Backscatter Tag based on Frequency Selective Surface for FMCW Radar Applications

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FMCW radar has been proposed in the literature as a reader for long distance transponders for wireless local positioning systems and sensing. One of the major challenges for positioning and for RFID systems are the disturbances due to multipath propagation. In addition, low-cost FMCW radars are often based on homodyne receivers, where the minimum measurement distance is limited by the transmitter coupling and the phase noise interference in the low-frequency band of the spectrum. To mitigate these problems, backscatter transponders have been proposed. This works presents an actively-controlled frequency selective surface (FSS) to implement a backscatter transponder at X band. The FSS is composed by dipoles loaded with PIN diodes which act as switching elements. The transponder exploits the change in the radar cross section (RCS) of the FSS to modulate the field illuminated by the FMCW radar. This change is performed varying the bias of the diodes. The basic operation theory of the system will be described. An experimental setup based on a commercial 9.25-10.75 GHz FMCW radar working as a reader is proposed to measure the transponders. The transponder response can be distinguished from the interference of non-modulated clutter, modulating the transponder's RCS. Some FSS with different number of dipoles are studied, as a proof of concept. Measurements at several distances are provided with a 10 dipoles prototype. The tag distance can be obtained from the frequency offset between the peaks around the modulating frequency. The standard deviation error is 12 cm.

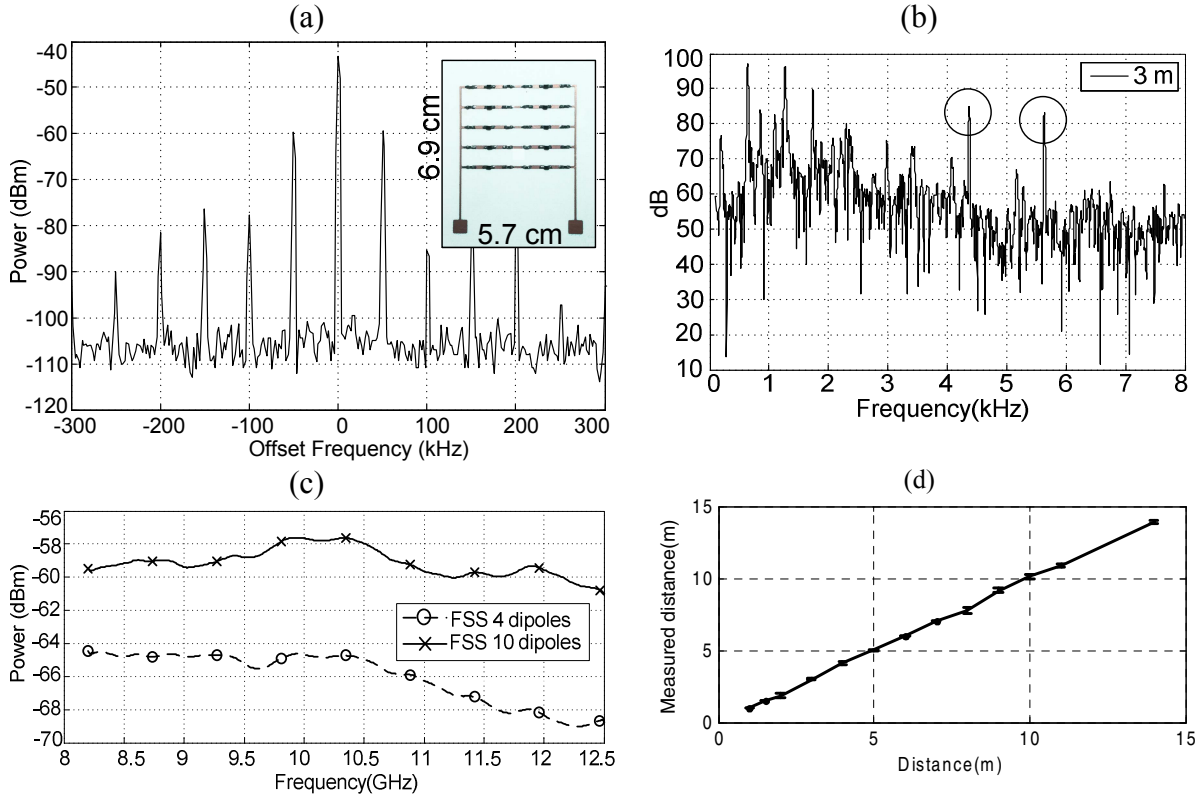

Fig.1: (a) Photograph of a FSS with 10 dipoles (arm length 6.25 mm, separation 7.5 mm). Measured spectrum at 10 GHz with the FSS modulated at 100 KHz. (b) Base band output spectrum obtained with the FMCW radar at 3 m. (c) Comparison of the modulated power as function of the frequency for a FSS with 4 and 10 dipoles. (d) Measured distance and error as function of the distance.