A Novel Ultra-Wideband UHF Low-Profile Monopole for UAV Platforms

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***Abstract*— In this contribution, a novel low-profile blade monopole is presented, working in the 500-2500 MHz frequency band. The simple yet effective design is such to grant both physical strength and stable performances in terms of radiation pattern over the entire working frequency band, confirming this antenna as an excellent candidate for high precision Direction-Of-Arrival (DOA) avionic systems.**

***Keywords*— ultra-wideband, blade monopole, UHF, DOA**

I. Introduction

The growing interest in COMmunications (COM) spectrum, especially in relation with Electronic Warfare (EW) equipment aboard lightweight aircrafts, is recently focusing noticeable efforts in the design of low profile and low-weight antennas. Those antennas are required to be as wideband as possible [1-6] in order to be shared among different system, as for instance, DOA prediction systems. Moreover, the stability of the radiating element pattern, in terms of beam-width and gain performances, has always to be taken into account.

II. Antenna Design and Performances

The principle schema of the proposed antenna is depicted in Fig. 1, comprising a metallic base-plate and top, both made in aluminum, and a printed board, made of two stacked Rogers 3035 dielectric slabs with thickness 0.762 mm.

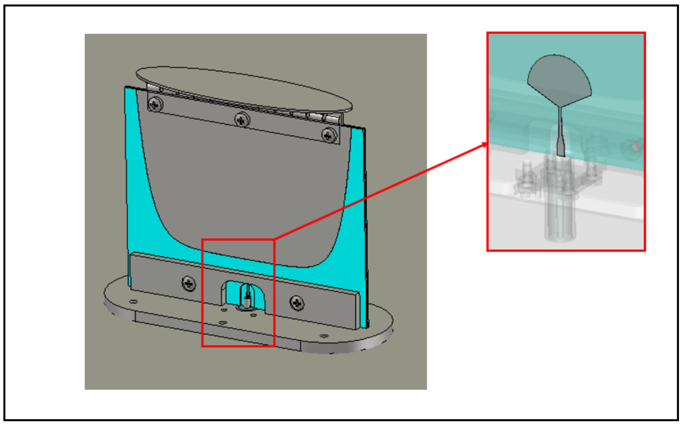


Fig. 1. Geometry of the proposed antenna and detail of the feed.

A modified, exponentially shaped radiating profile is here used, fed by a capacitively coupled balun through a coaxial-to-stripline transition. The shape of the balun, as well as the distance of the exponential profile from the ground plane, are tapered to grant pattern stability even at the upper limit of the working frequency band and a suitable return loss keeping around -10dB over the whole working frequency band (see Fig. 2).

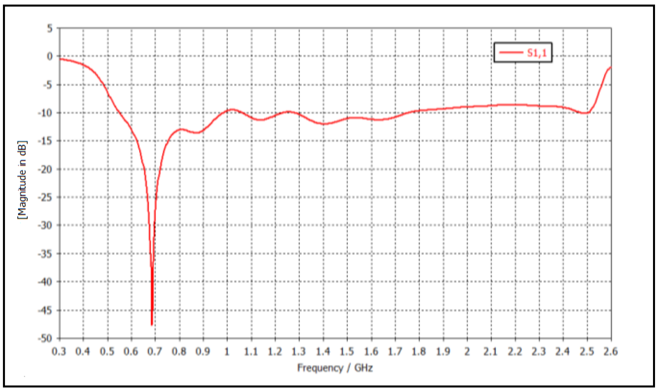


Fig. 2. Return Loss of the proposed antenna.

The performances of the proposed radiating element, in terms of nominal realized realized gain vs. frequency are shown in Fig. 3.

