Auto Tuning Network for a SAR Wearable Antenna

A. Baroni* and P. Nepa
Department of Information Engineering, University of Pisa, Italy

The Cospas Sarsat Search and Rescue (SAR) system is based on a constellation of satellite that collect a distress beacon (406MHz) activated during an emergency situation. The collected emergency beacon is then forwarded to a central emergency station that will activate and coordinate a rescue team.

If the antenna of the user terminal is integrated into the life jacket, the human body presence can affect several antenna radiating parameters (such as the radiation pattern, the input impedance, the field polarization, or the antenna gain) because of wearer natural sudden movements and position changing, or because of possible antenna damaging while putting on the life jacket. Moreover, in maritime scenarios, its proximity to the sea surface could further affect the antenna performance. In previous works concerning Cospas Sarsat wearable antennas (A. A. Serra, et al., *Antennas and Propagation, IEEE Transactions on* , vol.60, no.2, pp.1035,1042, Feb. 2012 and J. Lilja, et al., *Antennas and Propagation Magazine, IEEE* , vol.55, no.2, pp.324,341, April 2013) above effects did not get much attention.

For compensating the variation of the reflection coefficient due to the human interaction and for maximizing the probability of correct transmission of the distress beacon, an automatic tuning circuit has been developed and will be presented in this paper.

The realized network is able to collect and measure the actual reflection coefficient (both amplitude and phase) by means of directional couplers and a gain-phase detector. The collected reflection coefficient is then sampled by a microcontroller that use it for changing several parameters of an impedance matching circuit (LC network composed of inductors and varicap diodes), according to a dedicated algorithm. Four different algorithms have been developed and compared through an extensive measurement campaign. Two of them perform the impedance matching having as input the absolute value of the reflection coefficient only. Another one was designed to perform the impedance matching just looking at the phase component of the reflection coefficient. The fourth algorithm is able to adapt the input impedance of the antenna using both the amplitude and phase of the measured reflection coefficient.
Different algorithms have been developed in order to increase SAR system reliability. Indeed, in a normal situation both information (module and phase of the reflection coefficient) could be used for having a correct impedance matching, but it could happen that an information could not be available because of a damage. In this case the system should be able to detect it and to select the proper algorithm. Moreover, cheap off-the-shelf detectors could provide only one quantity (either the absolute value or the phase).

A prototype of the auto-tuning circuit has been tested by using a meandered printed dipole integrated into the floating elements of a commercial life jacket. During measurements, the life jacket has been worn by a volunteer, while performing several random movements to simulate an emergency situation. Performance analysis has been carried out in terms of return loss CDF (cumulative distribution function). It has been proved that the auto tuning circuit can guarantee a return loss greater than 10dB in more than 95% of the observation interval.