Unmanned Aerial Vehicular Antenna Reception Tester for Spectrum Utilization

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Cellular carriers (CC), wireless internet service providers (WISP) and autonomous metering infrastructure providers (AMI) have antenna networks requiring surveys to determine the capabilities of their network. When preforming antenna surveys companies must obtain aerial lift trucks, safety training, and multiple technicians to complete the task. The entire process is time-consuming and costly giving thought to an innovative approach to surveying these antenna networks. The unmanned aerial vehicular antenna reception tester (UAV-ART) an autonomous unmanned aerial system (UAS) which performs signal surveys for antenna networks at an aerial altitude. The UAV-ART flight plans equipped to survey "canopy" and "point to point" antenna networks used by CC, WISP and AMI.

"Canopy" are antenna networks where the transmitter antenna is stationary and the reception antenna is mobile. "Point to point" are antenna networks where both transmitter and reception antennas must be stationary to communicate. A proof of concept of the UAV-ART has been tested for the "point to point" antenna network. A stationary access point broadcasting 2.4GHz and 5GHz frequencies was set a distance from the UAV-ART. The initial flight plan was established to go up in 10 feet increments, turn 360 degrees and survey 2.4GHz and 5.8GHz frequencies. The survey determines best antenna location to receive the strongest signal from the access point. The flight controller is using barometer/altimeter, gyroscope, compass and global navigation satellite system (GNSS) receiver to determine the location/orientation, altitude and azimuth to be used with signal strength data to determine ideal installation points for a reception antenna. A graphical user interface (GUI) will show a graph laying out all possible installation points.

From the proof of concept, it is determined the accuracy of the solo GNSS receiver was within 3 feet radius from the intended location, the azimuth within 3 degrees' accuracy, and altitude within 3 inches' accuracy. The signal strength test used 2.4GHz and 5.8GHz antenna which were preconfigured to assess the link between transmitter and reception antenna. A Software Defined Radio (SDR) receiver is being implemented to cover all Worldwide Interoperability for Microwave Access (WiMAX) unlicensed frequencies (2.4GHz, 5.8GHz and 900MHz) and licensed frequencies (3.65GHz, 6GHz) with one device. A real time kinematic – global navigation satellite system (RTK-GNSS) is implemented into the system to increase the accuracy of position to within 0.8 of an inch. An upgraded flight controller with triple redundancy in its barometer/altimeter, gyroscope and compass is implemented to improve accuracy of azimuth to under 1 degree, and increase altitude accuracy to under 0.5 an inch. The triple redundancy in the RTK-GNSS system and the flight sensors increase the overall robustness of the unmanned aerial system. This paper presents not only the flight aspect of the project both also development of the SDR receivers with patch antennas that cover all WiMAX frequencies.