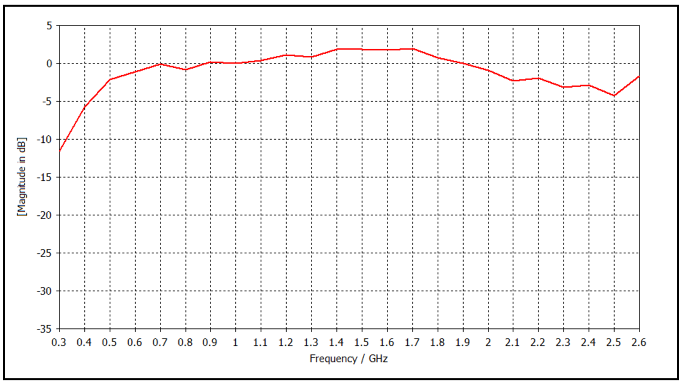
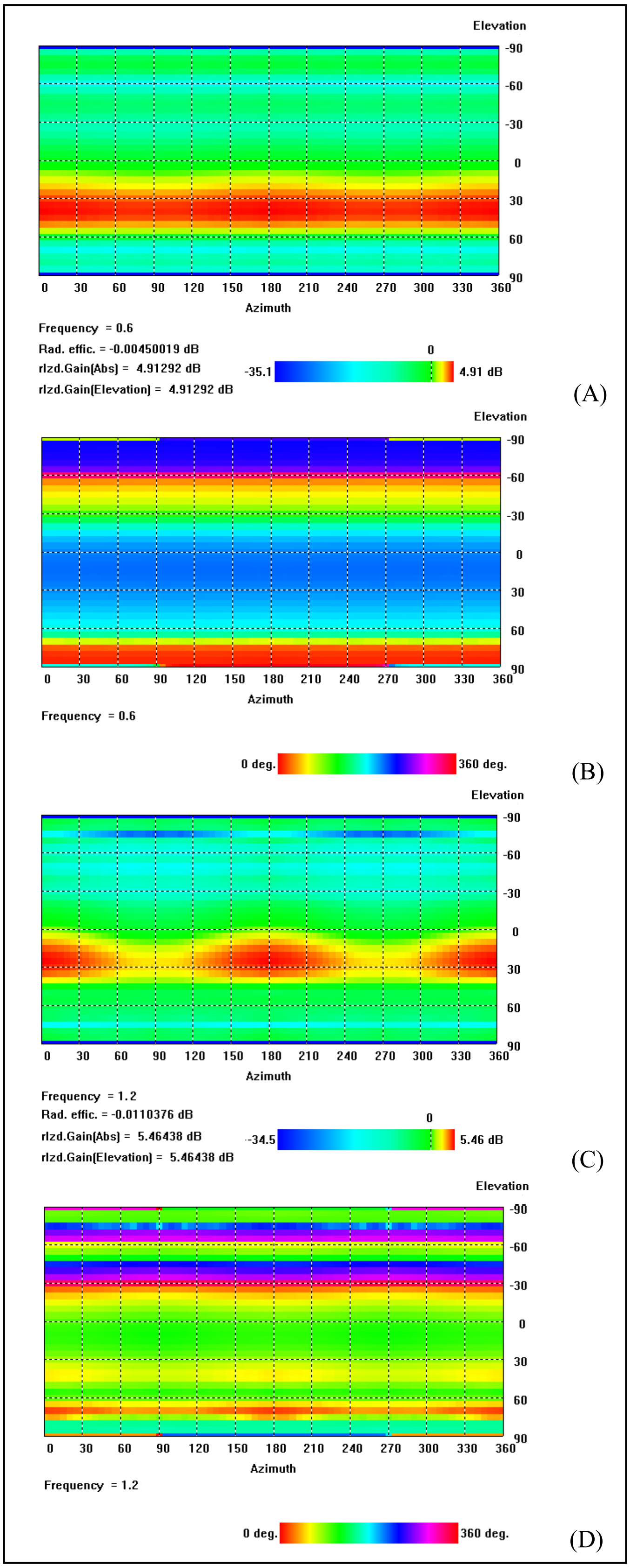


Fig. 3. Nominal realized gain of the proposed antenna at elevation 0°.



