Numerical synthesis and realization of broadband loaded monopole antennae

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***Abstract* — This paper presents the successful synthesis and practical realization of a robust design of broadband loaded wire monopole antennae with matching networks. The loads consist of parallel LRC–circuits. For synthesis we use an efficient Galerkin MoM computational technique in combination with an evolved PSO algorithm to maximize frequency bandwidth and optimize the radiation pattern in the horizontal plane.**

The numerical electromagnetic model considers all ideal conductors or L, C and R components, that differ from reality. At first the antenna was built as closely as possible according to the numerical design. Thereafter the components and configuration have been changed and optimized with preservation of the return loss.

Antennae having bandwidth ratios of 12:1 or more, with measured VSWR less than 3.5 and calculated system gain greater than -5 dBi, are discussed and presented.

Keywords-component: Loaded monopole, Broadband VHF antenna, Particle Swarm Optimization, MoM

I. INTRODUCTION

Loaded monopole antennas for broadband applications have been investigated previously [1,2]. This paper investigates the design and realization of an antenna system comprising of a loaded monopole and a matching network, optimized by using a stochastic optimization algorithm, known as Particle Swarm Optimization (PSO) [3], to obtain broad bandwidth and a desired radiation pattern. The antenna is intended to be used for ground to ground communication on a vehicle. Preservation of sufficient gain in the horizontal plane is desired. Radiation upwards will reduce that gain and has to be minimized. During the practical realization special attention has been paid to preserve the radiation in the horizontal plane.

Optimization goals

- Requirement for return loss < -5.1 dB over frequency band of 30 to 450 MHz
- VSWR < 3.5 over frequency band of 30 to 450 MHz
- Gain > -5 dBi in the horizontal plane over frequency band of 30 to 450 MHz

II. FABRICATION OF THE LOADED MONOPOLE

The antenna is constructed using the following system parts

A. Antenna pole
Copper pipe connected with plastic spacers

B. LRC Gaps

Metal oxide resistors with an inductor wrapped around the pole, capacitors and the resistors (see figure 1)

C. Antenna foot

The antenna foot is of polyurethane and is mounted on a metallic plate connected with plastic screws

D. Transformer 1:4

The transformer below the foot is a Guanella-type 1:4 transmission-line transformer (unun) constructed of two copper pipes of 8 mm diameter. One pipe of the transformer is equipped with ferrite rings to reduce the outside currents

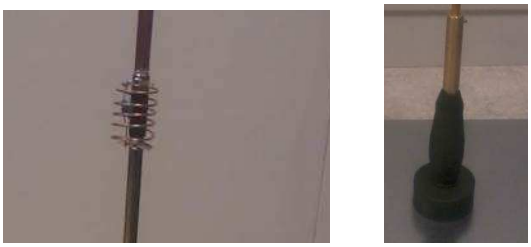

Figure 1. Example of a realized gap and foot.

III. CONCLUSIONS

Any practical realization of a numerically designed antenna does involve special attention to assure that mechanical and electro-technical constraints are incorporated in the numerical design parameters. During the presentation, these constraints and consequences in the design procedure will be elucidated. Finally, the successful design will be presented and measurement results will be shown and discussed.

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