EM Implosion Memos

Memo 8

Dec 2006

Numerical Focal Waveforms for Double-Exponential Excitation Waveforms Driving a Prolate-Spheroidal IRA

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Abstract

This paper considers the time domain characteristics of the numerical waveform of a prolate-spheroidal IRA near second focus which is driven by a double-exponential excitation.

1 Introduction

This paper focus on the numericalresults of a prolate-spheroidal IRA that is based on [1],[2],[3]. The anumerical waveforms for 2-TEM-Feed-Arm, 45^{o} 4-TEM-Feed-Arm and 60^{o} 4-TEM-Feed-Arm cases for x, y, z axis variations near the second focus are calculated.

1.1 Description of geometry

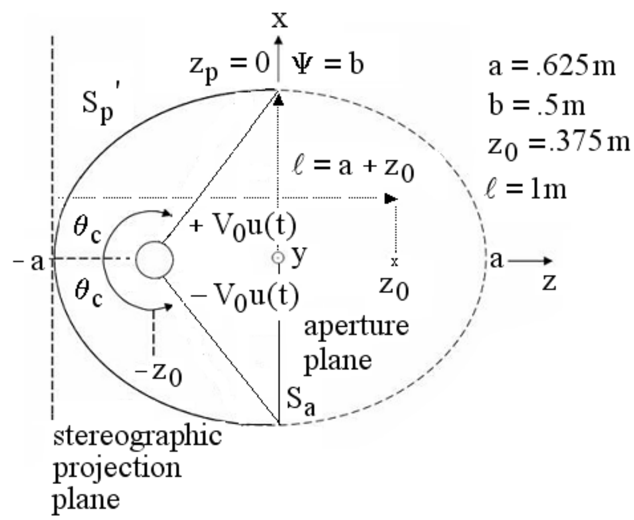

Figure 1.1 IRA Geometry [1]

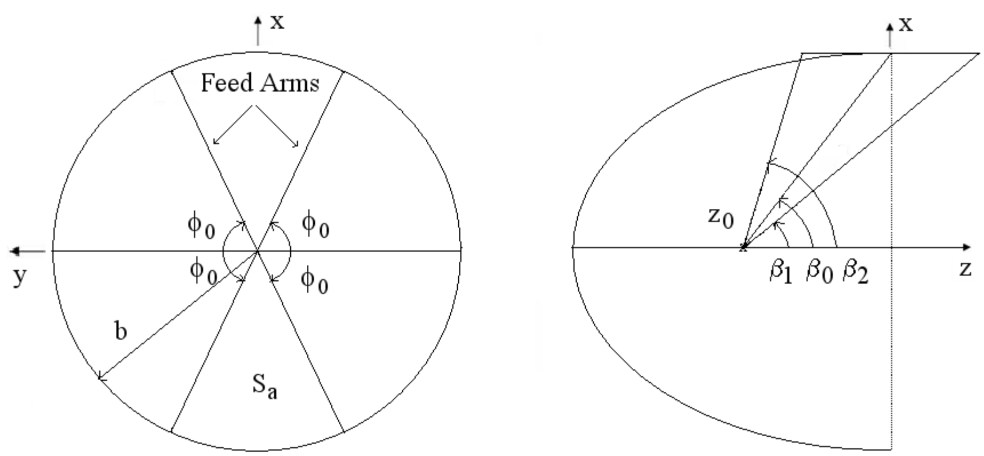

Figure 1.2 Feed Arm Geometry [1]

For our design, we choose a special case of the prolate-spheroidal IRA's geometric parameters as [3]

$$z_p = 0,\ b = \Psi_0 = .5\,\mathrm{m},\ a = .625\ \mathrm{m}\ ,\ z_0 = .375\,\mathrm{m}, \ell = 1\,\mathrm{m} \tag{1.1}$$

ϕ_o is the angle from the y-axis to the feed arm in a plane of constant z and $\beta_0, \beta_1, \beta_2$ are the angles from the z-axis to the electrical center, the first edge and the second edge of the feed arms as in Fig. 1.2

2. Analytical Focal Waveforms

We are using double-exponential excitation waveforms to drive our prolate-spheroidal IRA where $t_\delta = 100\,\text{ps}$, $t_d = 1\,\text{ns}$, t_δ is the rise and t_d is the decay time [4].

Let's consider 45^o degree 4-Arm $200\,\Omega$ and 60^o degree 4-Arm $200\,\Omega$ cases, they are just $\sqrt{2}$ and 1.606 times of this waveforms, by symmetry.

