NeTS: Large: Collaborative Research: ASTRO: A Platform for 3-D Data-Driven Mobile Sensing via Networked Drones

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Project Details

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Abstract: The driving vision of this project is to detect Volatile Organic Compounds (VOCs) through ASTRO, a platform for autonomous 3-D data-driven mobile sensing via networked drones equipped with gas sensors. VOCs are hazardous to human health and the environment; they are released by explosions, gas leaks, and industrial accidents prevalent in low-income and under-resourced urban neighborhoods in close proximity to industrial processing plants, chemical refineries, and other sources of airborne pollutants. The project is located in an economically disadvantaged area of Houston, Texas. With Technology For All (TFA), the project team has a history of engaging the local community via broadband access, technology training, and connected health. The TFA wireless network already serves 1000's of community members in several square kilometers in Houston's East End via a mix of commercial Wi-Fi and software defined radios. The project targets realizing a high-resolution ground truth of environmental conditions in low-income urban areas which can impact emergency response procedures and environmental justice via policy and law. The project will develop a mobile app that alerts community residents of hazardous VOC concentrations near their current location. This project will impact urban areas with a demonstration of fusing next generation environmental sensing with next generation wireless access via networked drones. The project's objective is to realize an unprecedented resolution in VOC sensing by development and demonstration of ASTRO, a system for networked drone sensing missions without ground control. ASTRO will realize the unique capability to dynamically move sensors in 3-D according to real-time measurements. Consequently, networks of drones

with on-board sensors can find and track VOC plumes, solely by coordinating among themselves, and without requiring a centralized ground controller. Two inter-related thrusts will realize this vision. The first is target detection, tracking, and modeling high VOC concentration clusters, targeting health and environmental safety. The second is development of the underlying principles and methodologies for data-driven mobile missions via drone networks. The project's outcomes will include lightweight machine learning methods that provide foundations for real-time distributed autonomous sensing with environmental and health objectives. These data sets will yield development of atmospheric models of VOCs at a finer resolution than is possible today. Moreover, the outcomes will also include methods for adaptive communication among the networked drones via software defined radios that can adapt their network topology and spectrum usage to realize mission objectives.