Development of Smart UAV Technologies for Structural Health and Disaster Monitoring

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Dr. ZhiQiang Chen joined the Civil and Mechanical Engineering Department at the University of Missouri-Kansas City in 2010, and currently is a tenured Associate Professor of Civil Infrastructure and Computer Engineering. Dr. Chen received his Ph.D. in Structural Engineering (minor in Machine Vision) from the University of California, San Diego in 2009. He originally graduated from with a BS degree from Southeast University, Nanjing. Besides directing his research lab at UMKC (the DIGIT Lab), Dr. Chen directs the UMKC Initiative for Big Imaging and Smart Technologies, and he is an affiliated senior personnel of US NSF funded IUCRC Center of Big Learning. He co-founded with others Aware Vehicles, Inc. that focuses on vehicle automation and situational awareness technologies that solve challenging problems in precision agriculture, infrastructure health monitoring, and emergency response. His research has been funded by NSF, DOT, NASA, USDA, and industries.

Small or micro-sized UAV technologies are disrupting the practice of data collection and decision making in many industrial sectors and scientific domains. To this date, they can found their use in many civil engineering practices, including the specific arenas of structural and infrastructure health monitoring, disaster and emergency response, smart cities, and community resilience. The power of drones, is not merely its aerial sensing capability. Fundamentally, it provides a new normal of sensing and detection – the opportunistic monitoring, wherein the human users are at the center, the sensing topology is not static, and the data interpretation and computing is distributed at the 'edge'. However, to fully unleash the power of the drones as an opportunistic sensing platform, several challenges exist towards the true opportunistic sensing and autonomous situational awareness for civil infrastructure and city/community monitoring. In this overview of our research activities at UMKC, we present several key developments to this date – including (1) mobile drones-cloud video connection; (2) autonomous drones for complex surface-following flight; (3) level-of-detail structural damage sensing and identification; (4) real-time deep learning of structural damage and disaster scenes; (5) aerial-ground sensing network: communication inference and sensor activation; and (6) several ongoing projects focusing on aerial-ground vehicle automation and high-throughput imaging for bridge monitoring.

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