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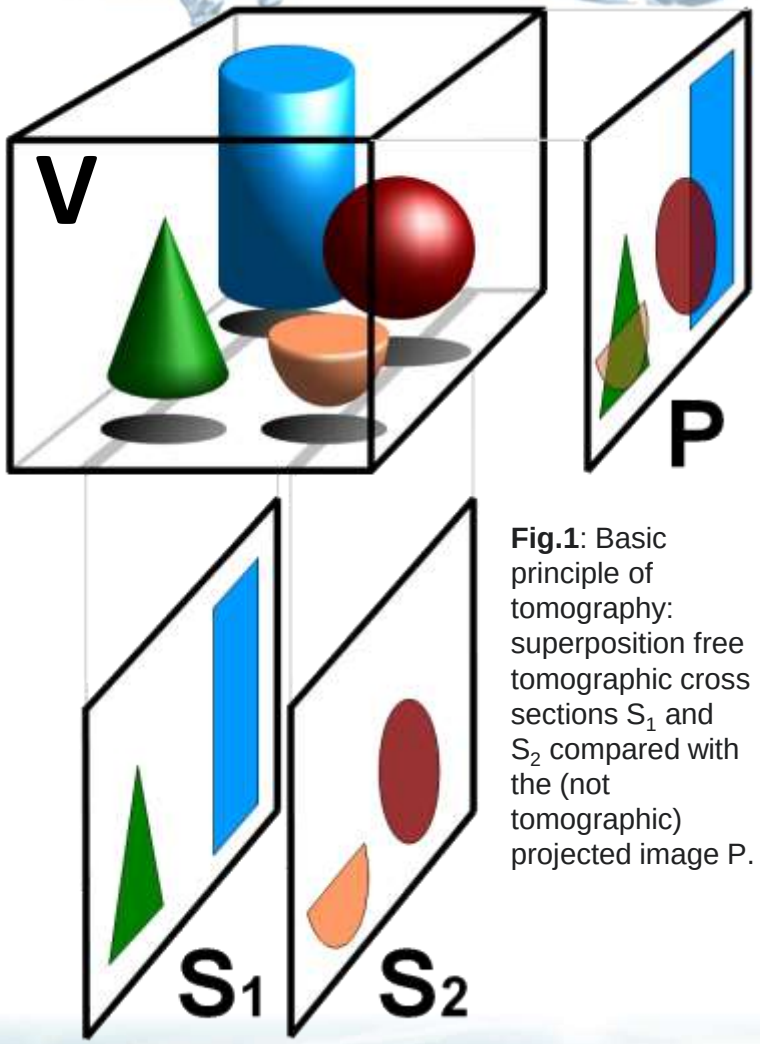

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Fig.1: Basic principle of tomography: superposition free tomographic cross sections S_1 and S_2 compared with the (not tomographic) projected image P.

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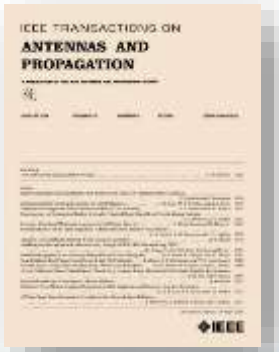

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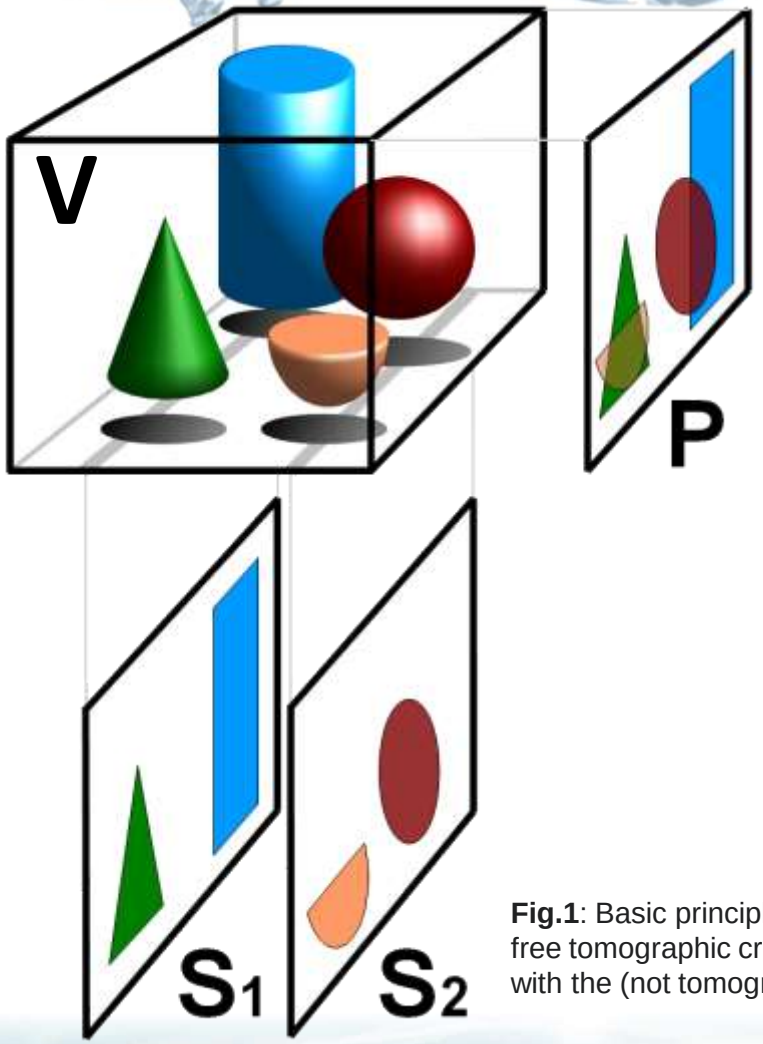

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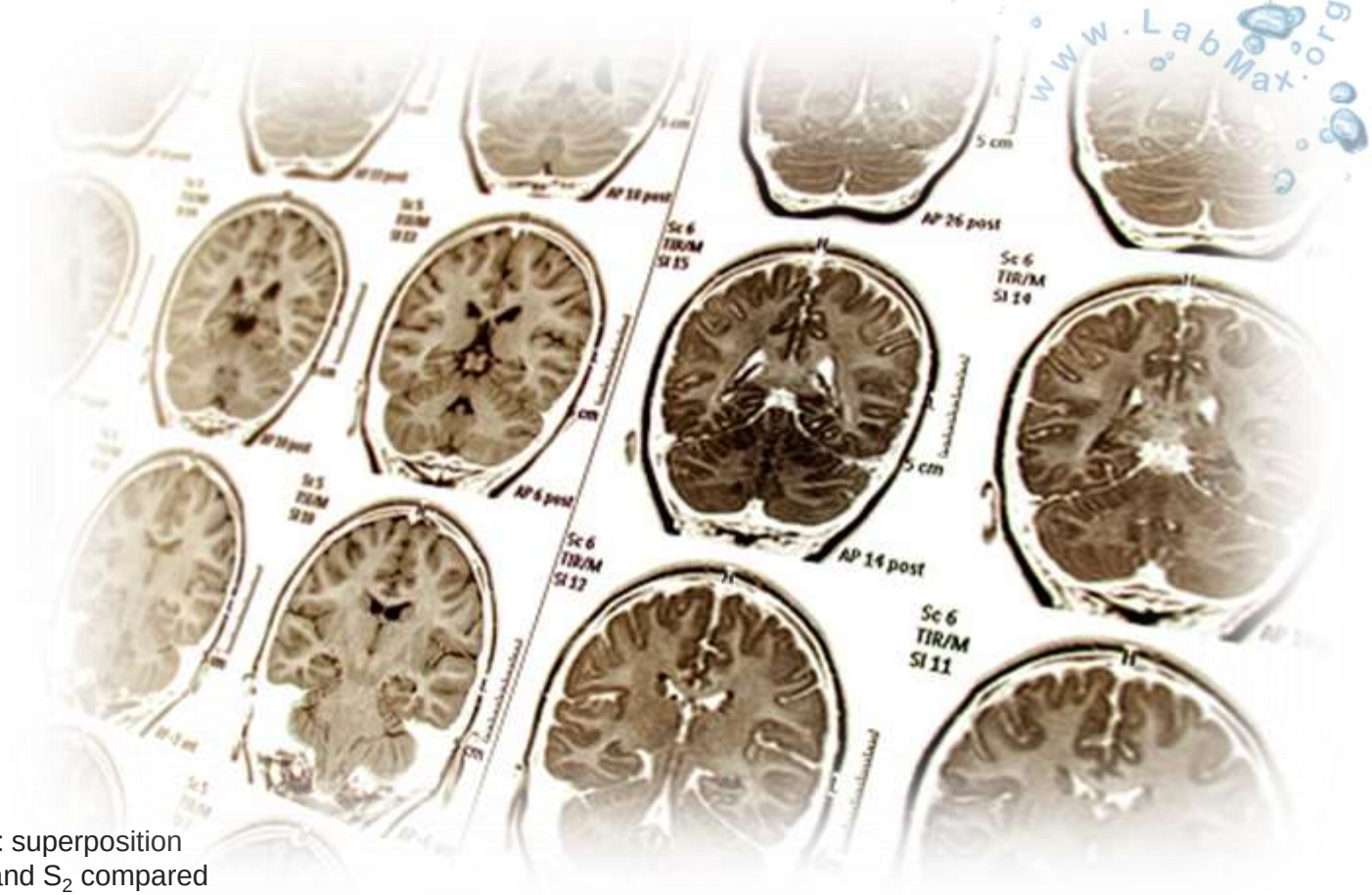

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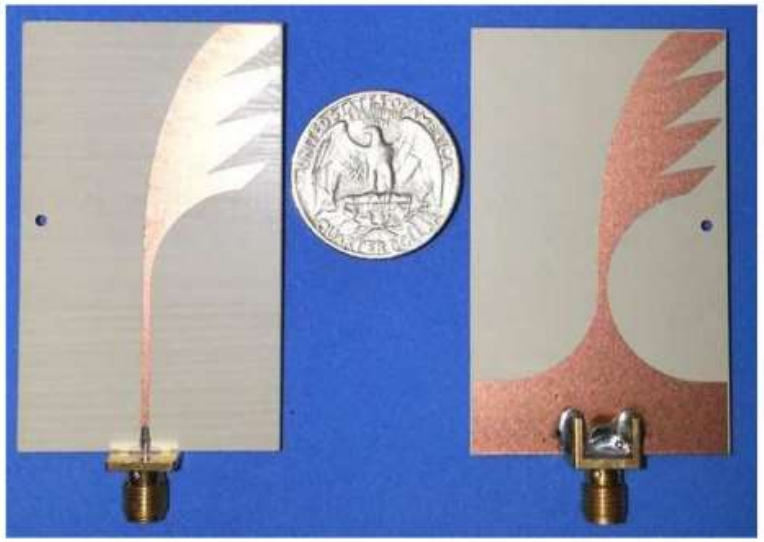

Fig. 2. Fabricated ESE-AVA photograph, top view on the left and bottom view on the right.

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A Palm Tree Antipodal Vivaldi Antenna With Exponential Slot Edge for Improved Radiation Pattern

Alexandre M. De Oliveira, *Student Member, IEEE*, Marcelo B. Perotoni, Sergio T. Kofuji, and João F. Justo

Abstract—This letter presents an Exponential Slot Edge Antipodal Vivaldi Antenna (ESE-AVA), with improved radiative features as compared to the conventional Antipodal Vivaldi Antenna (AVA) design. It extends the low-end bandwidth limitation, mitigates the side and back lobe levels, corrects squint effect, and increases its main lobe gain. In order to confirm those features, a comparative study among the ESE-AVA, the low directivity conventional AVA and two popular modifications, regular slot edge (RSE) and the tapered slot edge (TSE) AVA is performed. A comparison between AVA and the proposed ESE-AVA at 6 GHz shows an improved gain of 8.3 dB, −15.5 dB of Side Lobe Level (SLL), and 0 degrees of main lobe squint (MLS), in contrast with 5 dB of gain, −5 dB of SLL, and 5 degrees of MLS in the conventional AVA. By comparing the ESE-AVA with RSE-AVA and TSE-AVA, it was observed that its notches in exponential shape, similar to open the main radiator, besides mitigating the SLL also directs the E-fields distributions towards the main lobe. It reflects into a main lobe gain improvement.

Index Terms—Antipodal Vivaldi antenna, directivity improvement, ultra-wideband.

antenna still has its shortcomings. The original design, especially its side edges, increases the SLL coming from edge currents, which compromises antenna directivity, in addition to a squint on its radiation pattern, which compromises the directional control of the main lobe (ML). Over the last few years, several antenna designs have been proposed, in order to mitigate this problem, using directors in many forms, such as dielectrics [3], [12], [13] and metamaterials [14], which compromises its main constructive qualities, increasing the final antenna dimensions and making its design complex.

In order to reduce the SLL of an AVA, a tapered slot edge (TSE) has been recently used [12], [15], [16], which also improves directivity, without increasing the volume of the antenna, but no additional gain for the antenna was reported. The TSE design inhibited edge currents, which would promote the emergence of side lobes, acting as a resonator. Therefore, by removing edge currents, there is a relevant attenuation on the SLL of the AVA [7], [12], [15]–[17].

Here, it is presented a new design for the Vivaldi Antenna, featuring a slot edge with exponential opening similar to the opening of the main radiator, called Exponential Slot Edge (ESE). Comparing with a conventional AVA, the new antenna simultaneously reduces the SLL, corrects squint effect and

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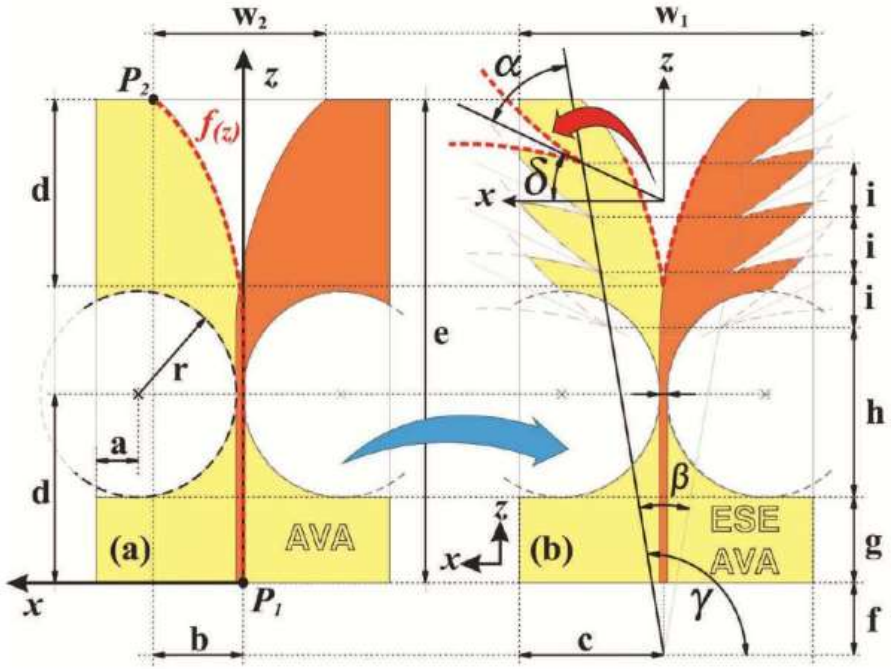

Fig. 1. Design and antenna parameters in xz-plane: (a) reference AVA. (b) proposed ESE-AVA.

$$f(z) = c_1 e^{Rz} + c_2 \tag{1}$$

$$c_1 = \frac{x_2 - x_1}{e^{Rz_2} - e^{Rz_1}} \tag{2}$$

$$c_2 = \frac{x_2 e^{Rz_2} x_1 e^{Rz_1}}{e^{Rz_2} e^{Rz_1}} \tag{3}$$

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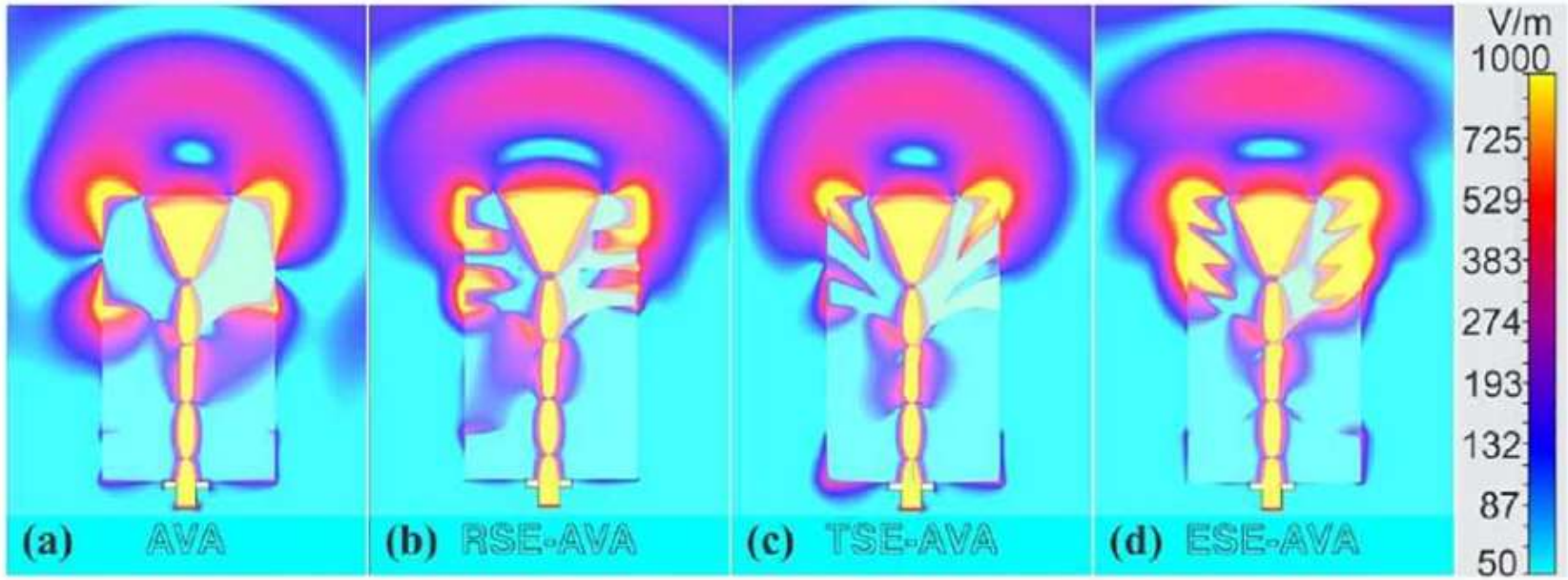

Fig. 9. E-field distribution in xz-plane at 6 GHz for (a) AVA, (b) RSE-AVA, (c) TSE-AVA, and (d) ESE-AVA at 6 GHz.

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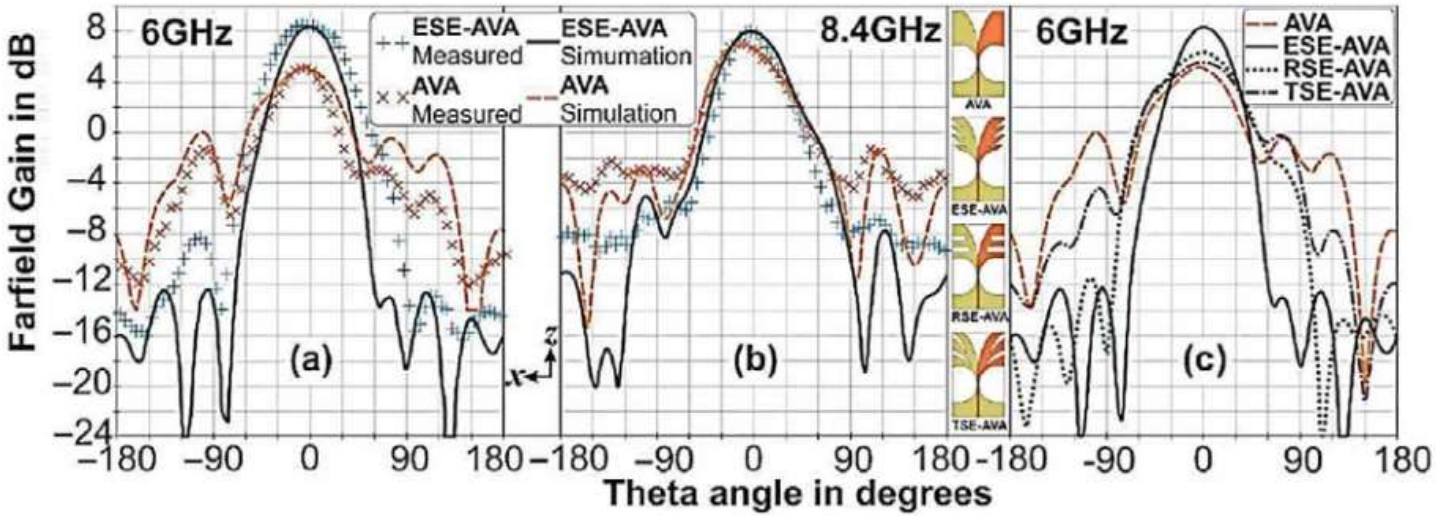

Fig. 10. Measured and simulated radiation pattern at (a) 6 and (b) 8.4 GHz of the AVA and ESE-AVA. (c) Simulated radiation pattern at 6 GHz of the AVA (dashed-line), ESE-AVA (solid-line), RSE-AVA (doted-line), and TSE-AVA (dotdashed-line).

