Efficient Design of Harmonic Transponder for UAV Based Harmonic Tracker

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Entomologists today are interested in investigating low flying pest insects for determining significance and causes of long range migration, population dynamics and role played by landscape in dispersal and survival of these insects. One of the widest used techniques today for monitoring smaller, low flying insects is using harmonic radars and transponders [1] collectively called harmonic tracker. The technique requires tagging of insects with a transponder mainly consisting of an antenna and non linear device like schottky diode. Antenna of harmonic transponder is primarily used for increasing the efficiency of the schottky diode. It also plays a significant part in determining the weight and size of the transponder. As per our research dipole and monopole have been widely used [1,2]. Presently, there is a need to increase the efficiency, detectable range, minimize the weight, size of the transponder's antenna.

The paper presents a novel idea of using microstrip patch antennas in transponders. Unlike monopole and dipole antennas, microstrip antennas offer various advantages. It offers ease of fabrication and integration with RF devices and development of compact, durable and low cost transponders. The paper uses circularly polarized microstrip antennas for eliminating alignment problems and reduction of polarization loss factors. The antenna being planar solves problems of horizontal transponder trailing behind the insect [2], vertical pole like transponders hindering movements of insects like bumble bee on entering or exiting their hives[1], introducing aerodynamic drags, effecting flight of the insect [3], entangling and overloading.

The paper investigates two different approaches for developing prototype of harmonic transponder at lower frequencies of 5.25 GHz and 10.5GHz. First approach investigates the use of two antennas of different shapes one for receiving the radar signal at frequency *f* and other for transmitting the harmonic signal at *2f* for locating the transponder. Size and weight of the antennas can further be reduced by using slots, shorting pins or by increasing the operating frequencies. The second approach investigates the use of a single dual frequency circularly polarized antenna [4] resonant at *f* and *2f* to overcome the constraint of size and weight of the transponder. The investigations reveal that the use of a single dual frequency antenna reduces the weight, size and efficiency of the transponder. For efficient transponder two antennas should be used. Further, circular shaped patches even though have less surface area but are less efficient when compared to square patches.

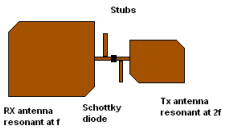
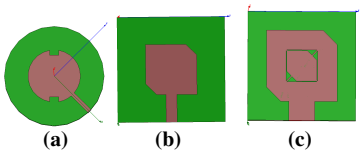
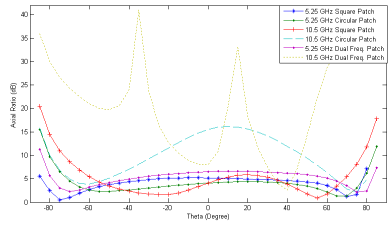


Figure 1: Proposed harmonic transponder for tracking low flying insects with harmonic radar

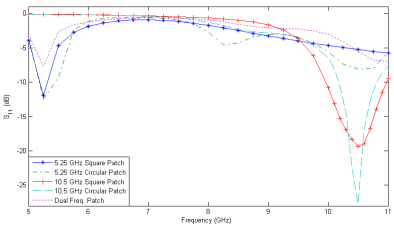


(a) (b) (c)

Figure 2: Circularly polarized (a) circular patch (b) square patch (c) dual frequency antenna



(a)



(b)

Figure 3: (a) Axial ratios of the investigated antennas (b) S_{11} of the investigated antennas

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