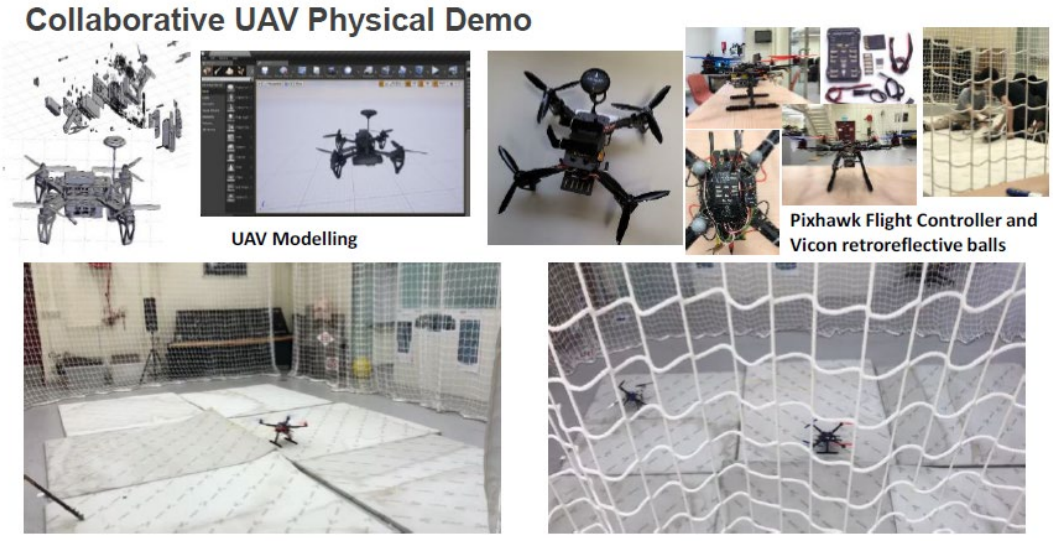
		Name	Department
1.	**Principal Investigator**:	Dr. Li-Ta Hsu	AAE
2.	**Name of EFA:**	Safety of Unmanned Airborne System	
3.	**Project Title:**	Resilient Urban PNT Infrastructure to support safety of UAV remote sensing in urban regions	

4. **Annual Progress/Achievement**

To develop safe and robust Unmanned Airborne System (UAV) to support the sustainability of smart cities, the capability to safely test the innovative UAV positioning and control algorithms is required. To achieve this goal, this year we focused on the preparation of the UAV platform in both hardware and software.

Hardware: the self-assembly quadcopter with an operation manual to be submitted to HK Civil Aviation Department. See the figure below for reference.

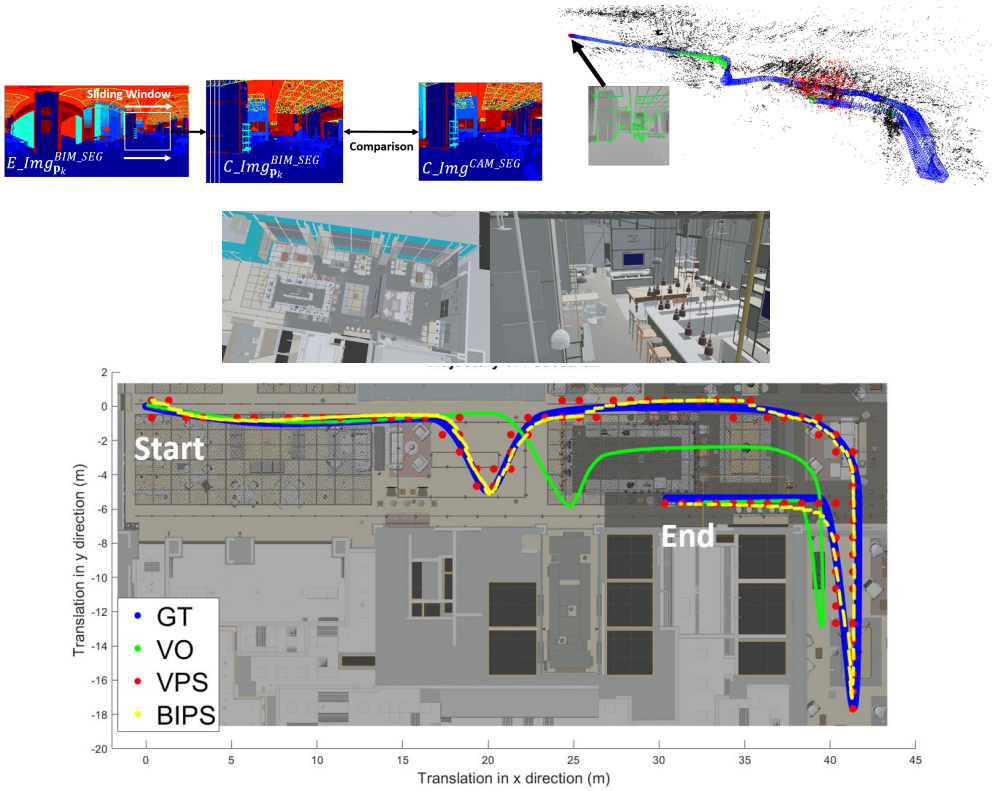
Software: The Digital Twin of the multi-agent UAV in urban canyons. Please find the YouTube Link below for the detail. https://www.youtube.com/watch?v=2ynQnzerOck and https://www.youtube.com/watch?v=1OpyZEihxJ8