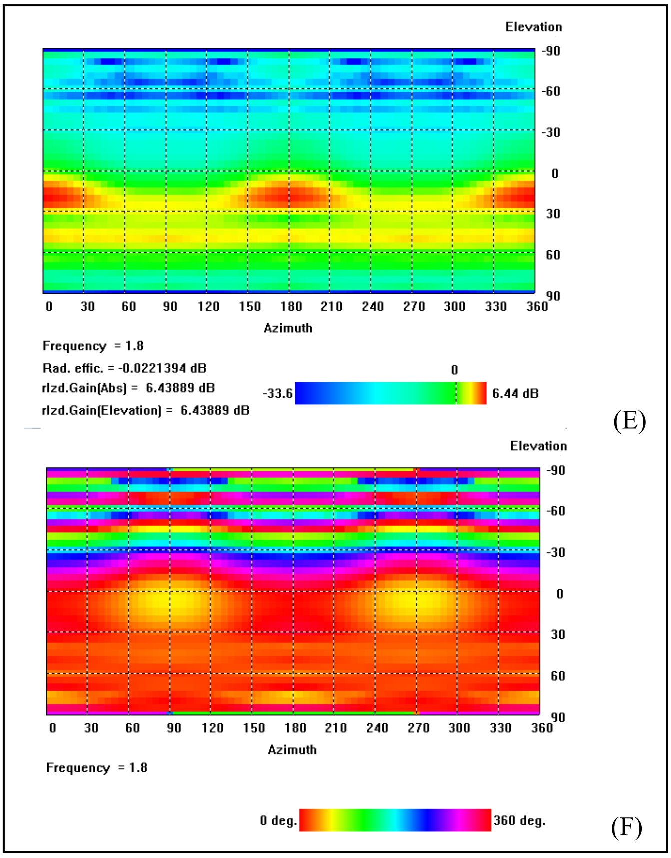


Fig. 4. Typical realized gain and phase patterns of the co-polarized radiated field component (vertical polarization), sampled at 600 MHz (A,B), 1200 MHz (C,D) and 1800 MHz (E,F).

In Fig. 4 2D plots of both phase and realized gain pattern at 0.6 GHz, 1.2 GHz and 1.8 GHz are shown, thus confirming the expected performances in terms of radiation pattern stability over the operating frequency band.

In Fig. 5, the maximum realized gain for the horizontally polarized component (cross-polarization) vs. frequency is depicted, exhibiting values below -15dB over the whole frequency band.

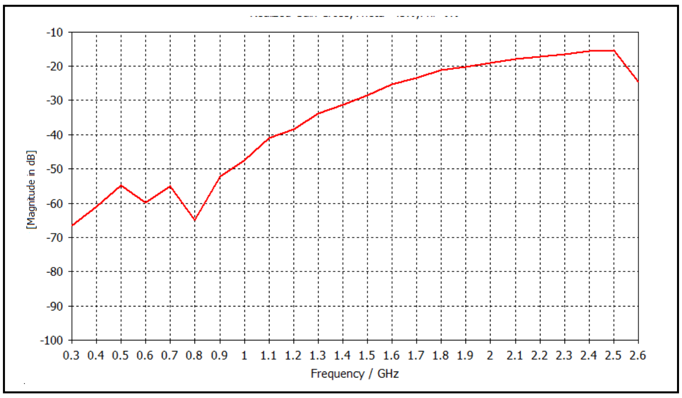


Fig. 5. Maximum level of cross polarization of the proposed antenna at elevation 0°.

The overall height and width of the proposed antenna are 97 mm (w) x 110 mm (h). Moreover, a metallic plate to lower the minimum working frequency, having elliptic shape and size 98 mm x 30 mm, loads the antenna.

The external exponential radiating profile is described by the following equation:

$$y = C_1 \cdot e^{\alpha \cdot (x - x_0)} + C_2$$

where C_1=0.002, C_2=2.4mm, α=0.16mm^{-1} , x_0=8.5mm.

The presented results are obtained through full wave simulations, performed by CST Studio Suite 2015 [7] with the antenna installed over a ground plane of radius 0.6 m.

III. CONCLUSIONS

A novel printed blade monopole for UAV application is here presented, working in the 500-2500 MHz frequency band. The excellent pattern stability versus frequency, as well as low profile, is obtained by a properly shaped capacitively-coupled balun and an exponentially shaped radiating profile. Experimental results as well as design details will be possibly presented at the conference.

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