Design of a Directive UHF RFID Tag Antenna for a Pavement Embedded System

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Radio frequency identification (RFID) has become popular in credit cards, access cards to buildings, and has become a method of tracking and identification for delivery services. This paper presents a directive RFID antenna for use as an embedded system for road workers and smart vehicles. These systems have a variety of applications. They can be used to communicate with intelligent vehicles, as a method of GPS and to obtain road information including traffic situations and road conditions. Ideally, the RFID tag antenna should be low-profile, easily buried, directive and matched with the RFID chip impedance. A directive antenna is ideal since this antenna will be placed in the pavement during use. Using an antenna that is not directive, such as a dipole would result in wasted power, since the pavement would absorb much of it.

In this paper, a size-reduced 2-element directive antenna is presented using the multiple folding technique. Previously, a closely spaced, folded Yagi antenna was designed with matching for 50-Ω characteristic impedance (S. Lim, IEEE Antennas and Wireless Propag. Lett., 418-420, 2006). The antenna to be proposed here is matched to the conjugate of the Higgs-3 chip impedance of 20 – j135 Ω for UHF passive RFID tags. The antenna consists of a folded dipole and a director element operating at 913 MHz. The multiple folding technique results in a driver length of 0.510λ. The spacing between driver elements is 0.060λ and the spacing between the driver and reflector elements is 0.032λ. The antenna is designed to have impedance matching with the conjugate of the Higgs 3 RFID chip. The input impedance of the antenna is 18.3 + j136.5 Ω at 913 MHz. This is achieved by varying the spacing between the folds in the driver element and the position of the feed. The antenna has a -3-dB impedance bandwidth of 905 MHz – 918 MHz. The proposed antenna has a directivity of 7.2 dBi and a front-to-back ratio of 11.2 dB at 913 MHz.

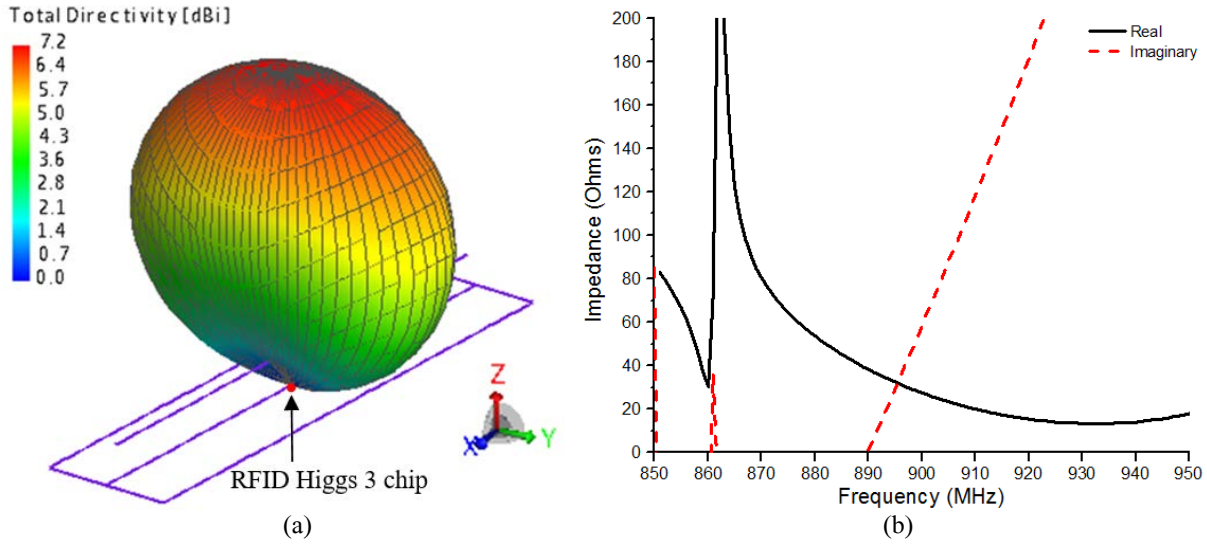

Figure 1. (a) Antenna geometry and directivity of 7.2dB. (b) Input impedance of the designed antenna.