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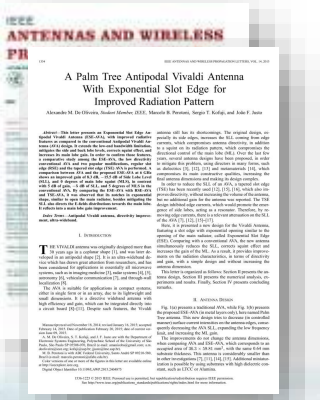

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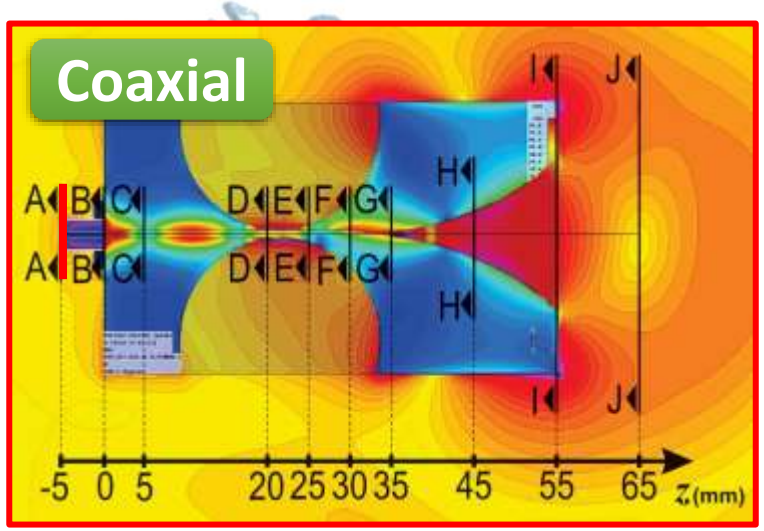

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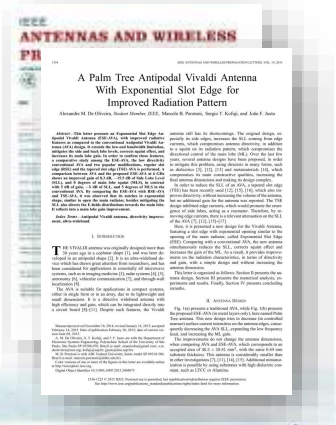

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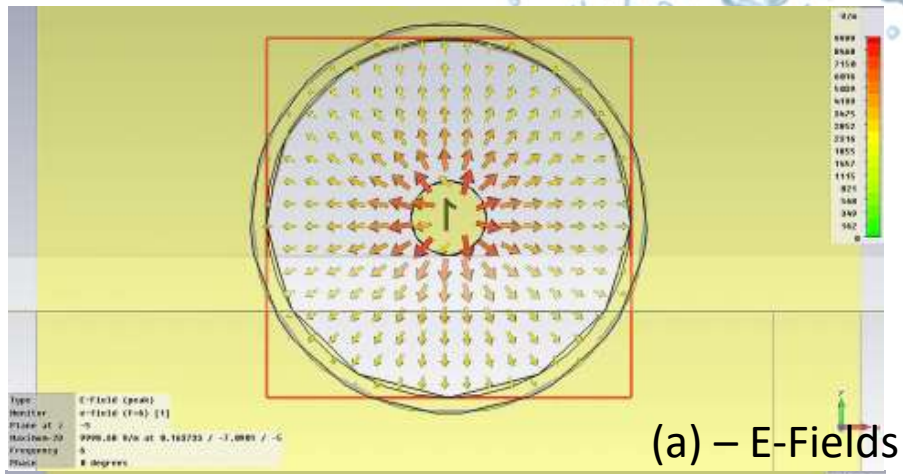
$$\begin{cases} \nabla \cdot \vec{E} = {}^{\rho}/_{\varepsilon_r} \\ \nabla \times \vec{E} = -{}^{\partial \vec{B}}/_{\partial t} \\ \nabla \cdot \vec{B} = 0 \\ \nabla \times \vec{B} = \mu_r \vec{J}_T \end{cases}$$



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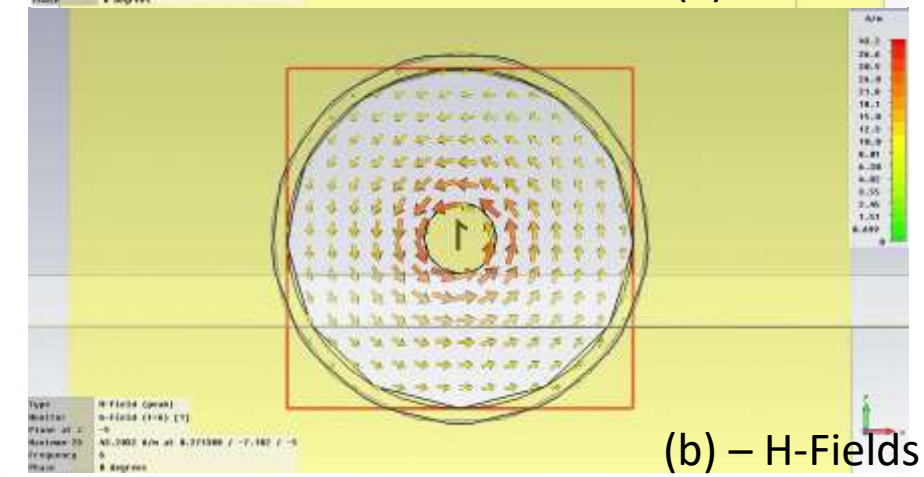

(b) – H-Fields

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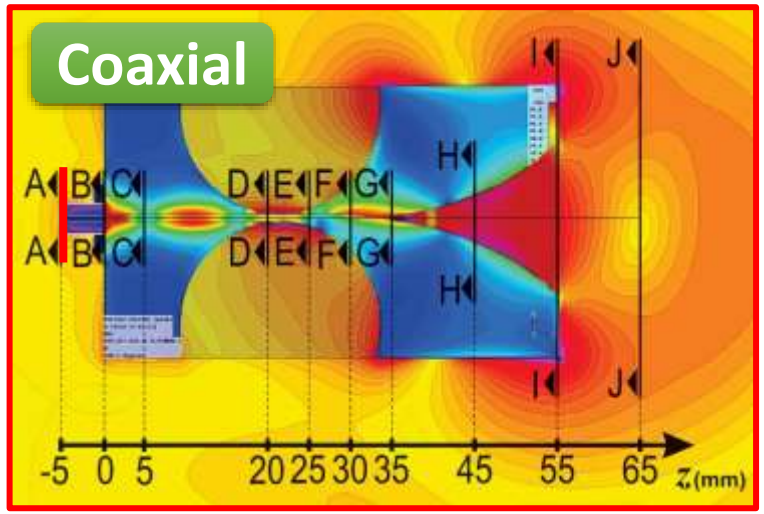

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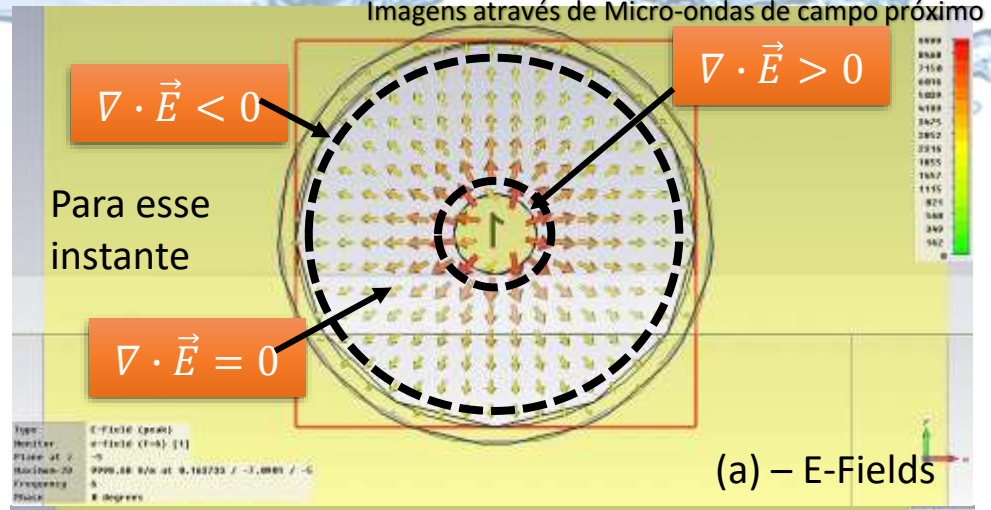

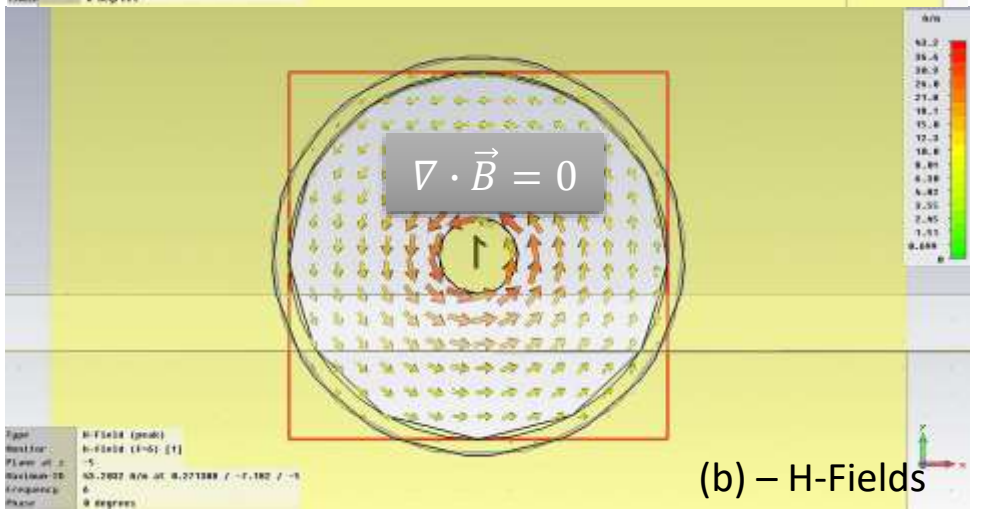

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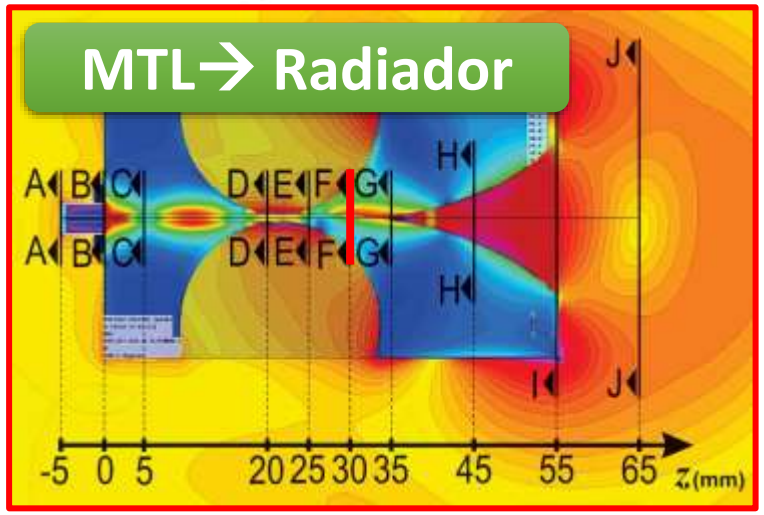

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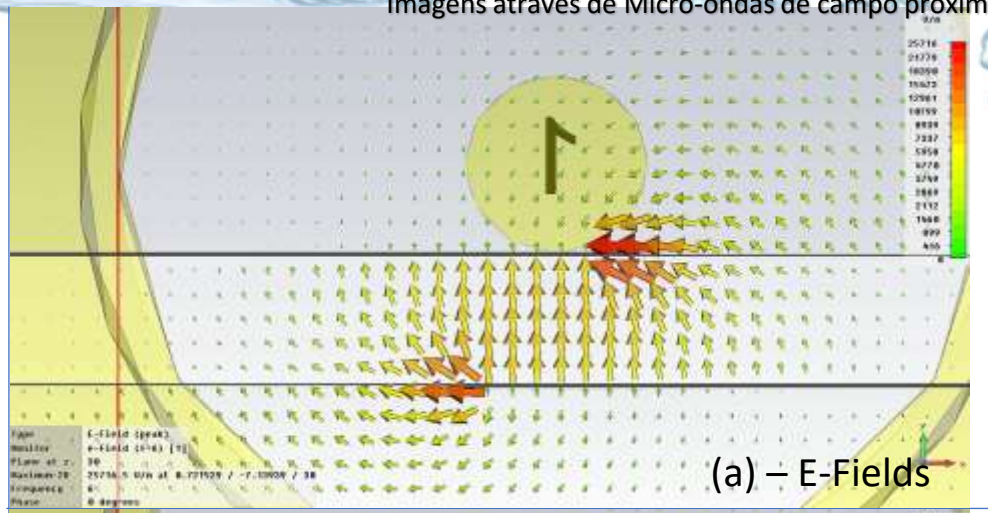

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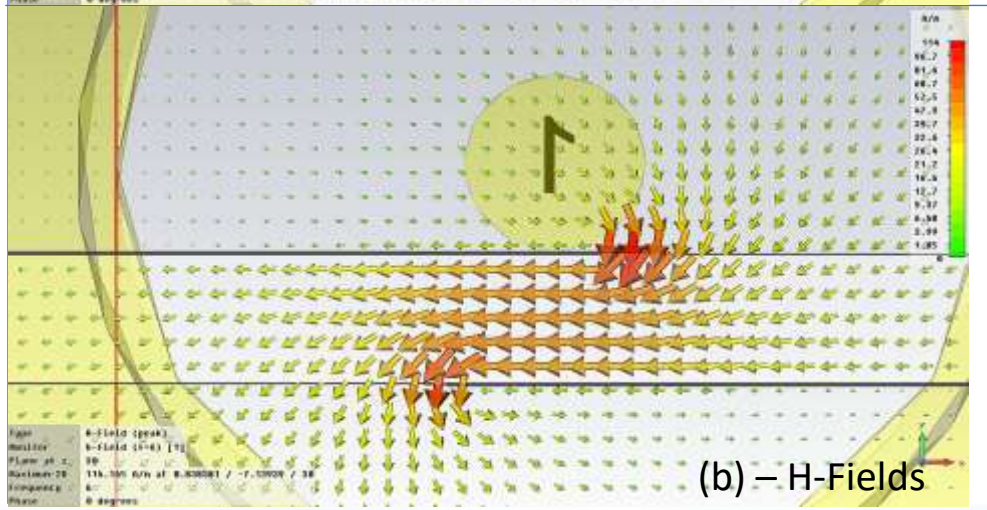

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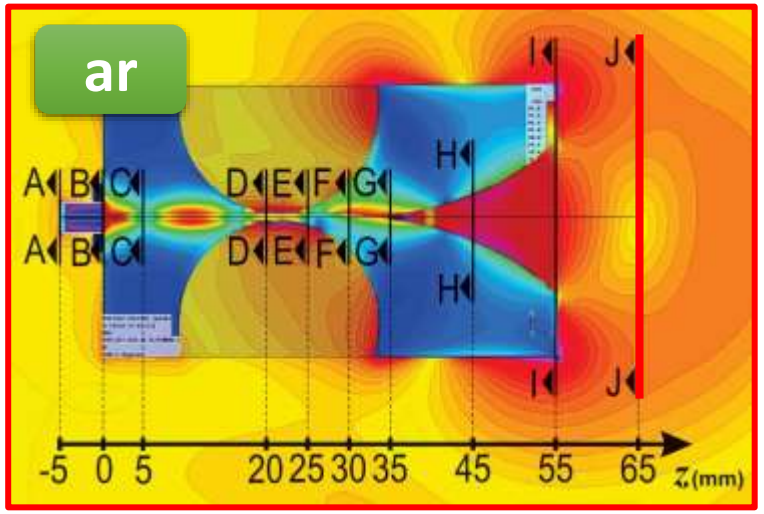

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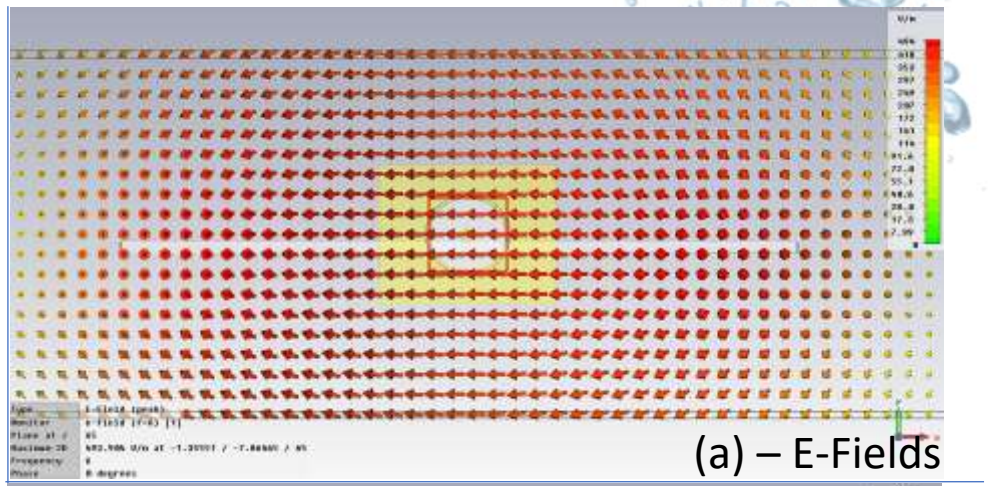

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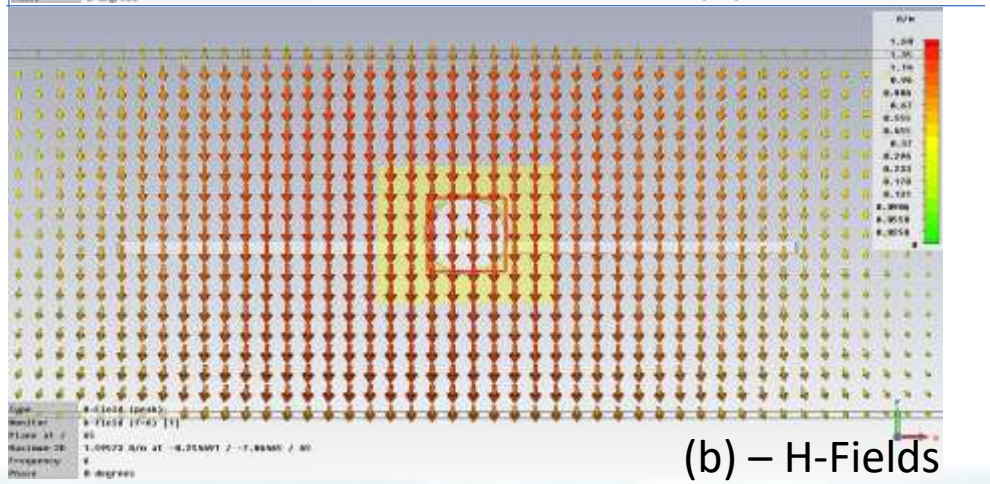