Enhancing UAV Remote Sensing Safety in Urban Regions: Development of a Building Information Positioning System (BIPS)

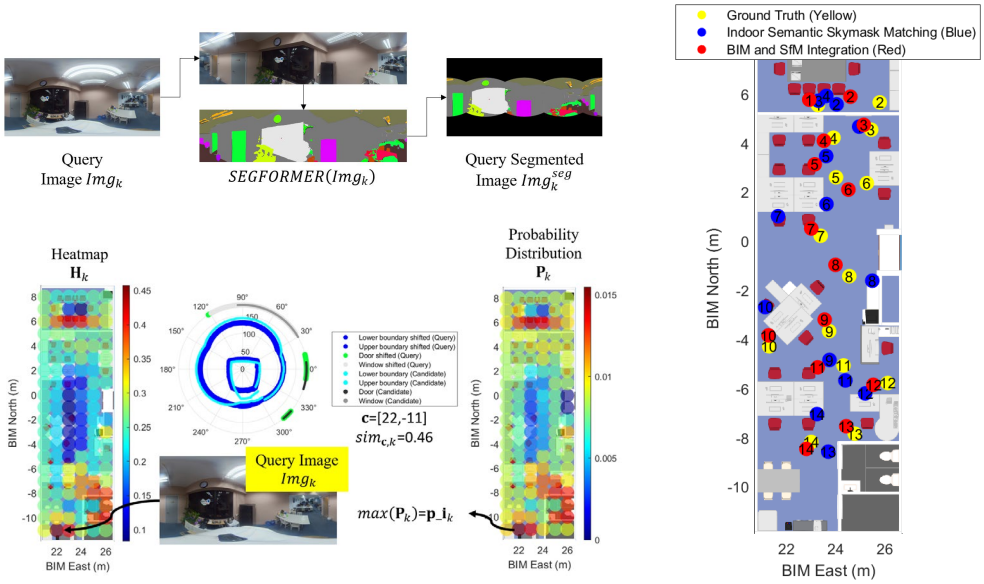
Urban PNT infrastructures have become essential in improving UAV remote sensing safety within urban regions. We have developed a Building Information Positioning System (BIPS) for UAVs,

leveraging 3D Building Information Modeling (BIM) and smart device cameras for precise navigation. This system eradicates the need for additional infrastructure, like beacons, and performs image matching in the 2D domain, significantly reducing computational load. Moreover, BIPS provides absolute positioning and orientation within urban environments, enhancing the resilience of UAV operations in these areas. This novel approach promises to greatly improve UAV remote sensing safety and efficiency in urban regions.



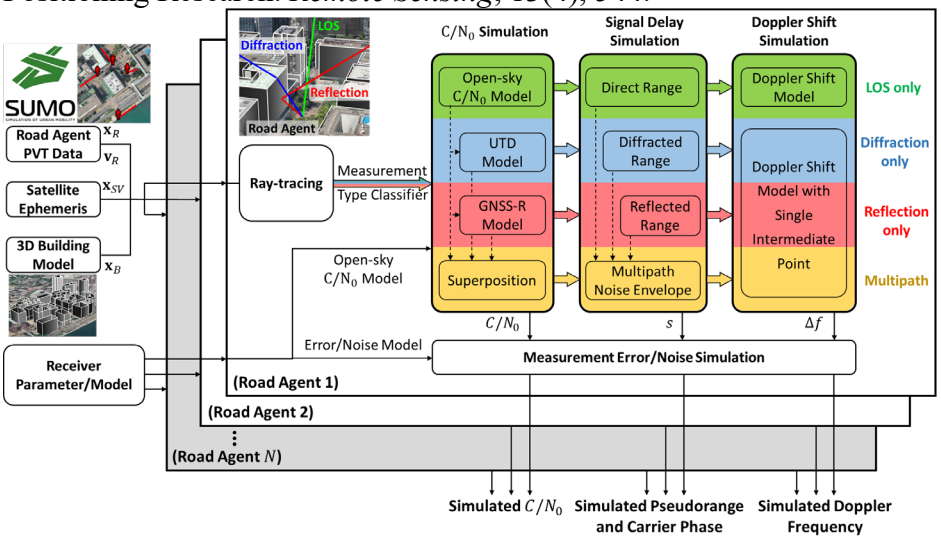
Developing a Resilient Urban PNT Infrastructure: BIM and SfM Integration for Precise UAV Positioning in Urban Environments