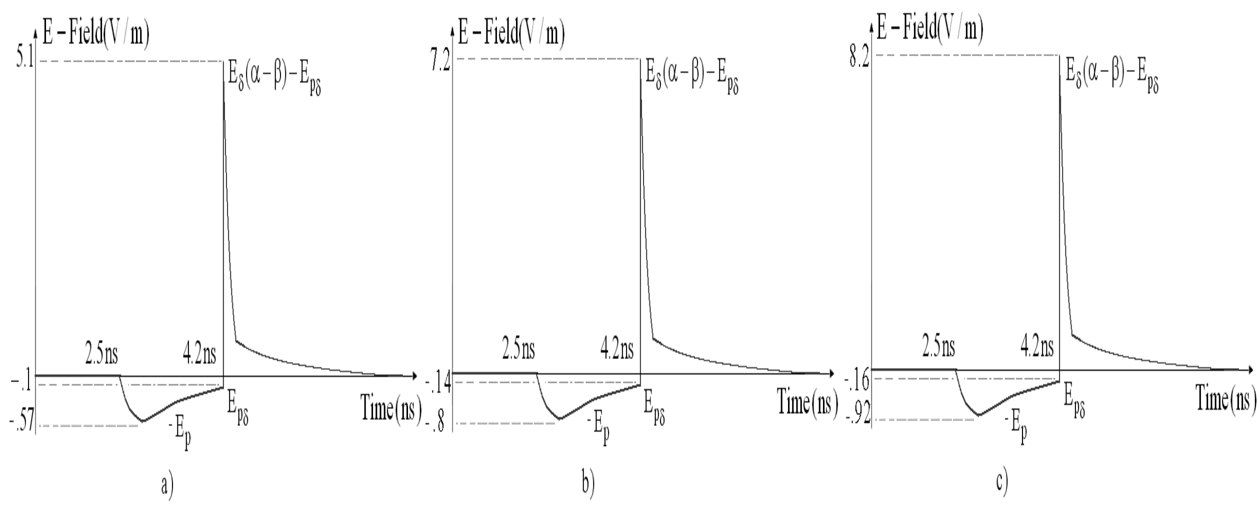

Figure 2.1 Double Exponential Excitation Analytical Responses for $t_\delta = 100$ ps , $t_d = 1\,\text{ns}$ a)2-Arm b) 45^o degree 4-Arm $200\,\Omega$ c) 60^o degree 4-Arm $200\,\Omega$ cases

Where $E_{p\delta}$ is the value of E_p at the time the impulse starts

$$E_{p\delta} = \frac{E_p}{f_{max}}\left[e^{-\beta(t_2-t_1)} - e^{-\alpha(t_2-t_1)}\right] \tag{2.1}$$

Where $t_1 = 2.5$ ns is the time that prepulse arrives the second focus, f_{max} is the max value of f.

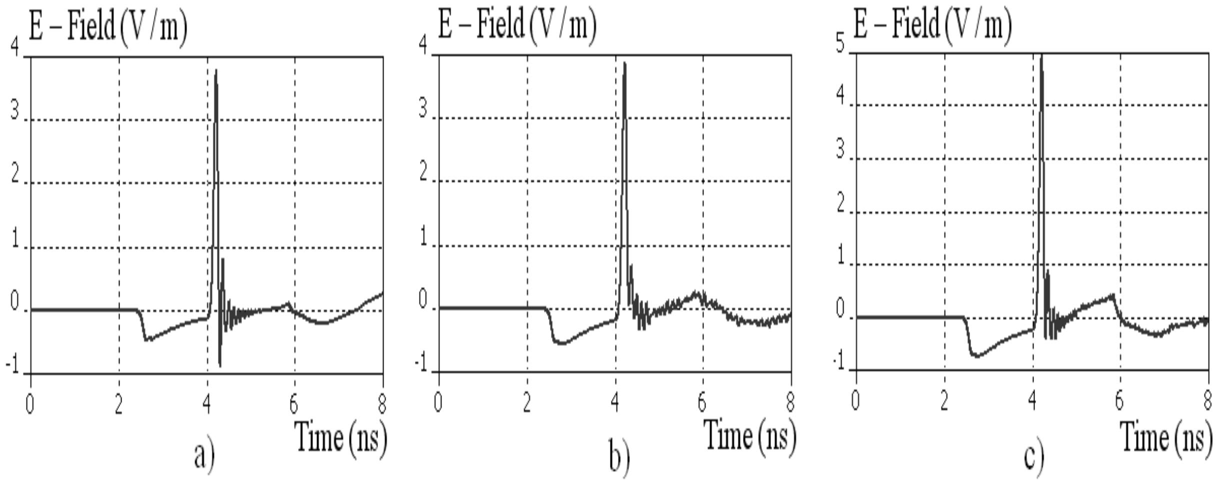

Figure 2.2 Double Exponential Excitation Numerical Responses for $t_\delta = 100$ ps , $t_d = 1$ ns and 9 LPW (lines per wavelength) a)2-Arm b) 45^o degree 4-Arm $200\,\Omega$ c) 60^o degree 4-Arm $200\,\Omega$ cases

3.Conclusion

Our numerical results for 2 – arm case is a similar analytical result for double-exponential excitation for prepulse and impulse. For 45^o degree 4-Arm $200\,\Omega$ and 60^o degree 4-Arm $200\,\Omega$ cases the prepulse is almost the same while we are having trouble for impulse amplitude and postpulse. We believe these inconsistencies are numerical errors.

References

1. S. Altunc and C. E. Baum, "Extension of the Analytic Results for the Focal Waveform of a Two-Arm Prolate-Spheroidal Impulse-Radiating Antenna (IRA)", Sensor and Simulation Note 518, Nov 2006.
2. S. Altunc and C. E. Baum, "Comparison of Analytical and Numerical Results for a Prolate-Spheroidal Impulse-Radiating Antenna (IRA)", Sensor and Simulation Note 519, Nov 2006.
3. C. E. Baum, "Focal Waveform of a Prolate-Spheroidal IRA", Sensor and Simulation
4. S. Altunc and C. E. Baum, "Focal Waveforms for Various Source Waveforms Driving a Prolate- Spheroidal IRA", EM Implosion Memos, Memo 6, Dec 2006.