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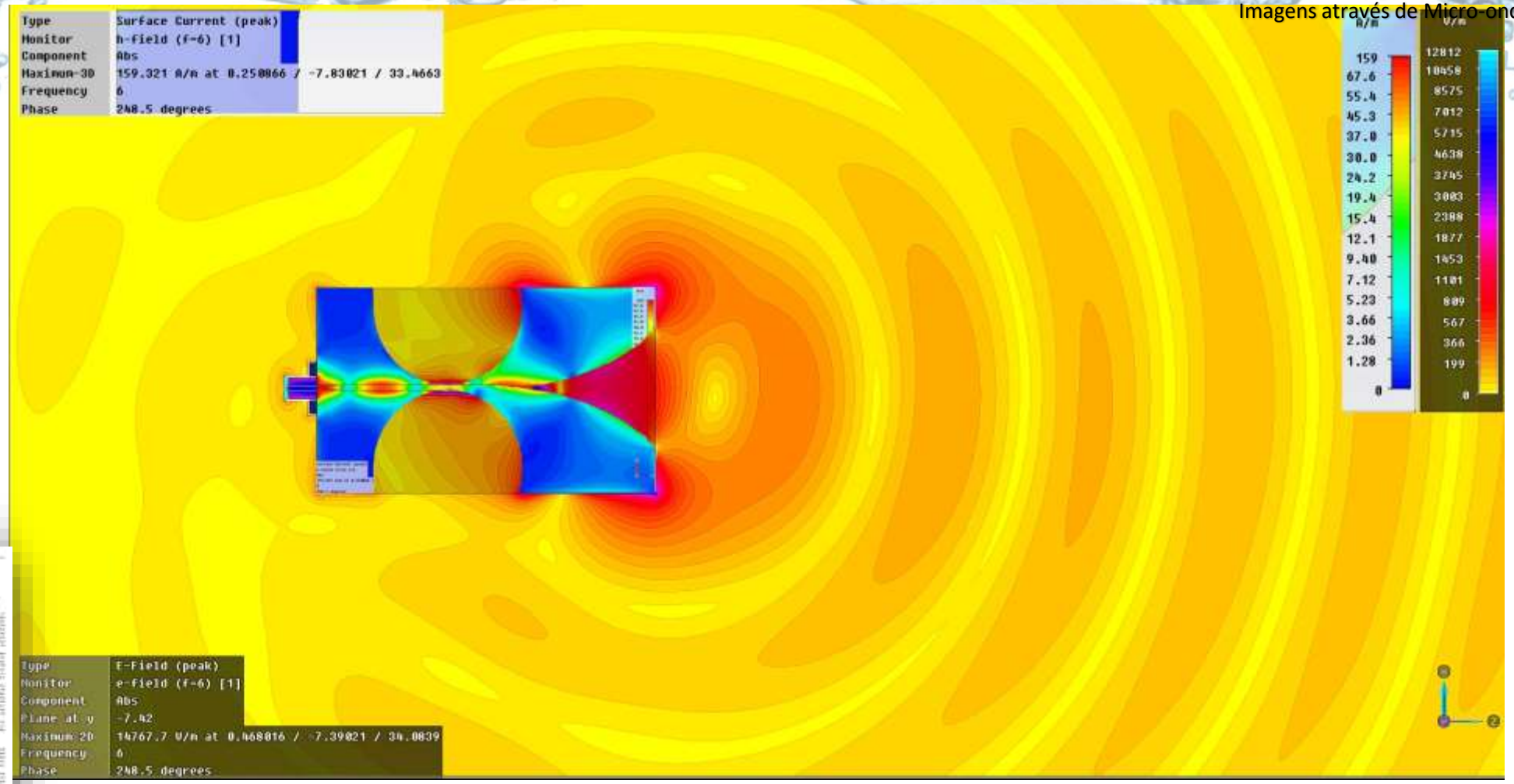

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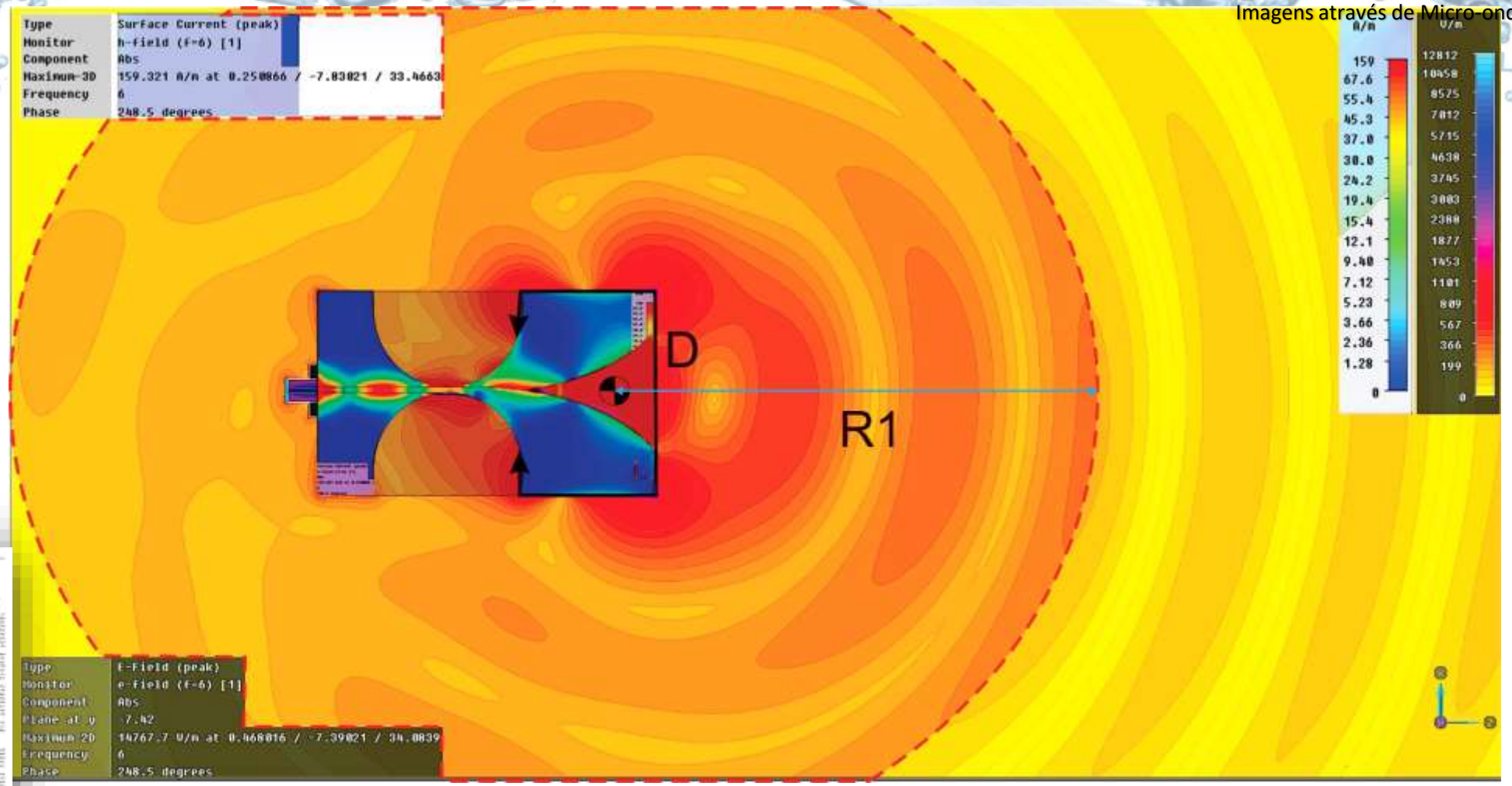

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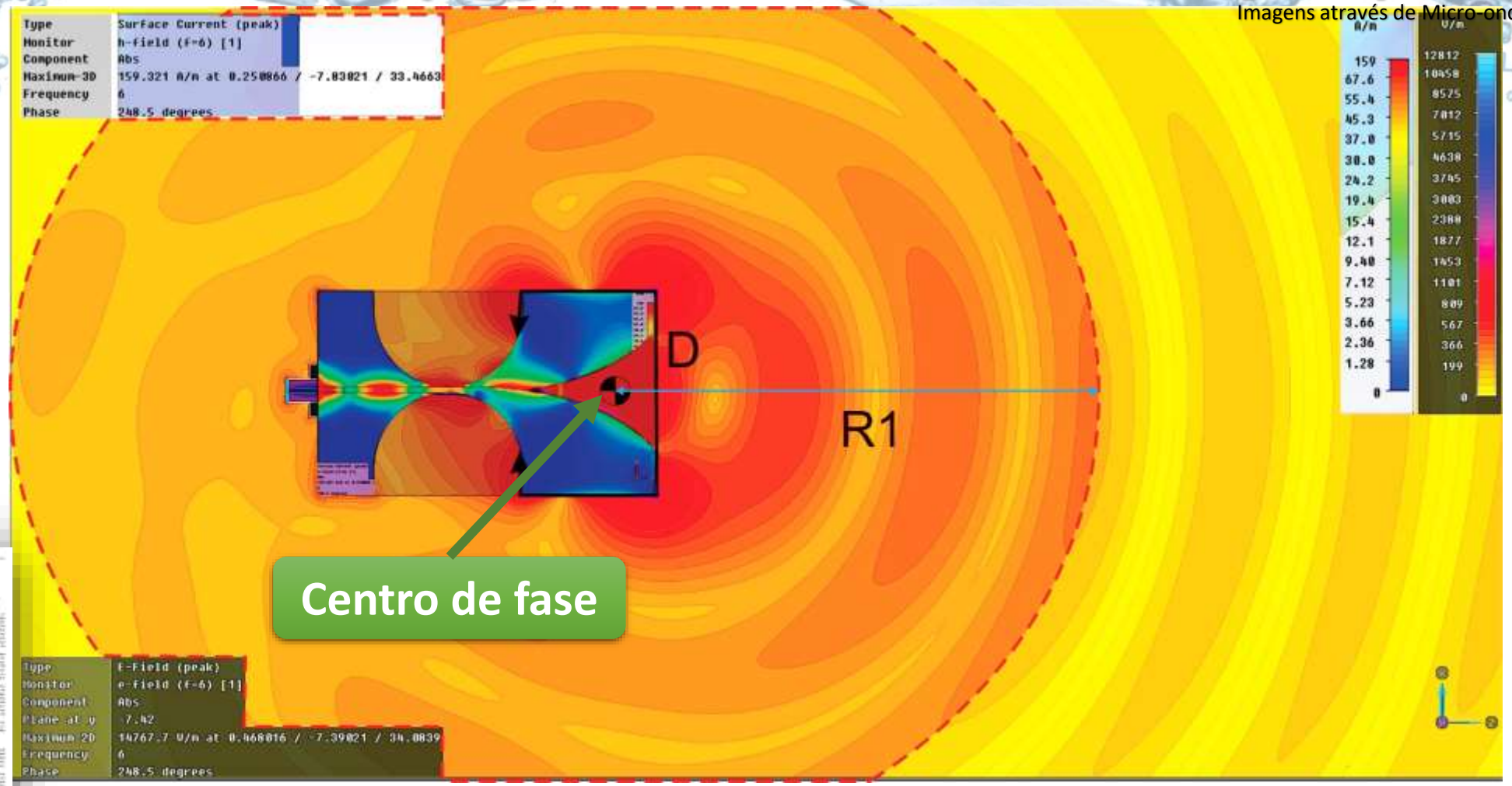

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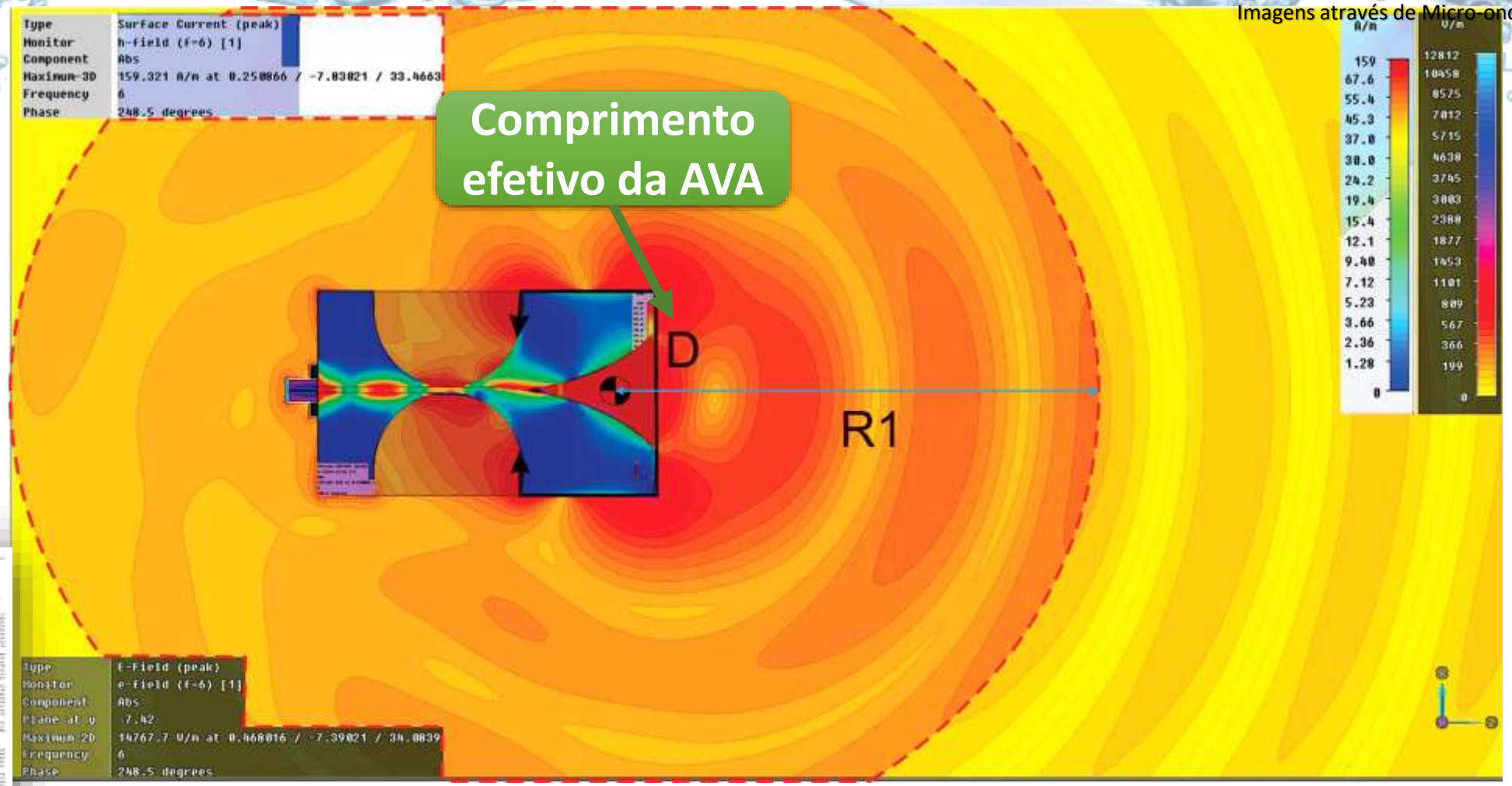

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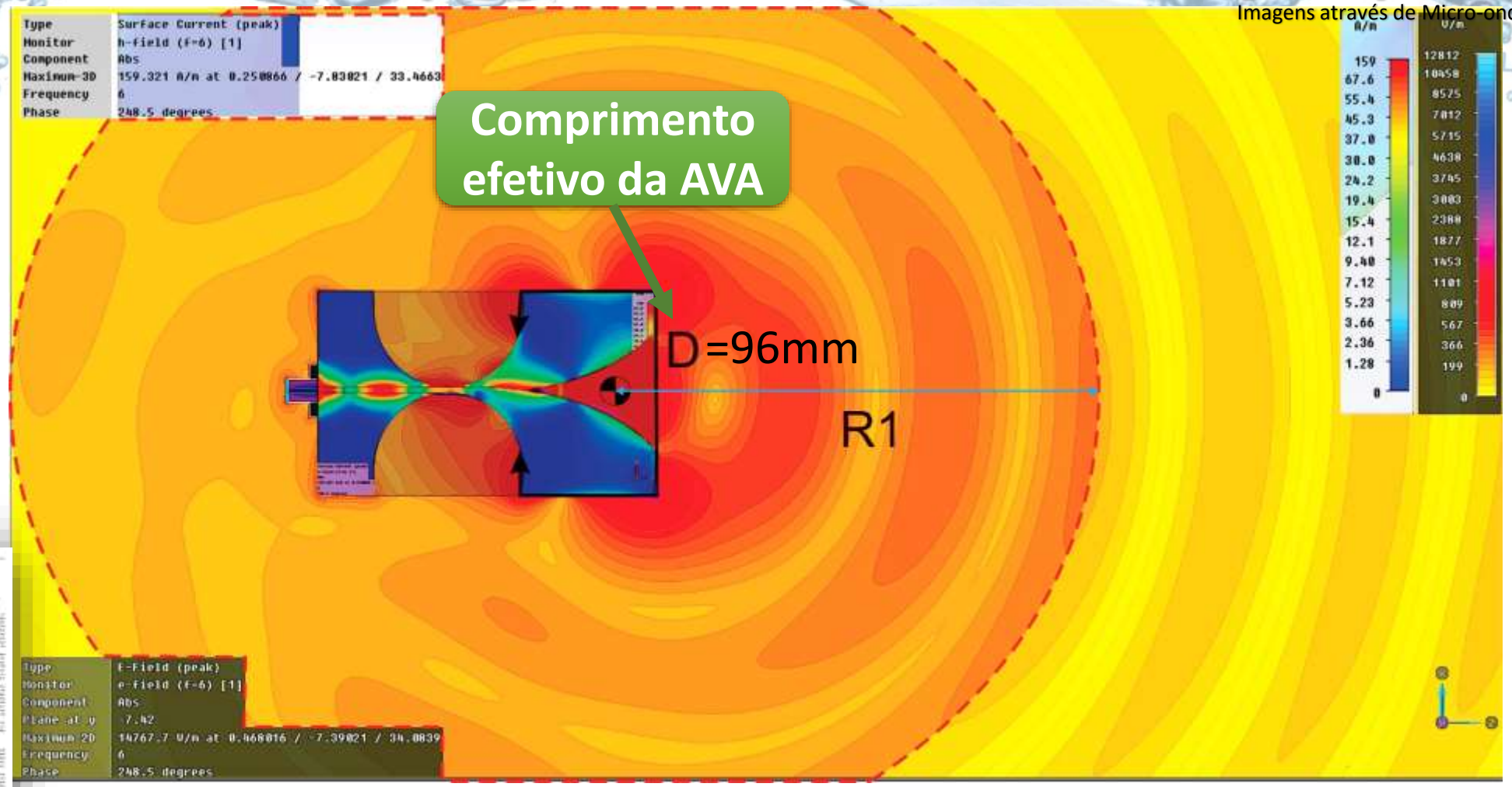

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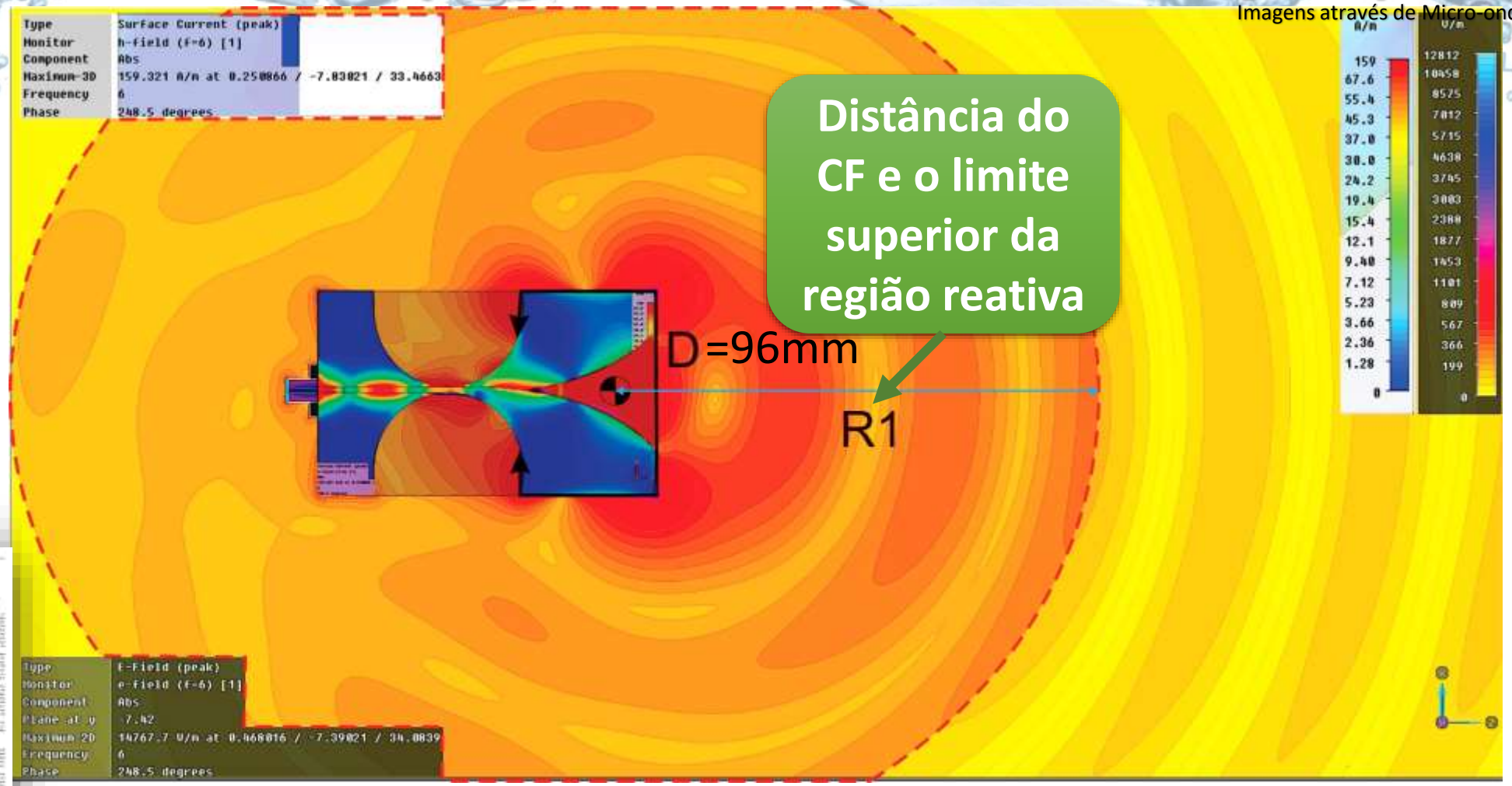