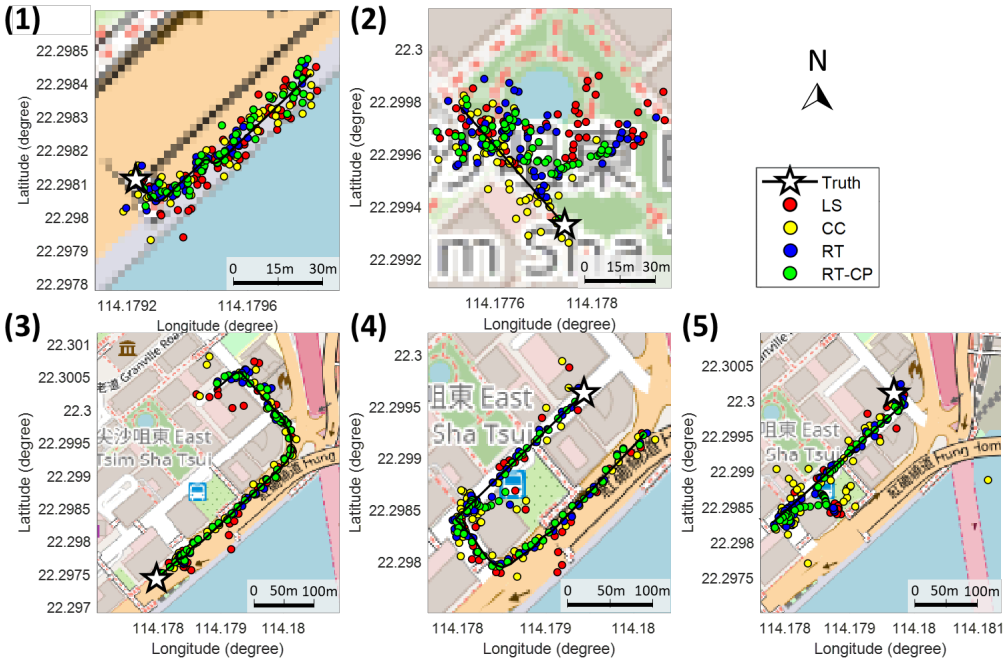
The increasing demand for automated construction and sophisticated urban management has motivated our team to leverage computer vision, photogrammetry, and Building Information Modeling (BIM) to enhance UAV safety in urban regions. We've developed a system that integrates BIM and Structure-from-Motion (SfM) techniques for precise UAV positioning. This system uses pre-computed indoor semantic skymasks, providing an efficient way of matching and positioning, and recovering appropriate scale information. By integrating both global and relative positioning, our system overcomes the limitations of individual techniques, offering precise and rapid UAV positioning in urban environments, thereby improving the safety and efficiency of UAV operations.



Collaborative Global Navigation Satellite Systems (GNSS)

As the essential sensor on UAV for navigation, GNSS is always experiencing large positioning errors in urban areas, threatening the safety of UAV missions. GNSS collaborative positioning is a promising technique to improve the accuracy, by extending the available measurement number or mitigating the shared measurement error with neighbouring agents. To investigate the feasibility and potentials of collaborative positioning, we developed a GNSS realistic urban multi-agent simulator (GNSS-RUMS). The measurement simulation is according to the multi-agent trajectory based on urban transportation mobility, employing the modern geometrical optics and ray-tracing to simulate the errors due to signal blockage, reflection, and diffraction. The developed simulator is evaluated by multiple experimental data, demonstrating a good consistency to the reality. The simulation data is also applied with different collaborative positioning algorithms, validating its capability of representing the positioning difficulties in urban areas for the future analysis/development of collaborative positioning algorithms. Zhang, G., Xu, B., Ng, H.-F., & Hsu, L.-T. (2021). GNSS RUMS: GNSS Realistic Urban Multiagent Simulator for Collaborative Positioning Research. *Remote Sensing*, 13(4), 544.

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