Abstract: Consumer drone developers often face the challenge of achieving safe autonomous navigation under very tight size, weight, power, and cost constraints. In this talk, I will present our recent results towards a minimalist, but complete perception and navigation solution utilizing only a low-cost monocular visual-inertial sensor suite. I will start with an introduction of VINS-Mono, a robust state estimation solution packed with multiple features for easy deployment, such as online spatial and temporal inter-sensor calibration, loop closure, and map reuse. I will then describe efficient monocular dense mapping solutions utilizing efficient map representation, parallel computing, and deep learning techniques for real-time reconstruction of the environment. The perception system is completed by a geometric-based method for estimating full 6-DoF poses of arbitrary rigid dynamic objects using only one camera. With this real-time perception capability, trajectory planning and replanning methods with optimal time allocation are proposed to close the perception-action loop. The performance of the overall system is demonstrated via autonomous navigation in unknown complex environments, as well as aggressive drone racing in a teach-and-repeat setting.

Bio: Shaojie Shen received his B.Eng. degree in Electronic Engineering from the Hong Kong University of Science and Technology (HKUST) in 2009. He received his M.S. in Robotics and Ph.D. in Electrical and Systems Engineering in 2011 and 2014, respectively, all from the University of Pennsylvania. He joined the Department of Electronic and Computer Engineering at the HKUST in September 2014 as an Assistant Professor. He is the founding director of the HKUST-DJI Joint Innovation Laboratory (HDJI Lab). His research interests are in the areas of robotics and unmanned aerial vehicles, with focus on state estimation, sensor fusion, localization and mapping, and autonomous navigation in complex environments. He was the regional program chair of SSRR 2017 and program co-chair of SSRR 2015. He is currently serving as associate editors for T-RO and AURO. He and his research team won the best student paper award in IROS 2018, best service robot paper finalist in ICRA 2017, best paper finalist in ICRA 2011, and best paper awards in SSRR 2016 and SSRR 2015.

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