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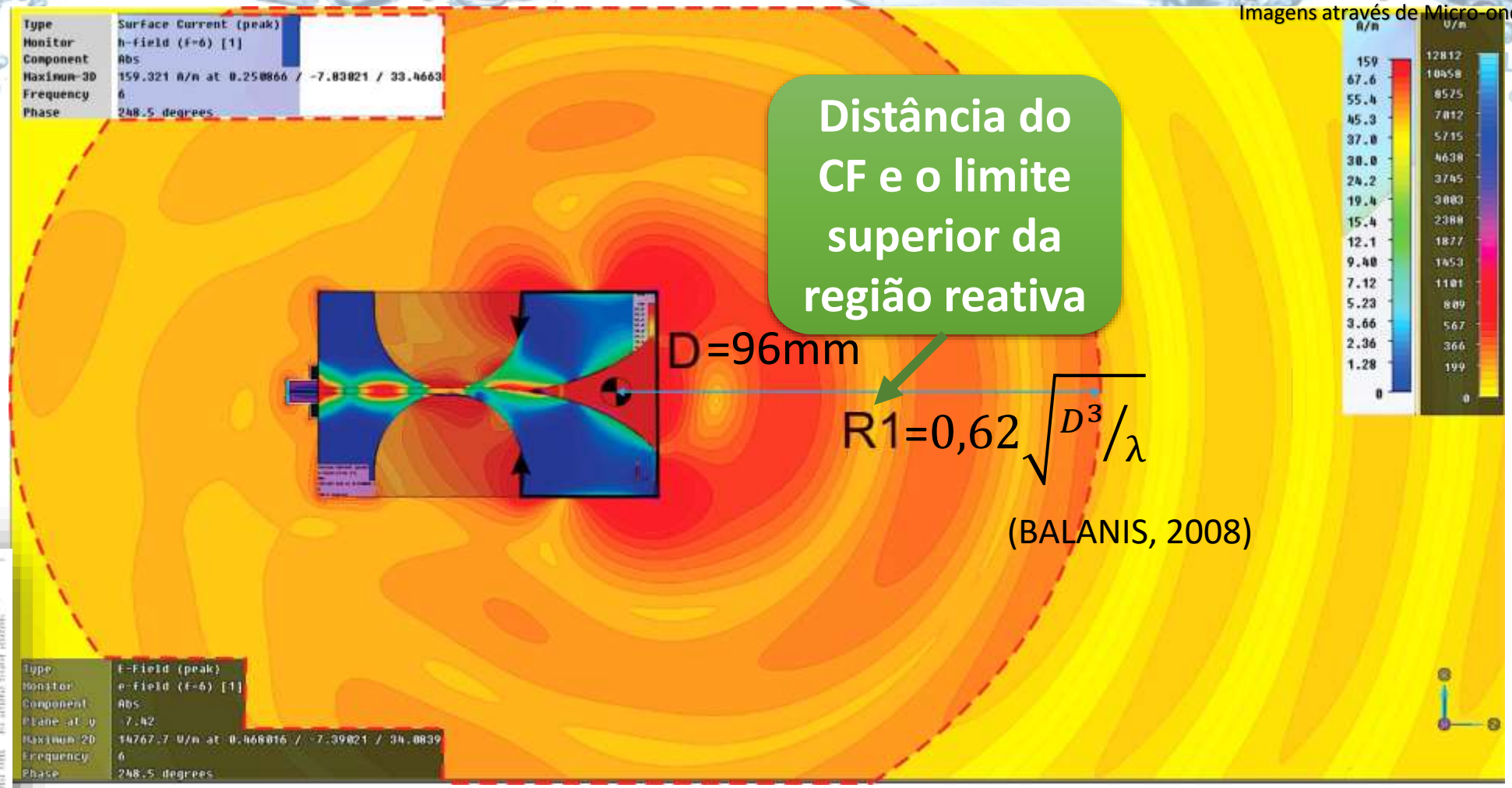

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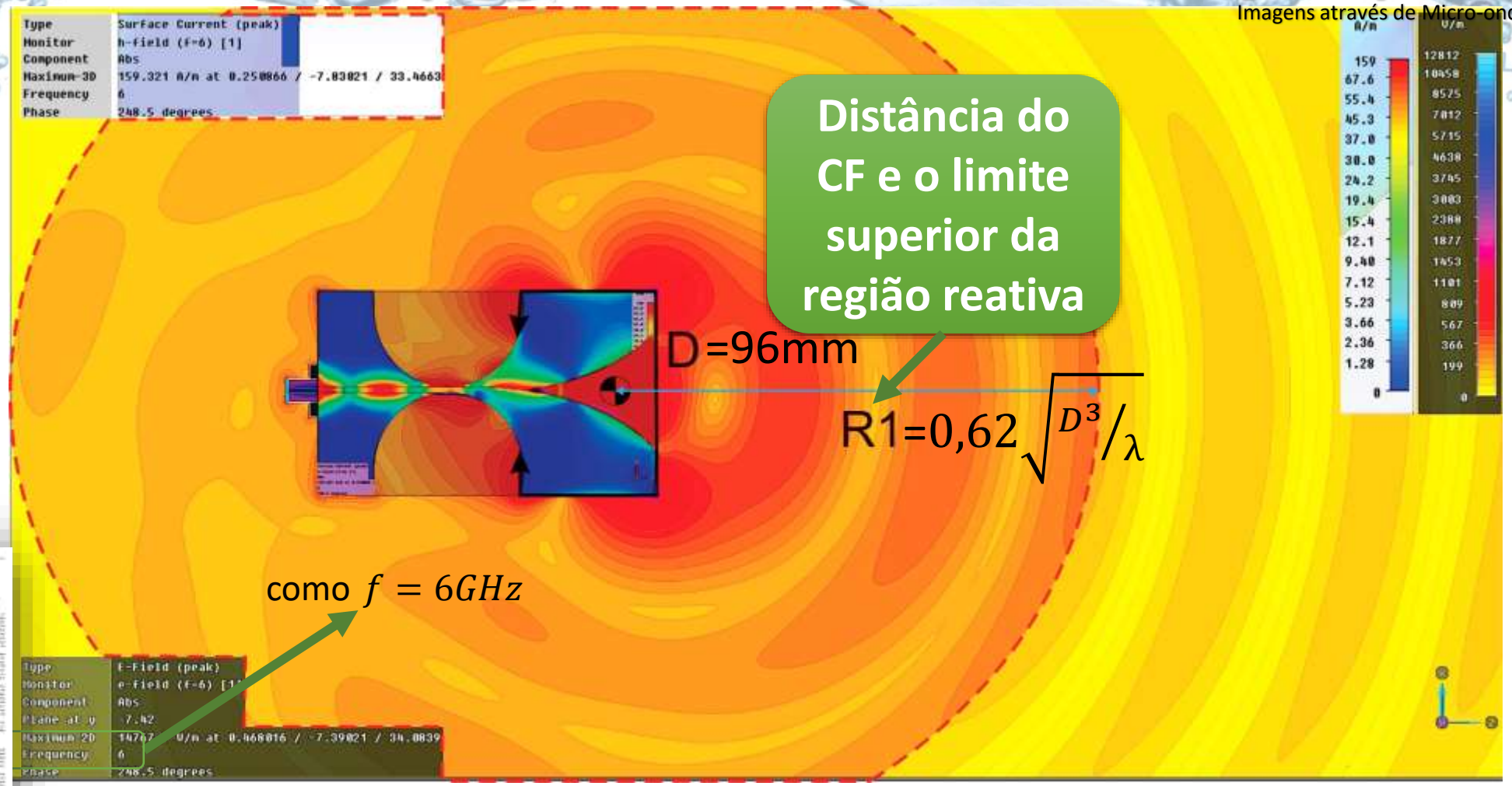

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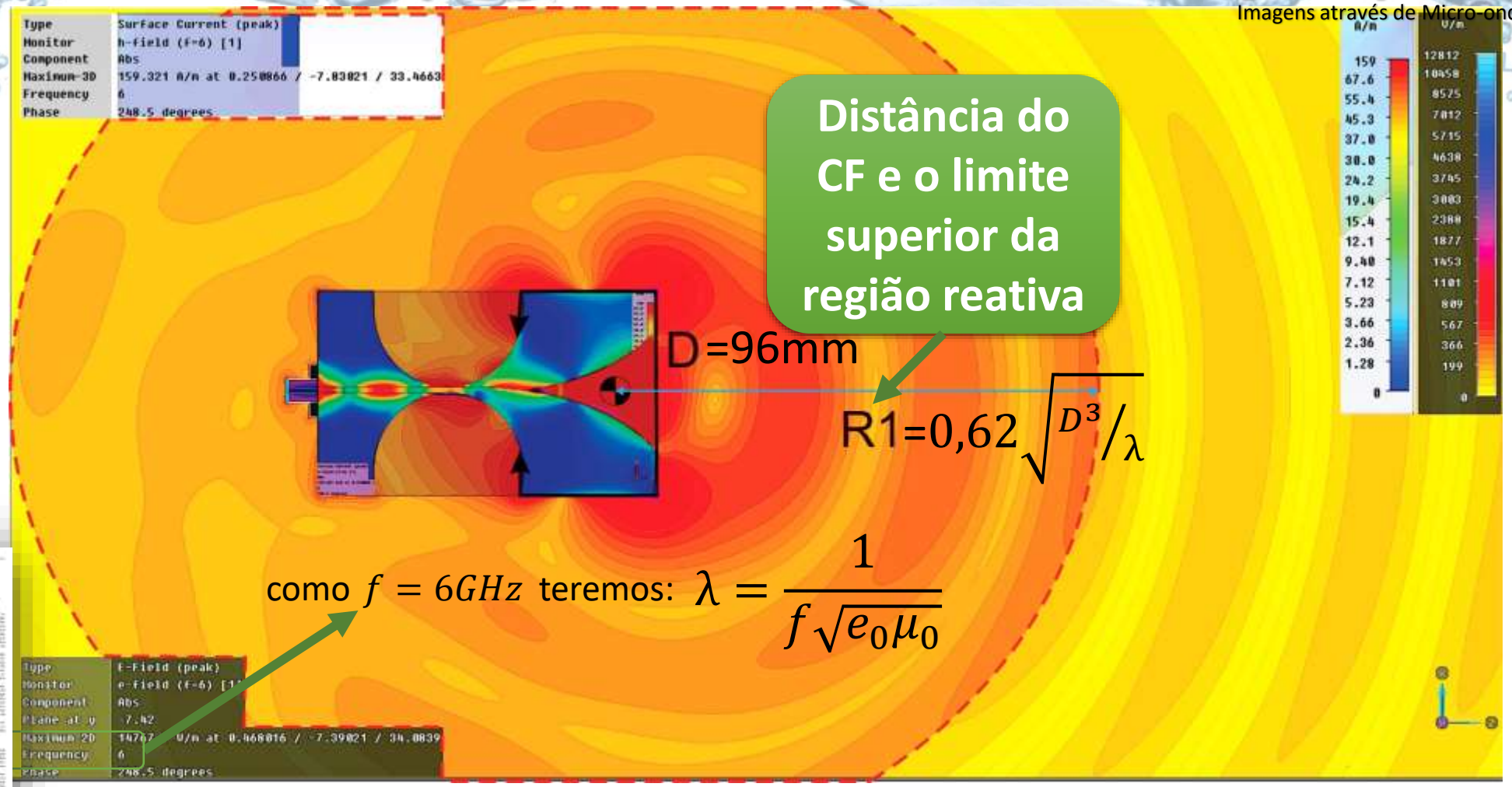

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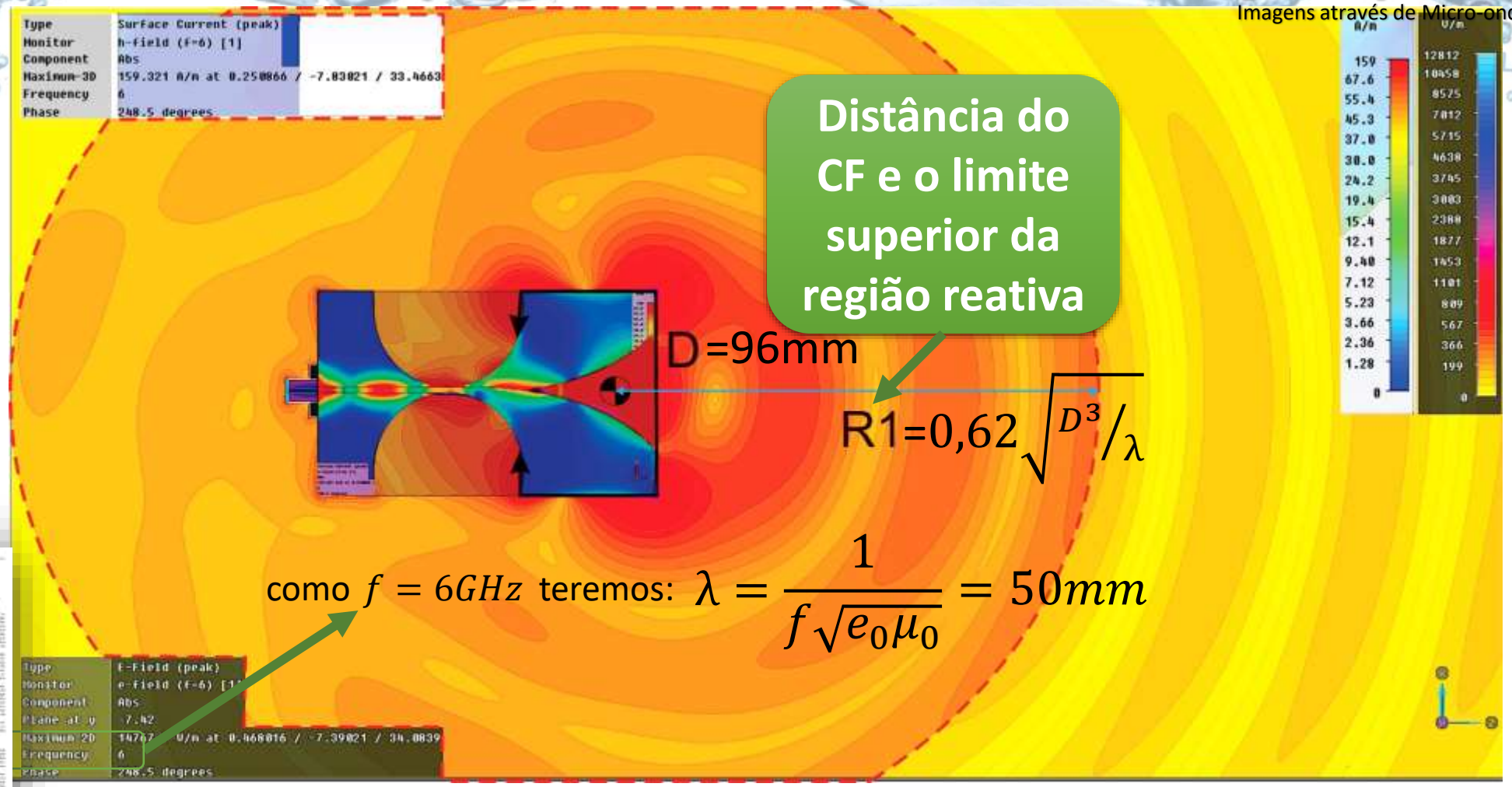

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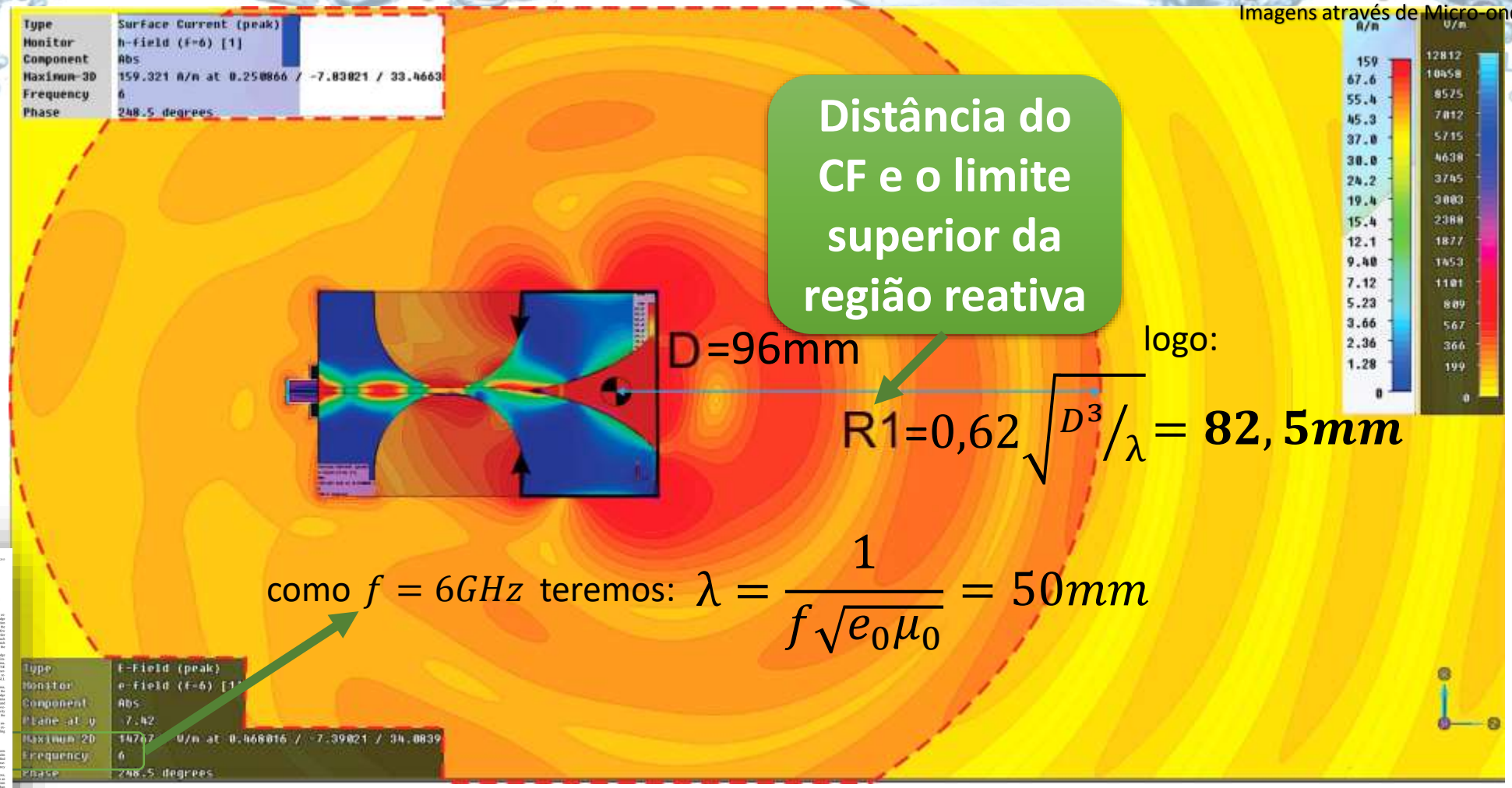

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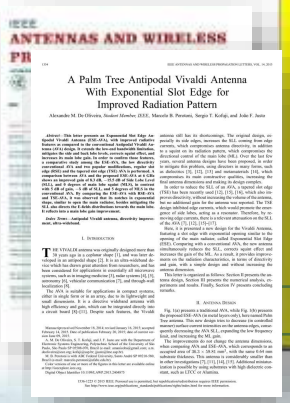

