Design of Water Hemispherical Antenna for Wide Band Applications

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ABSTRACT:Liquid antennas are a type of antenna utilizing fluid to transmit and receive radio signals. Two types of liquid antennas are widely investigated: liquid metal antennas and water-based liquid antennas. As a special type of liquid antennas, water antennas are one of the most popular. They have attractive features such as: a) low-cost and readily accessible; b) compact size - water is a high permittivity material.This project describes a hemispherical antenna made of pure water. The water hemispherical antenna is realized by replacing the metallic arm of a conventional hemispherical antenna with a plastic tube of circular cross section and filled with pure water. The axially symmetric TM01mode is excited along the water arm and accounts for the wave propagation and radiation. Circular polarization is achieved by choosing a proper dimension of the water helix. The hemispherical antenna exhibits polarization-reconfigurable capability over a wide frequency band.The proposed system is designed and simulated using HFSS software design tool by forming virtual radiation.The proposed work increases a gain and bandwidth by using circular polarization technique.

I. INTRODUCTION

Liquid antennas, especially the non-metal liquid antennas, have drawn more and more attentions in recent years due to the potential in reconfigurability and the virtue of flexibility, transparency, together with the low price, etc. Several kinds of non-metal liquid antennas have been proposed or demonstrated. The first type is to use sea water, saline water or distilled water to build the radiation structure. For instance, to form a monopole or a dielectric resonator antenna. The second idea is to substitute some part of the conventional antenna to make a new one. The water patch microstrip antenna is one of the examples. A wideband hybrid rectangular water antenna for DVB-H (Digital Video Broadcasting - Handheld) applications was developed. The hybrid structure combined a dielectric resonator antenna and a monopole antenna to effectively double the available bandwidth without compromising other characteristics. A transparent water dielectric patch antenna fed by an L-shaped probe was proposed. In contrast to other reported water antennas, the proposed design had the operation mechanism similar to the conventional metallic patch antenna. A mechanically reconfigurable frequency-tunable microstrip antenna that uses a liquid actuator as the dielectric layer to reduce the size is reported. The dielectric liquid is encapsulated in the polymer to form an actuator, which can change the liquid thickness. Thus, the resonant frequency of the fabricated antenna can be changed. A sea water monopole antenna consists of a feeding probe and a sea-water cylinder held by a clear acrylic tube for maritime wireless communications was presented to demonstrate the feasibility of liquid antenna. Measurement shows that the proposed sea-water antenna has high radiation performance. A Compact dual-feed water-based antenna for hand portable systems was developed, and a ground defect structure was employed to provide a decoupling path between the antenna ports.

A Sea-Water Half-Loop Antenna was designed for maritime wireless communications, which could generate a new antenna when needed with the help of a pump in the ocean environment. An antenna consisted of a cylindrical conducting monopole antenna, saline-water and a biocompatible shell was designed for Industrial, Science and Medical (ISM, 2.45 GHz) band. The miniaturization of a liquid-based DRA due to the high relative permittivity of water was demonstrated. Furthermore, a DRA-based technique was proposed for measuring liquid permittivity [8]. A hybrid antenna with solid and liquid materials was discussed [9], with the focus of the influence of the feeding locations and the distribution of the liquid.

The water antennas are designed according to different working mechanisms. By tuning the salt concentration, integrating the radiating and feeding structure or using water as a load, the water antenna can be considered as a conducting antenna, a hybrid antenna, or a water loaded antenna.

The rest of the paper contains the related works in the section 2 and the proposed methodology of water antenna illustrates in section 3. In section 4, the simulation and the design results of screenshot are presented and the performance analysis is given in section 5. Finally paper concludes in section 6.