Millimeter-wave Rotman lens-based radar system on the move for disaster rescue applications

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Radars on unmanned aerial vehicles (UAVs) such as drones are of interest since they can be deployed in close proximity to the scene under investigation, and thus offer remarkable sensing opportunities. However, placing a radar system with electrical scanning capability in both azimuth and elevation planes on a small drone is still a challenge due to size and weight constraints.

This paper proposes the use of a mm-wave compact radar system based on Rotman lens beam-forming for electronic scanning. Rotman lens is a cost effective, inherently broadband and planar analog beam former that creates a specific phase taper at its output ports to feed an array antenna (W. Rotman, R. F. Turner, "Wide-angle microwave lens for line source applications", 1963). This system will be integrated on small UAVs such as drones for scanning/searching missions in the case of natural disasters such as wildfire or earthquake. There are two main advantages of Rotman lens in the use for on-the-go rescuing missions with UAVs. First of all, it produces fast electrical scanning ability with high gain and low power loss. Furthermore, although these lenses are electrically large, operation at 5G frequencies render small sizes suitable for drones. They can further be reduced in overall size by folding the lens (Vo Dai, Toan K., O. Kilic, "Compact Rotman Lens Structure Configurations to Support Millimeter Wave Devices", 2016).

The operation of our rescuing drone-based system is based on one master drone, which works as the controlling unit and sends commands to other searching drones to perform communication and sensing missions. The master drone will operate as the relay between the mission drones and main hub, and will need 3-D scanning capabilities, while the mission drones will have simpler requirements. Due to high propagation path loss of mm-wave, a large number of antennas will be used to compensate for all the loss mechanisms. This is to make sure that the radar system can perform effectively while keeping its size and weight small enough to be integrated on standard drones.