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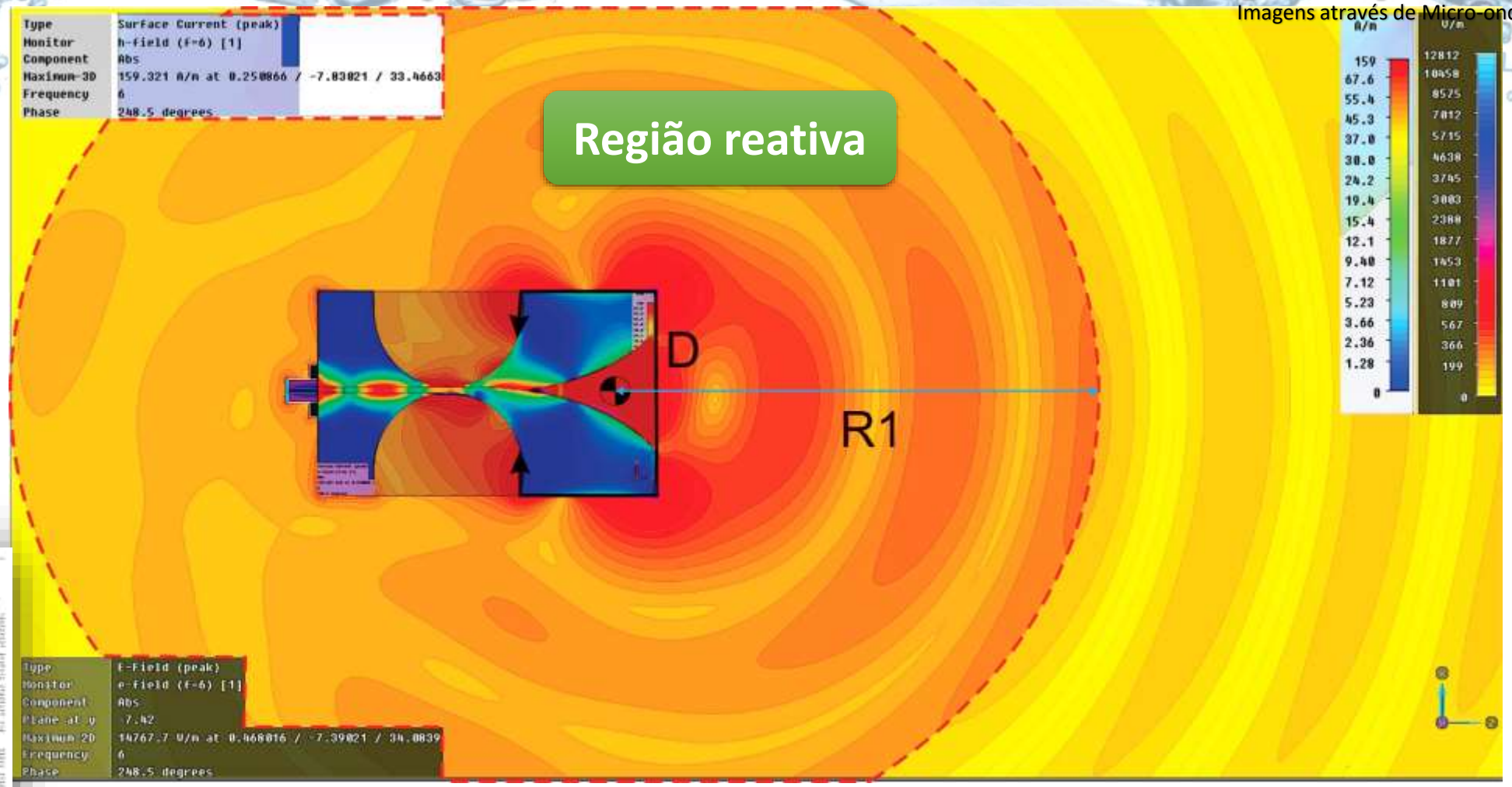

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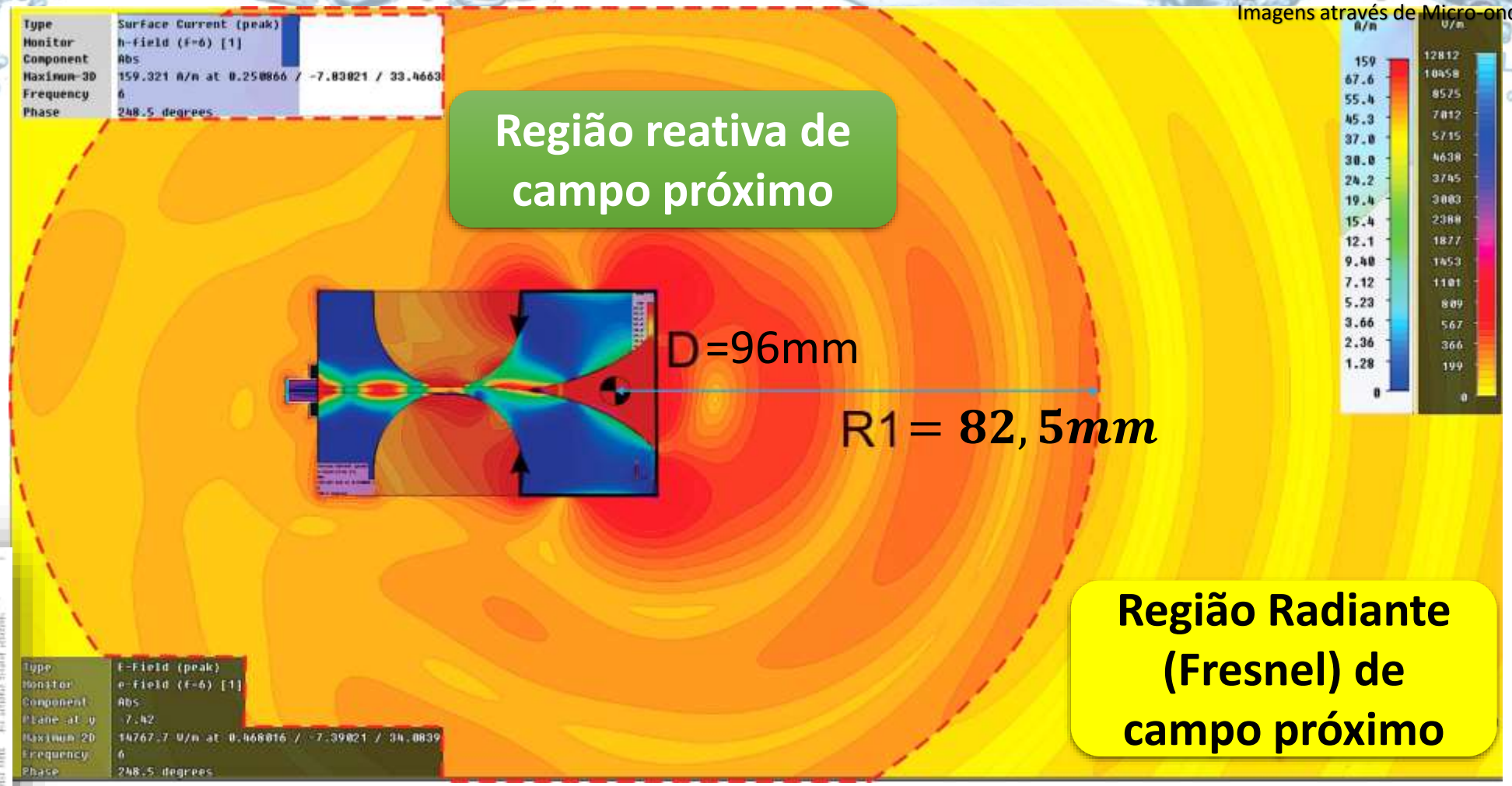

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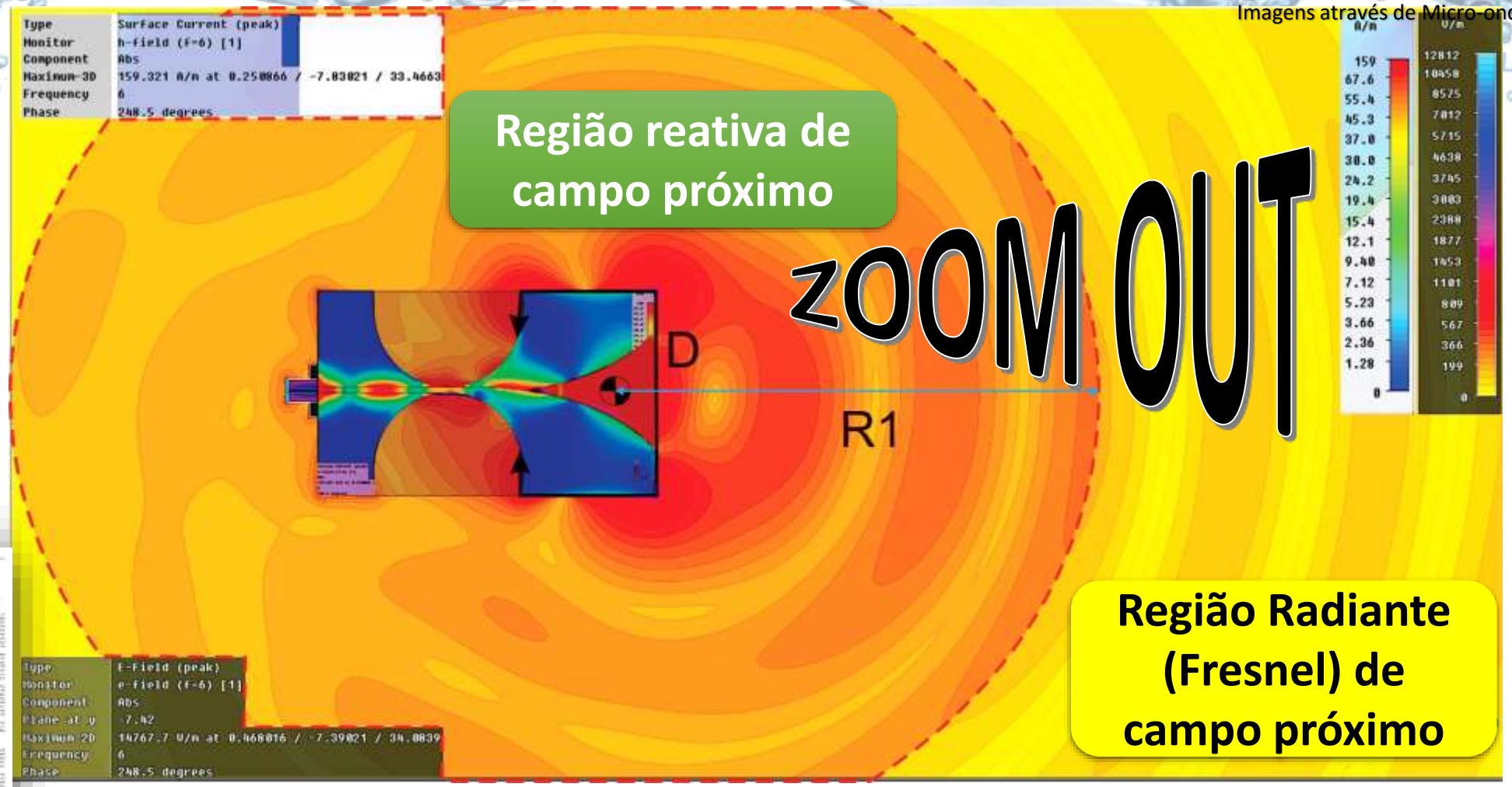

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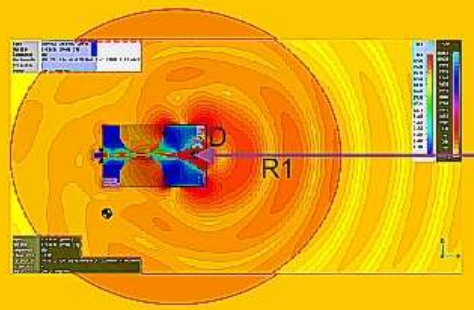

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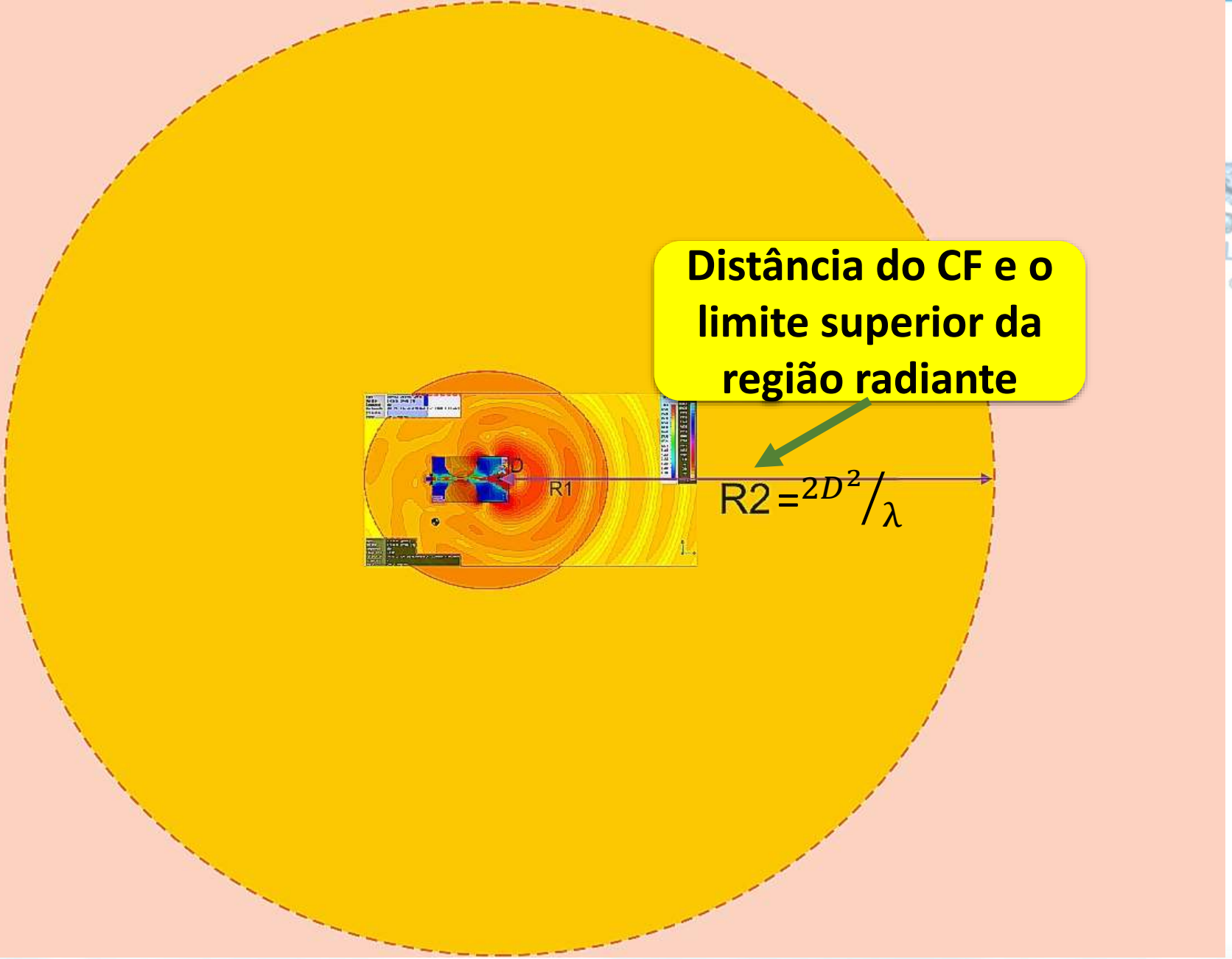

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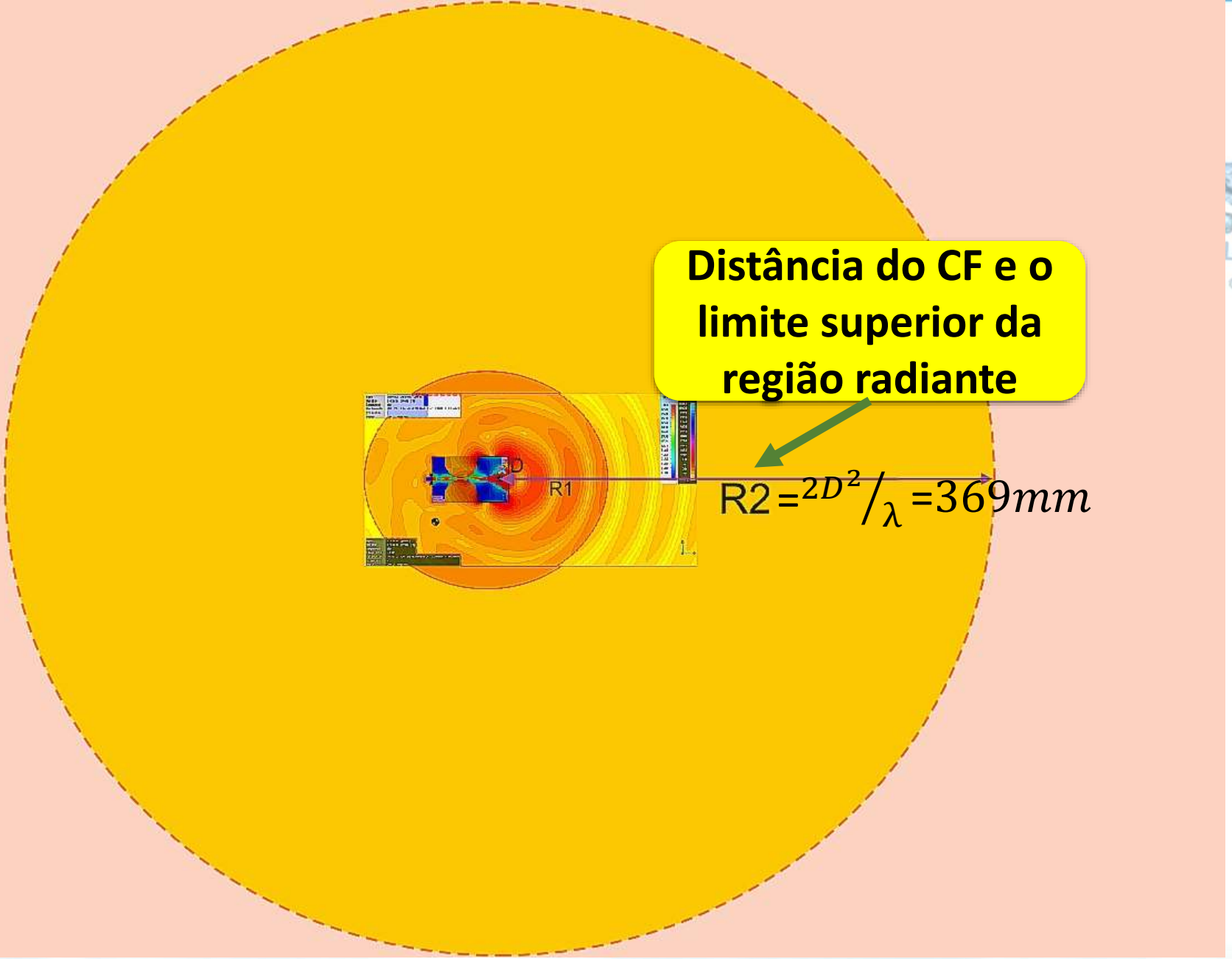

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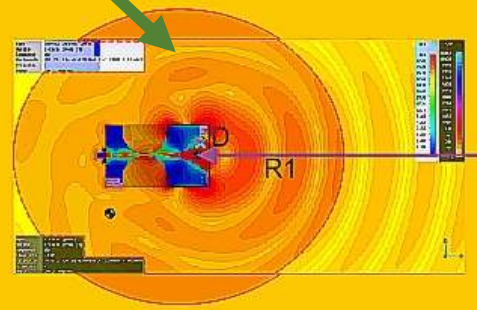
Região reativa de campo próximo



R2 =369mm

Região Radiante (Fresnel) de campo próximo

Região (Fraunhofer) de campo distante

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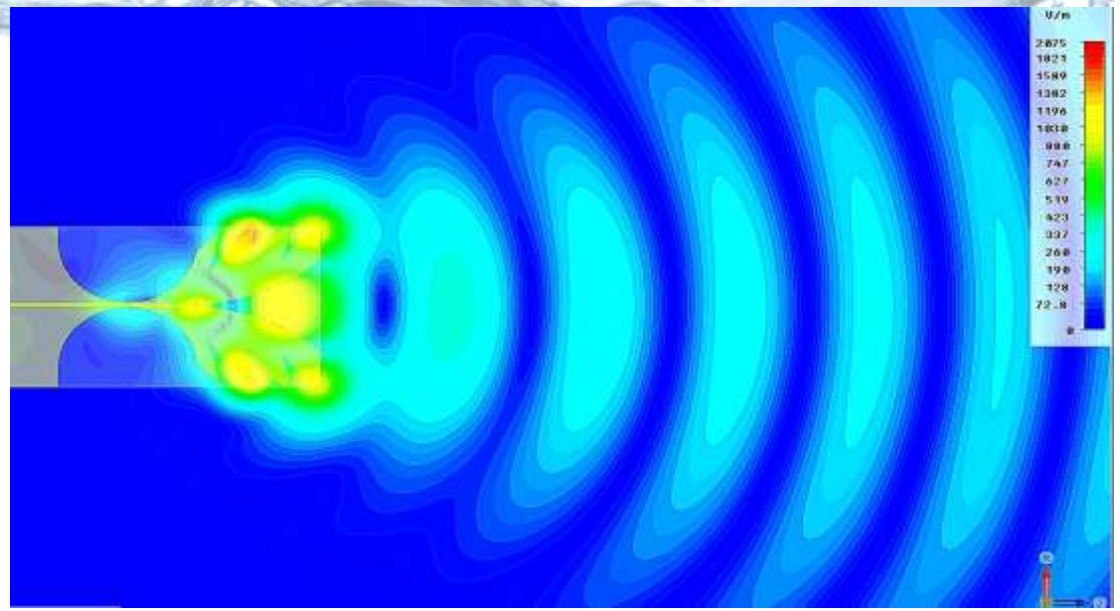
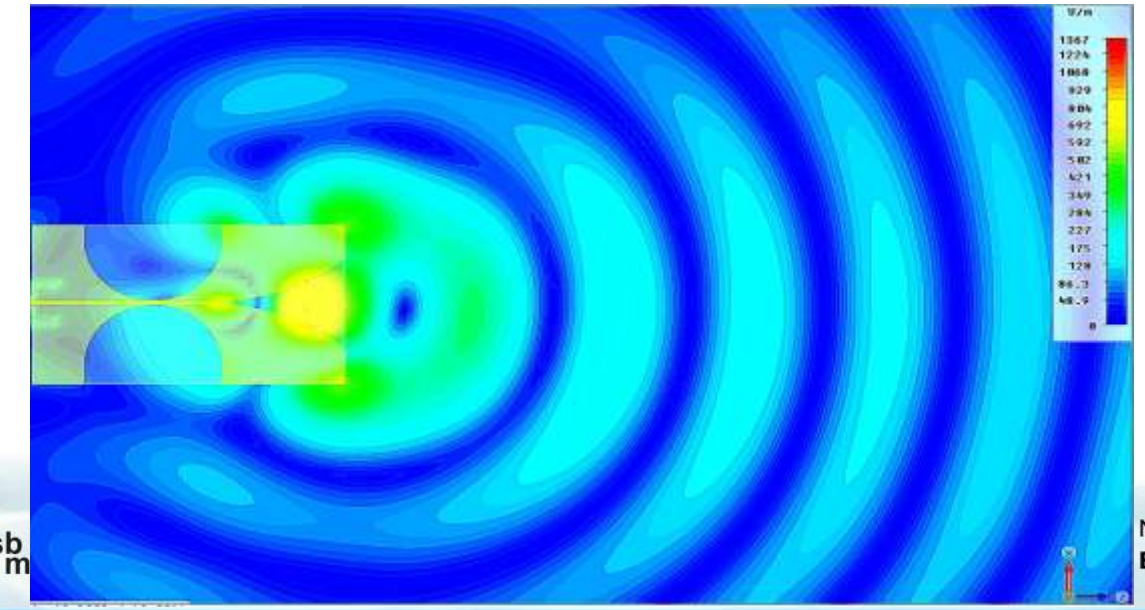


Diagrama de distribuição de campos elétricos no plano x-z, a 6 GHz da Palm Tree AVA-974.



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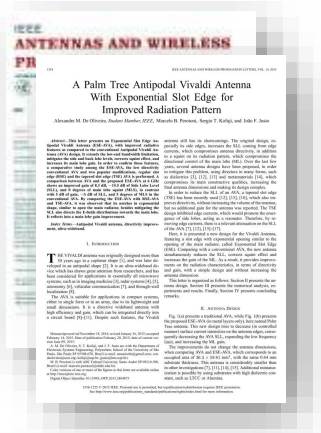
IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 14, 2015

A Palm Tree Antipodal Vivaldi Antenna With Exponential Slot Edge for Improved Radiation Pattern

Alexandre M. De Oliveira, *Student Member, IEEE*, Marcelo B. Perotoni, Sergio T. Kofuji, and João F. Justo

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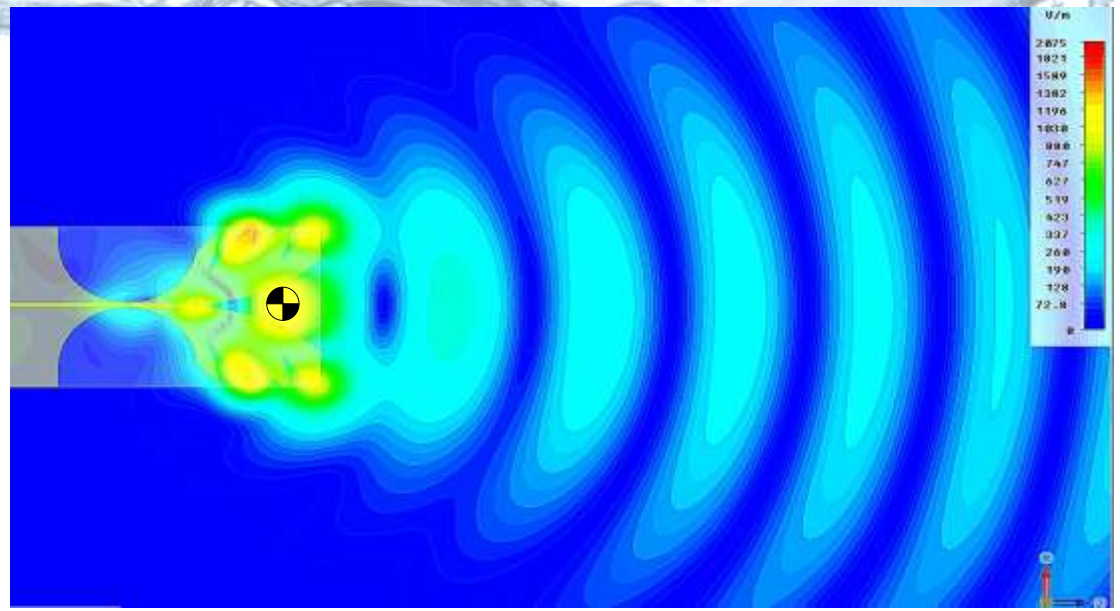

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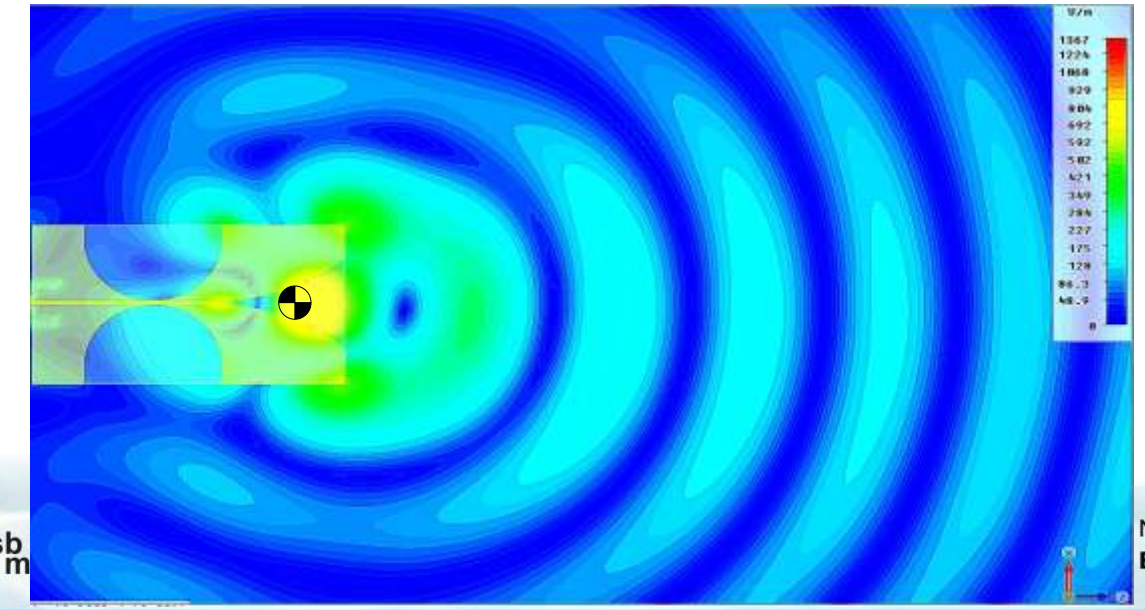

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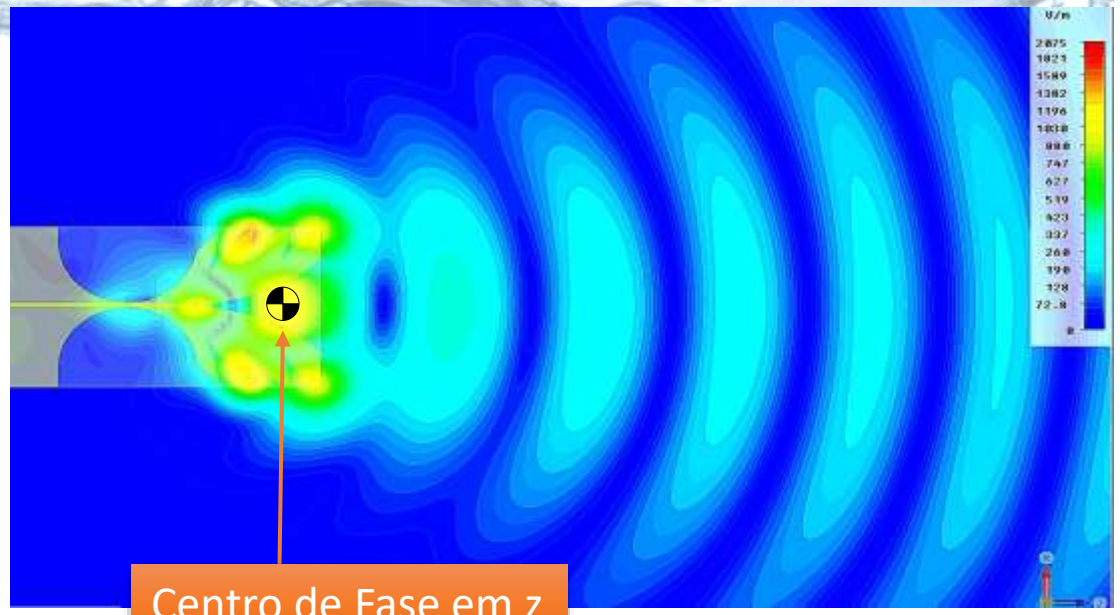

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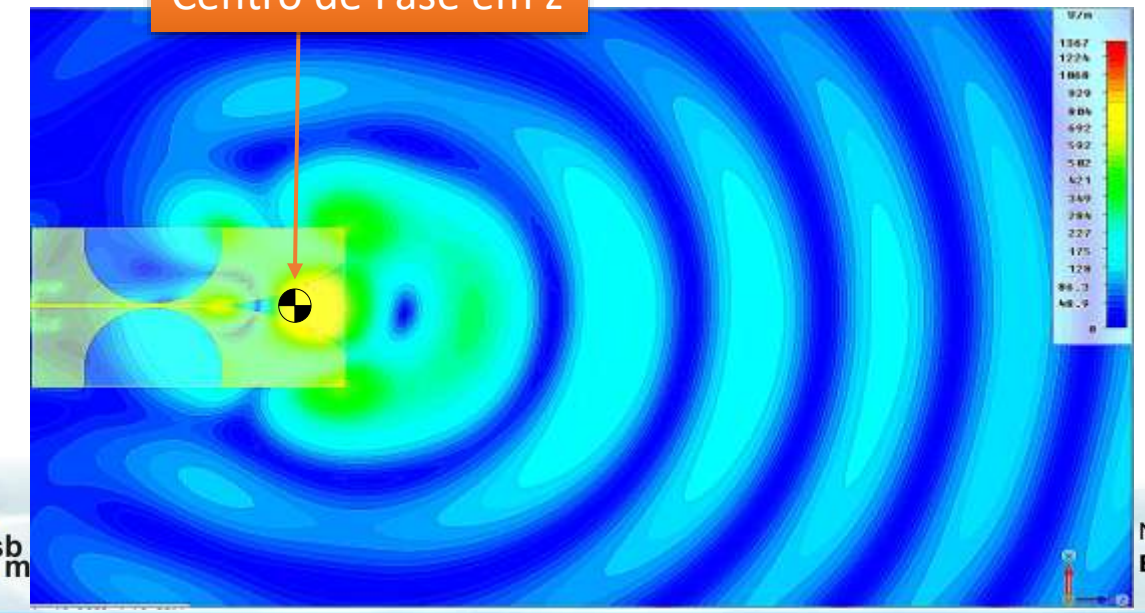

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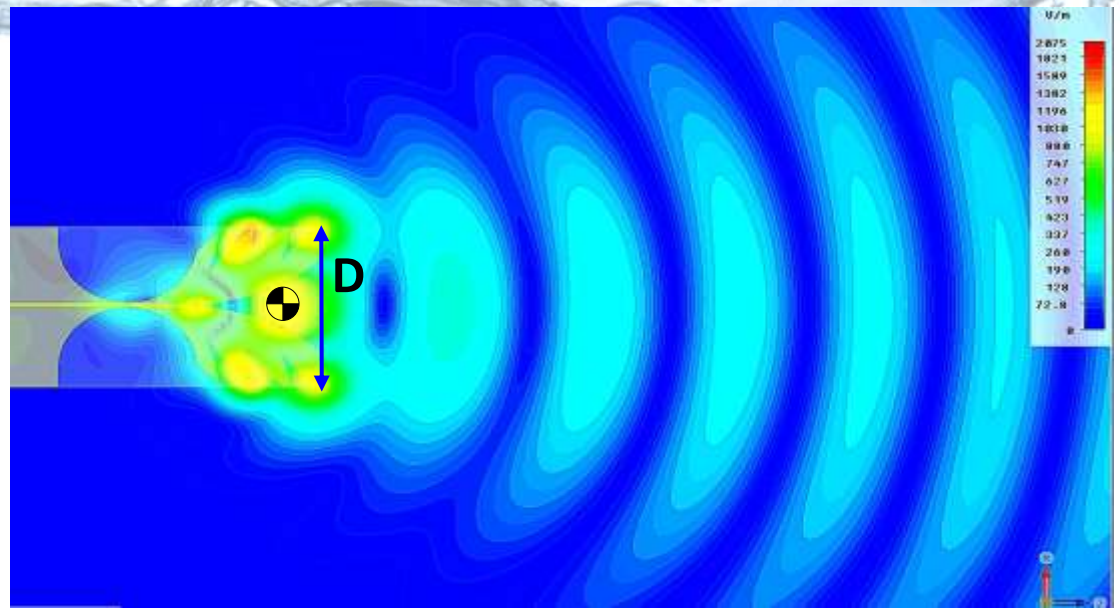

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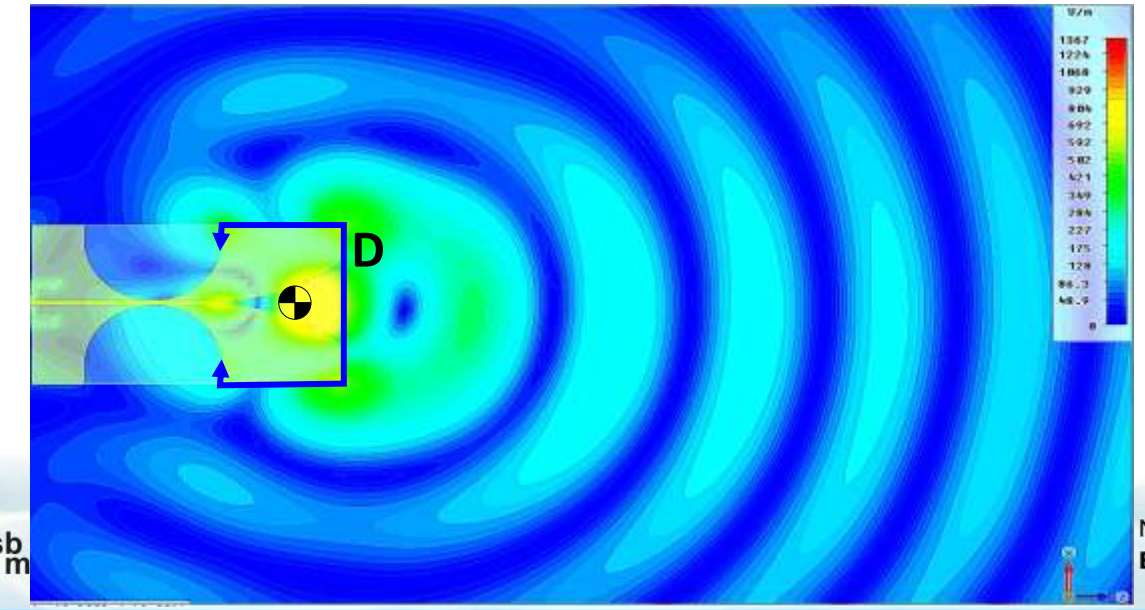

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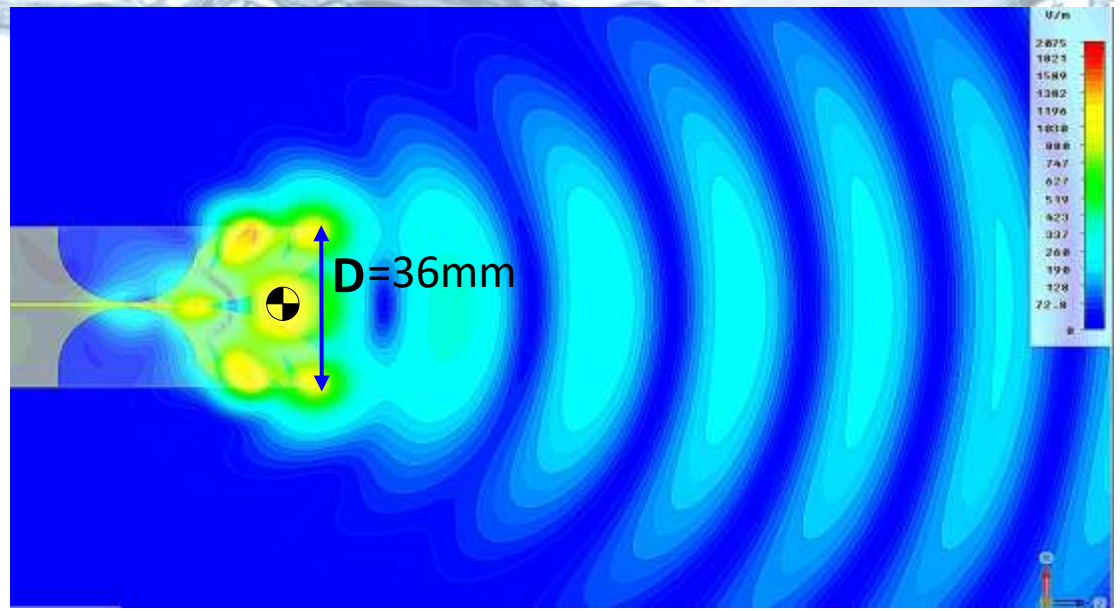

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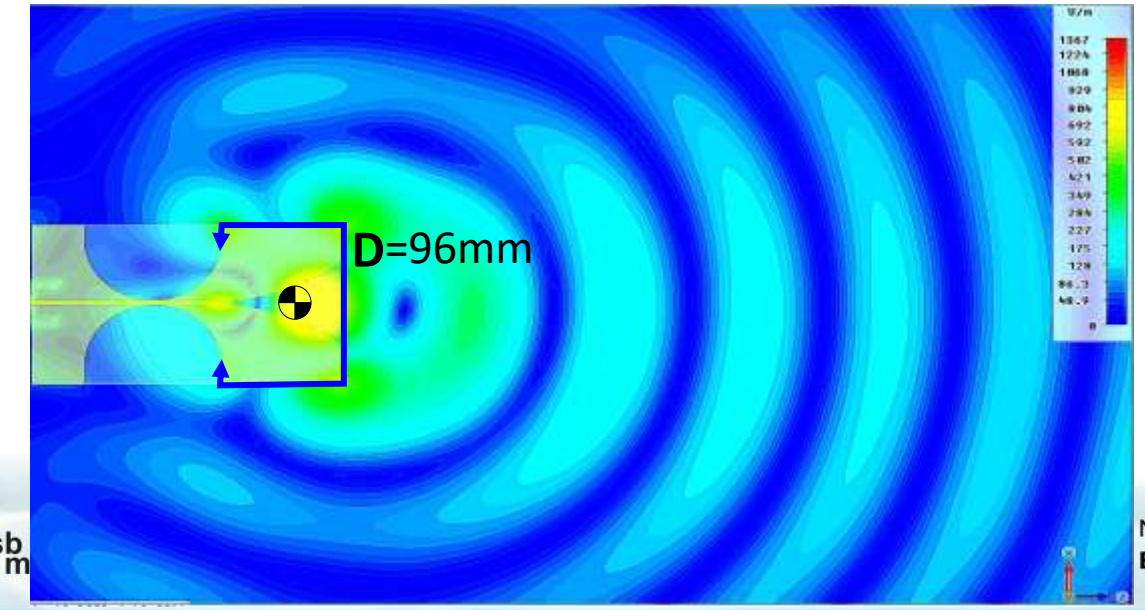

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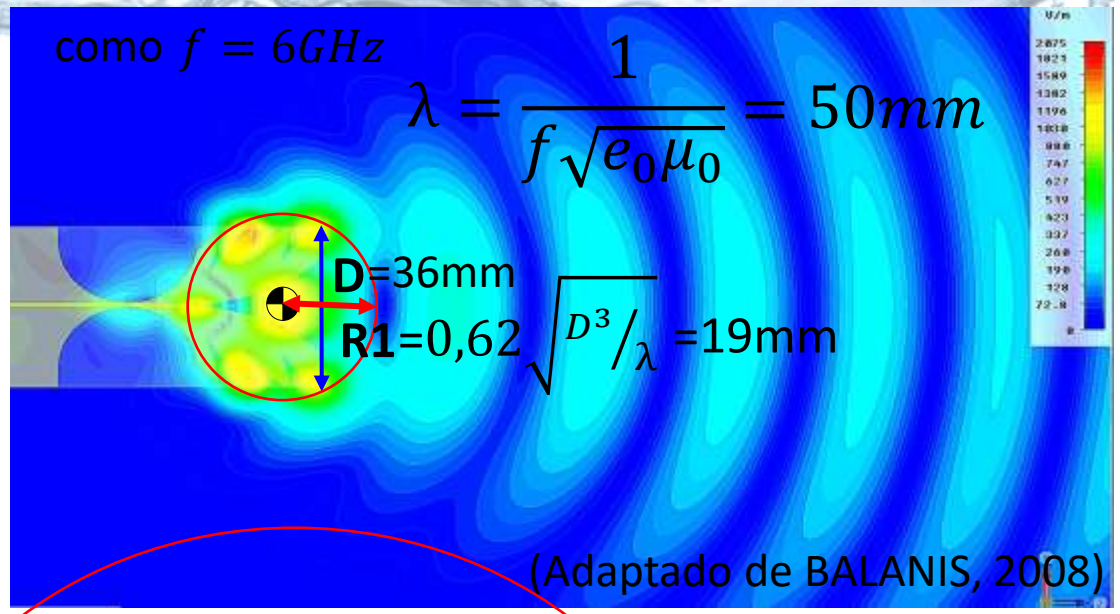

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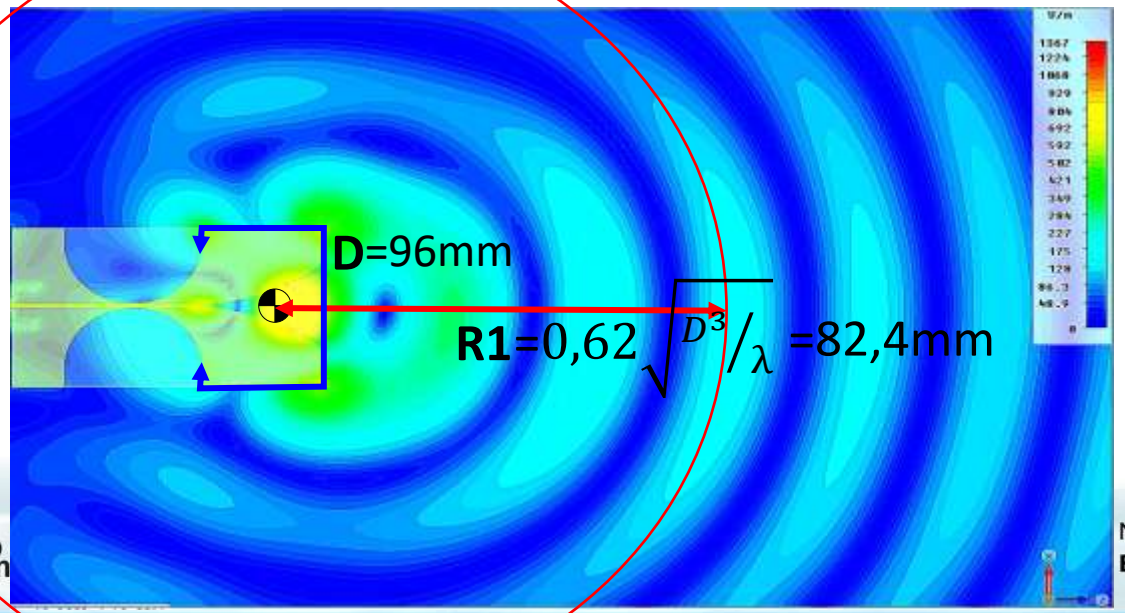

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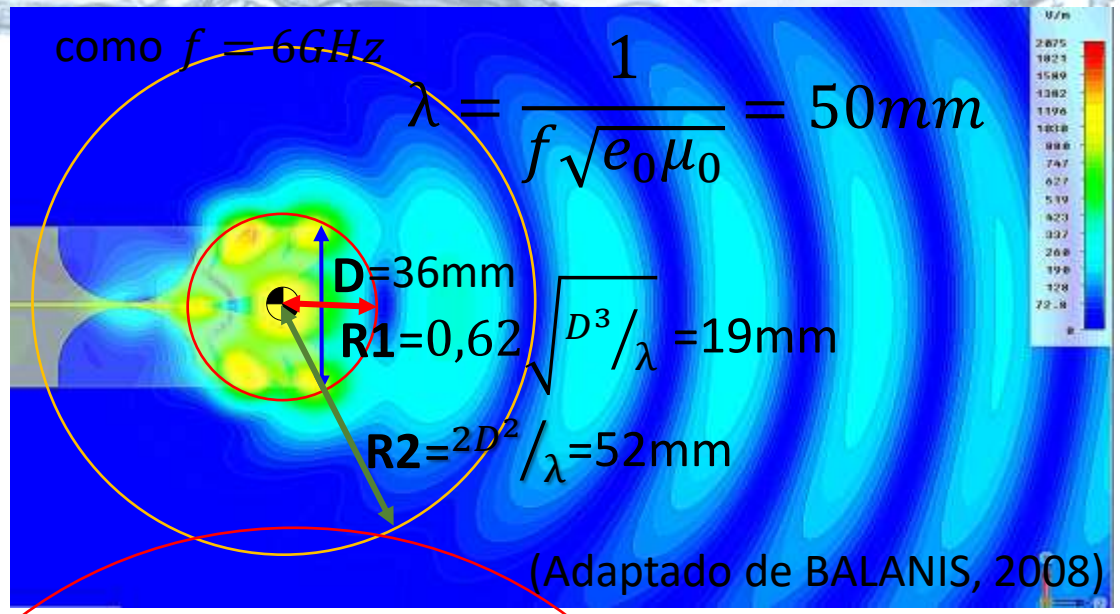

Diagrama de distribuição de campos elétricos no plano x-z, a 6 GHz da Palm Tree AVA-974.

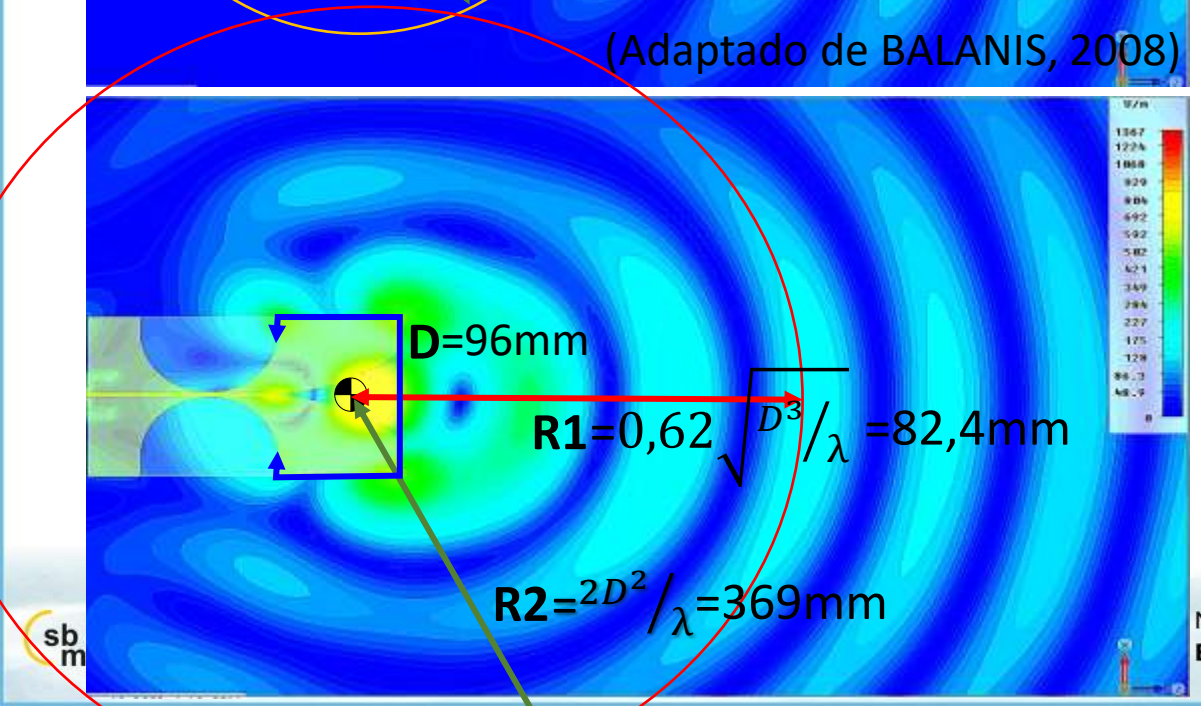

Diagrama de distribuição de campos elétricos no plano x-z, a 6 GHz da AVA-974.

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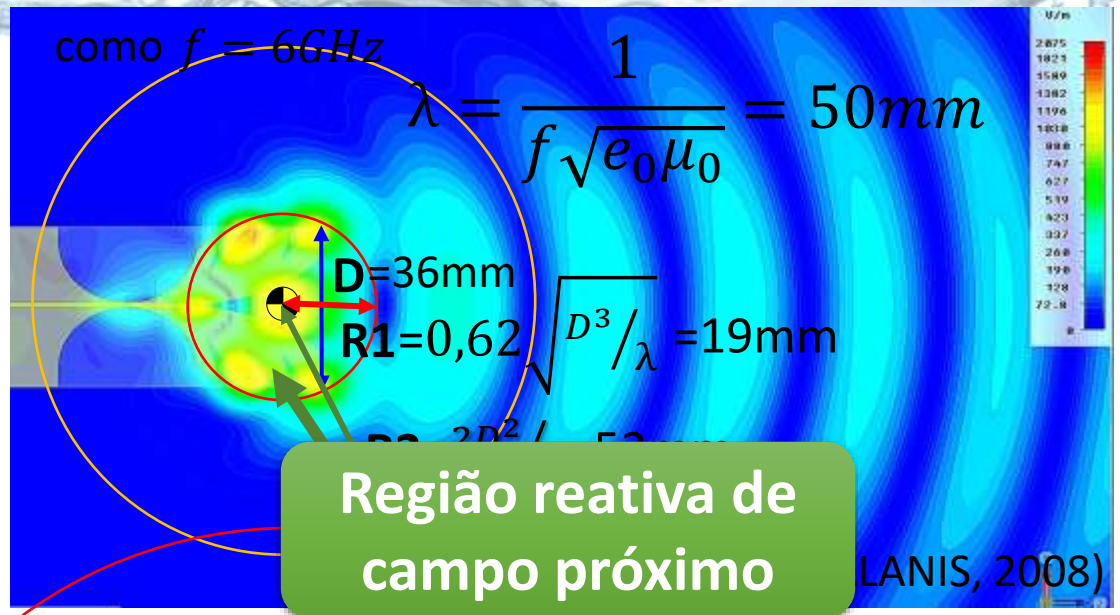
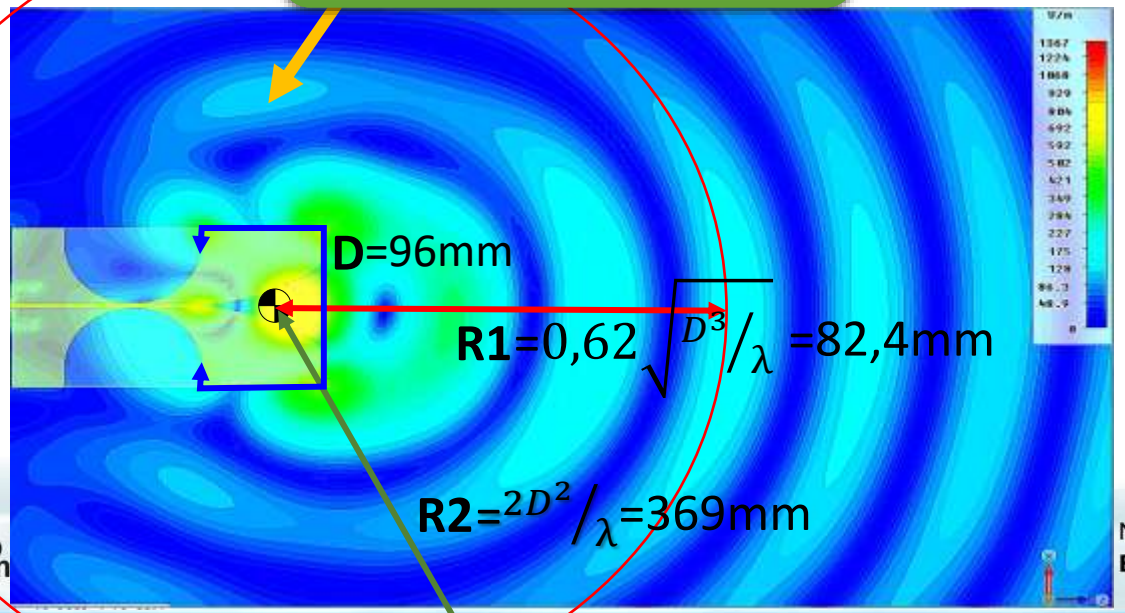


Diagrama de distribuição de campos elétricos no plano x-z, a 6 GHz da Palm Tree AVA-974.



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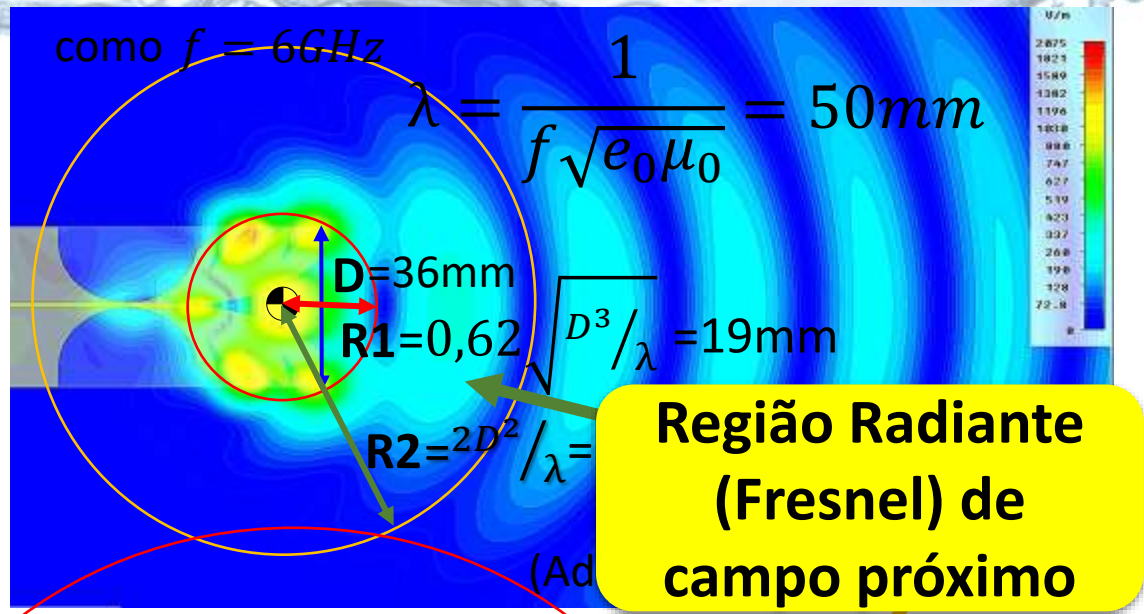

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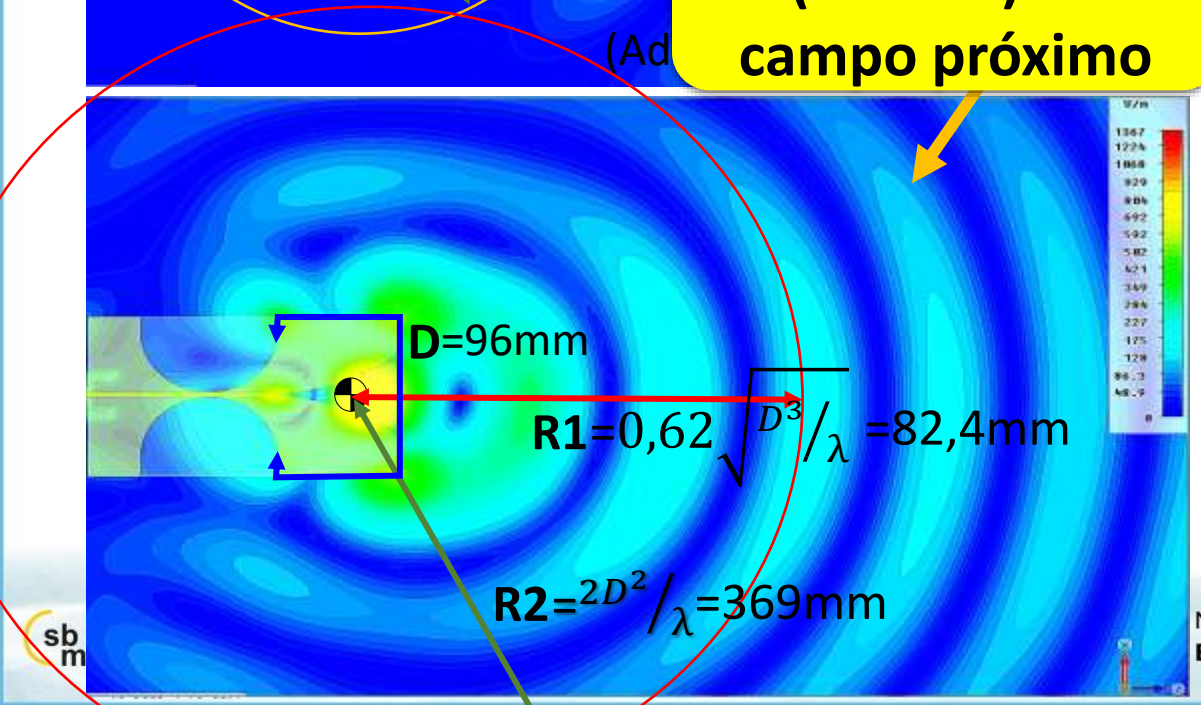

Diagrama de distribuição de campos elétricos no plano x-z, a 6 GHz da AVA-974.

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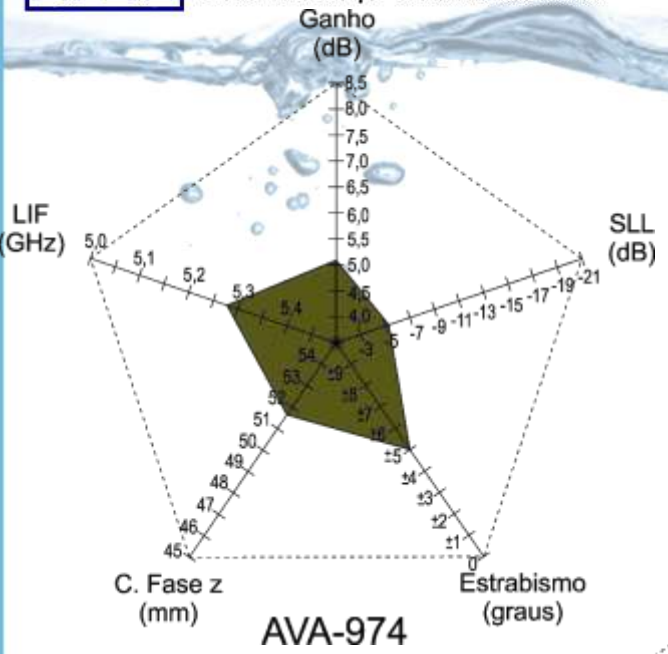
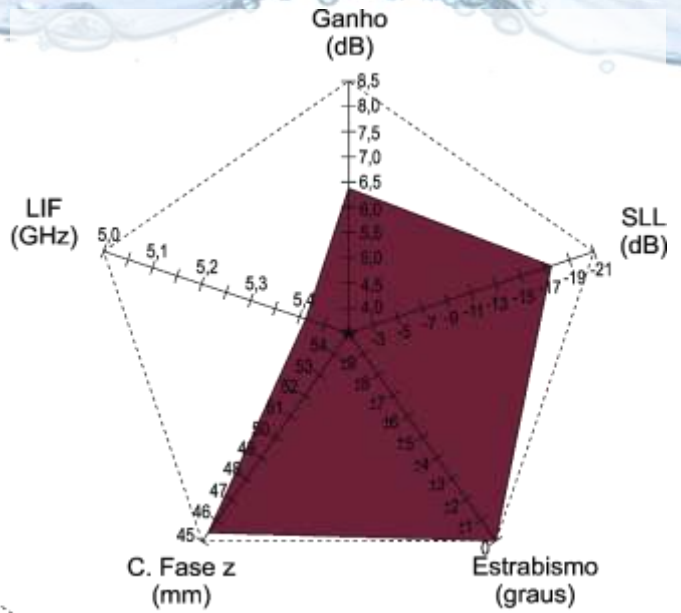


AVA-974



RSEAVA-974

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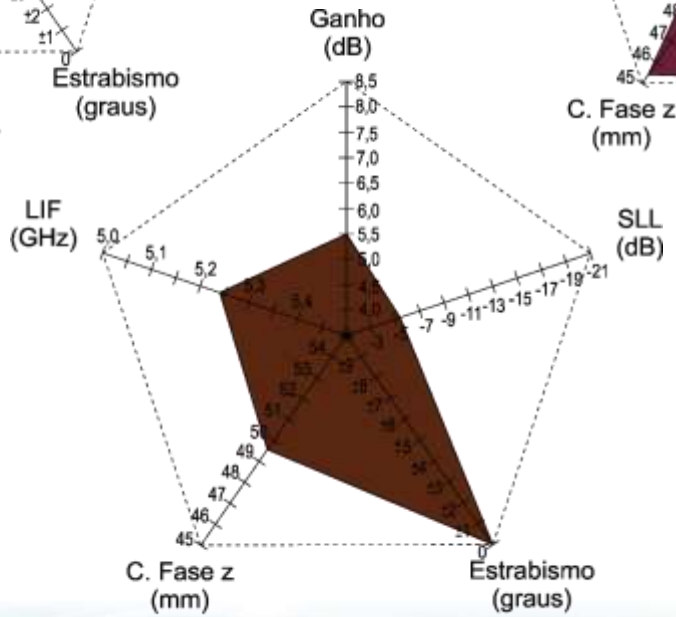
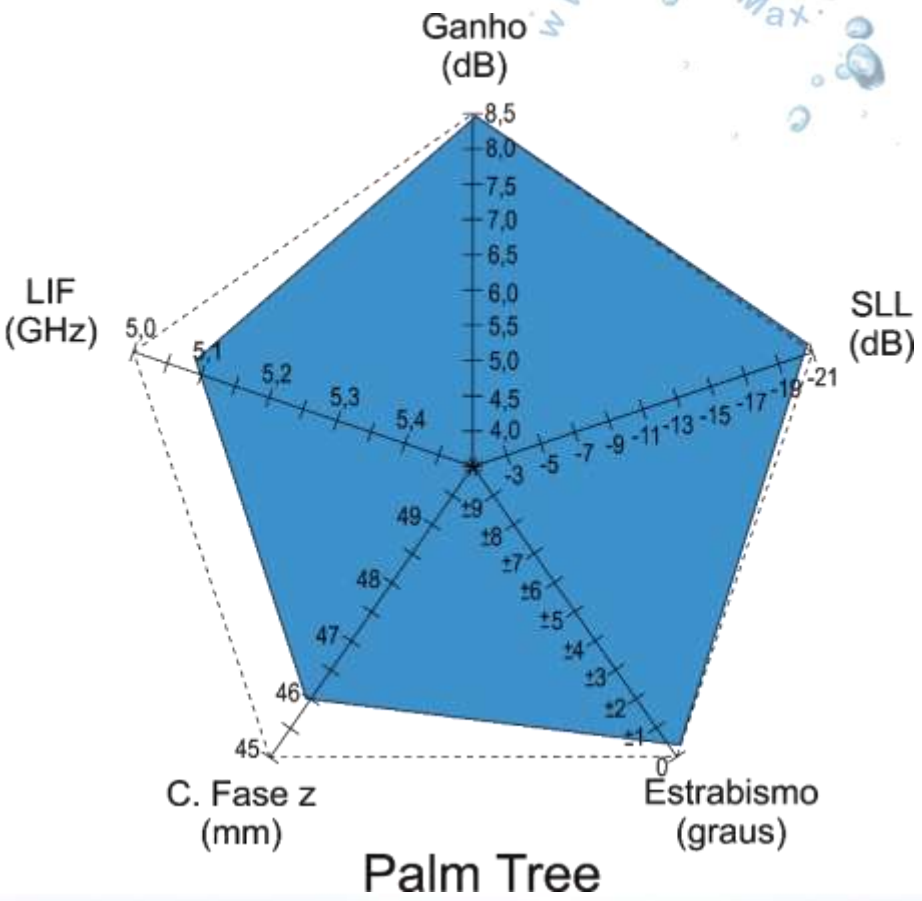


TSEAVA-974



Palm Tree

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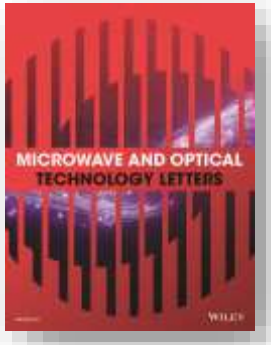

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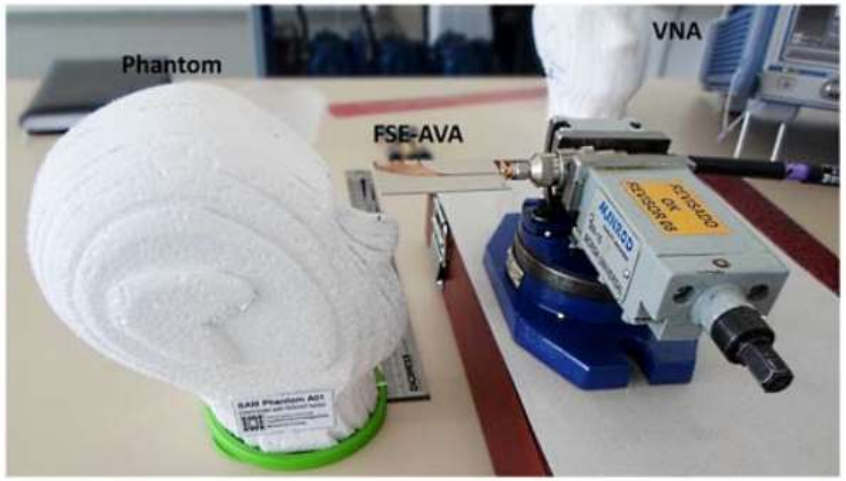

Figure 11 Real-world scenario of the SAM phantom imaged by the FSE-AVA.. [Color figure can be viewed at wileyonlinelibrary.com]

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MICROWAVE AND OPTICAL TECHNOLOGY LETTERS / Vol. 59, No. 2, February 2017

A HIGH DIRECTIVE KOCH FRACTAL VIVALDI ANTENNA DESIGN FOR MEDICAL NEAR-FIELD MICROWAVE IMAGING APPLICATIONS

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ABSTRACT: *We present a new fractal slot edge antipodal Vivaldi antenna (AVA). When compared to a conventional AVA, it simultaneously extends the low-end bandwidth limitation, mitigates the side lobe level, and increases the main lobe gain. © 2016 Wiley Periodicals, Inc. Microwave Opt Technol Lett 59:337–346, 2017; View this article online*
wileyonlinelibrary.com. DOI 10.1002/mop.30293

Key words: antipodal Vivaldi antenna; medi-
antenna

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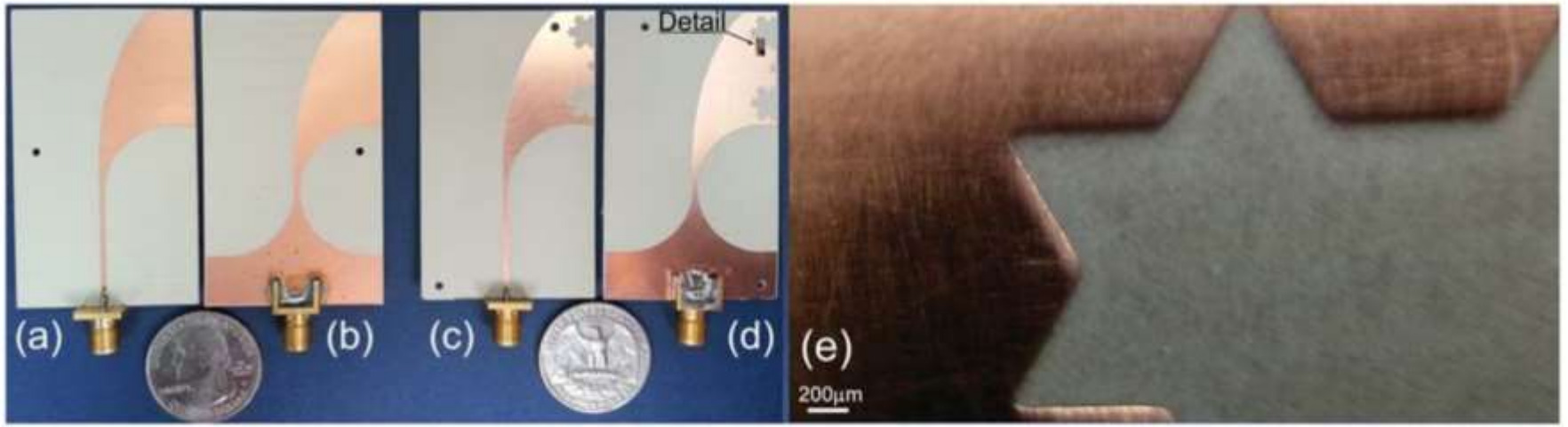

Figure 1 AVA (a, b) and FSE-AVA (c, d) photograph, top view on the left and bottom view on the right. (e) Detail of the third generation of the fractal. [Color figure can be viewed at wileyonlinelibrary.com]

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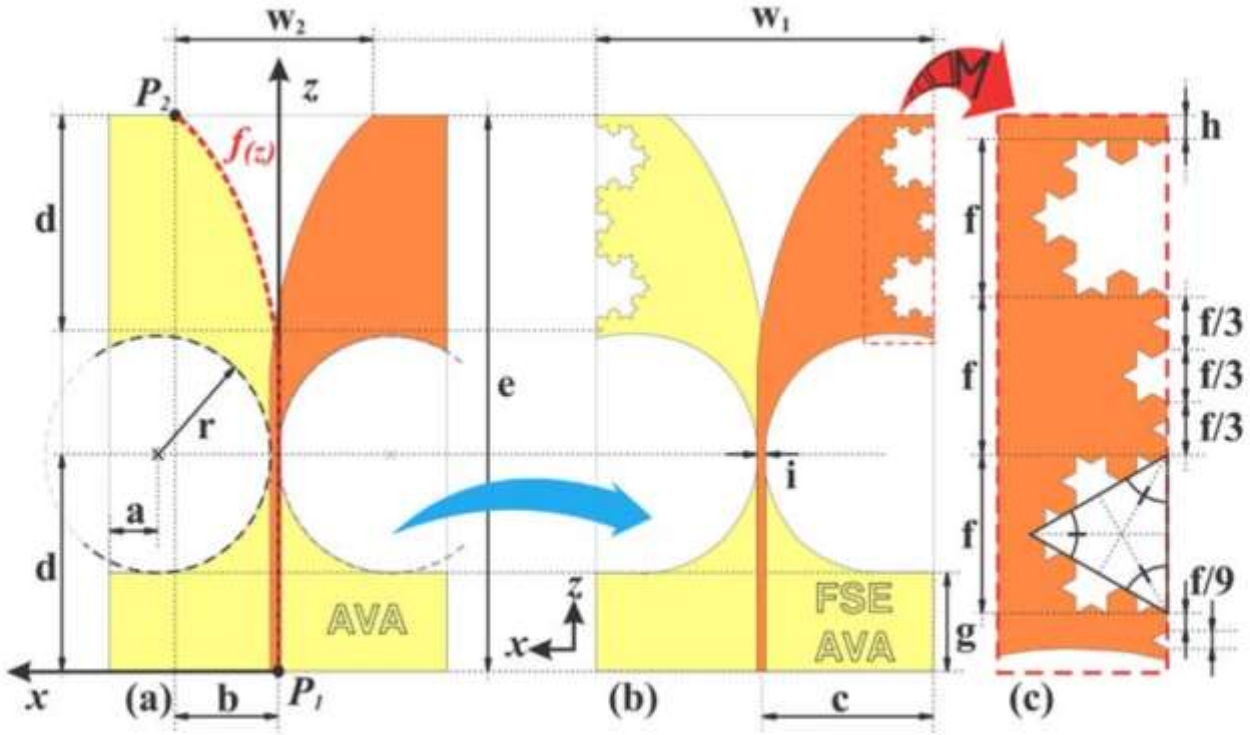

Figure 2 Design and parameters of antenna in *xz*-plane: (a) reference AVA, (b) proposed FSE-AVA, (c) details of the fractal design. [Color figure can be viewed at wileyonlinelibrary.com]

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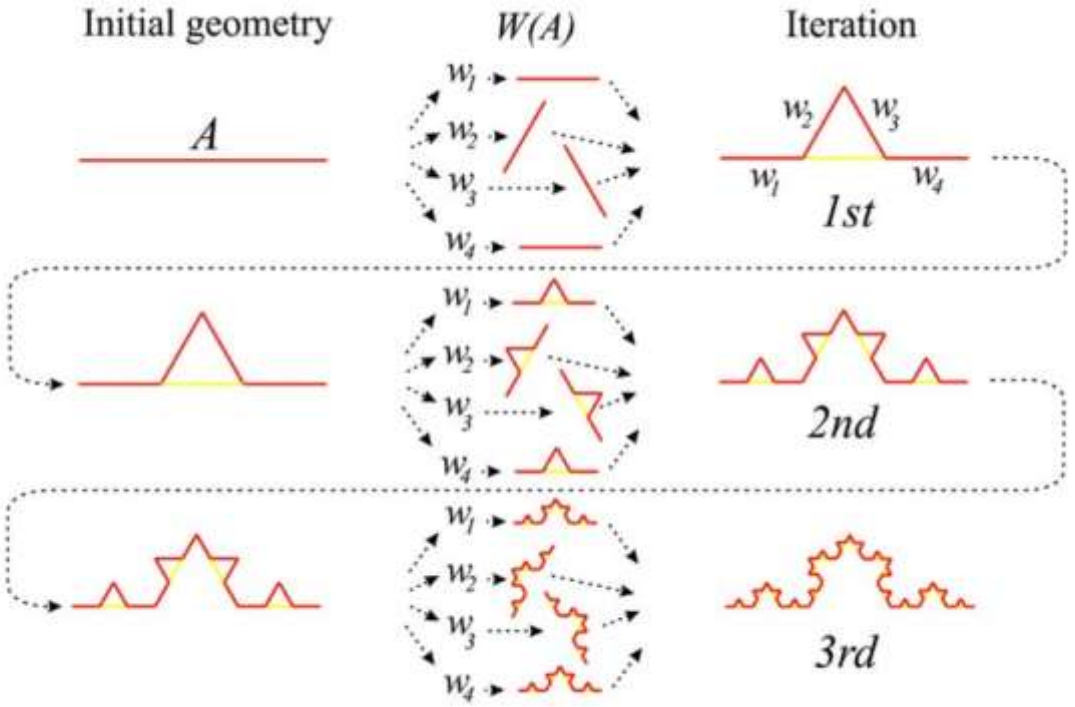

Figure 3 Three iterations of the Koch curve IFS from the initial geometry A. [Color figure can be viewed at wileyonlinel

$$w(A) = \cup_{n=1}^{4} w_n(A) \tag{1}$$

$$w_1\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1/3 & 0 \\ 0 & 1/3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} \tag{2}$$

$$w_2\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} \cos 60°/3 & -\sin 60°/3 \\ -\sin 60°/3 & \cos 60°/3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 1/3 \\ 0 \end{pmatrix} \tag{3}$$

$$w_3\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} \cos 60°/3 & -\sin 60°/3 \\ -\sin 60°/3 & \cos 60°/3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 1/2 \\ \sin 60°/2 \end{pmatrix} \tag{4}$$

$$w_4\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1/3 & 0 \\ 0 & 1/3 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 2/3 \\ 0 \end{pmatrix} \tag{5}$$

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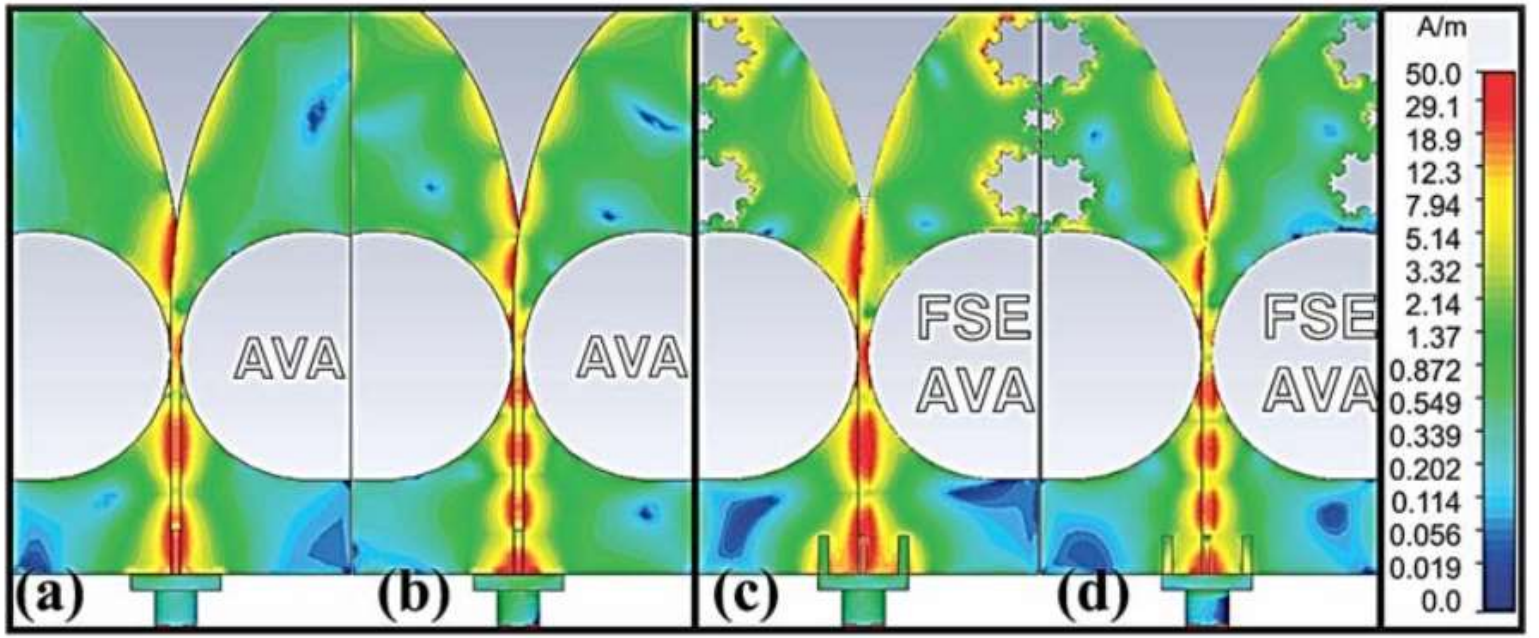

Figure 7 Surface current of (a) AVA at 7 GHz, (6) AVA at 11 GHz, (c) FSE-AVA at 7 GHz, and (d) FSE-AVA at 11 GHz. [Color figure can be viewed at wileyonlinelibrary.com]

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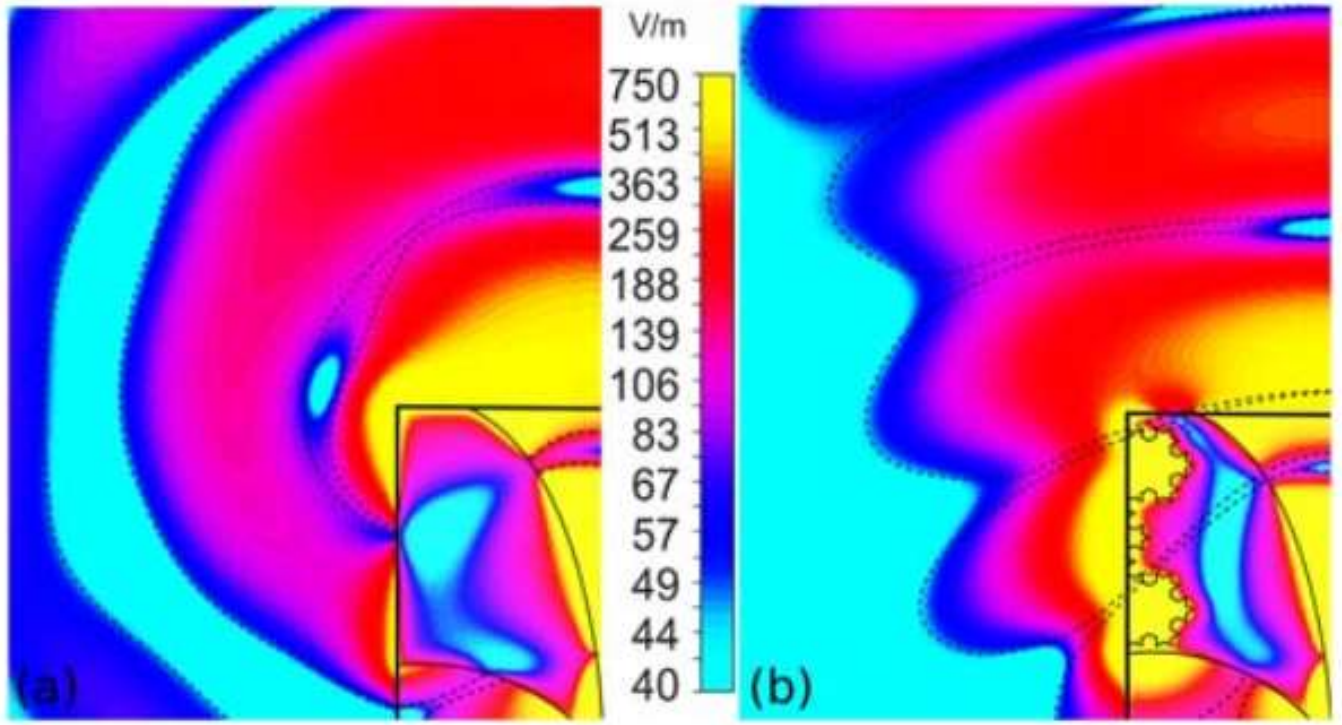

Figure 8 *E*-field in *xz*-plane at 7 GHz for (a) AVA and (b) FSE-AVA. [Color figure can be viewed at wileyonlinelibrary.com]

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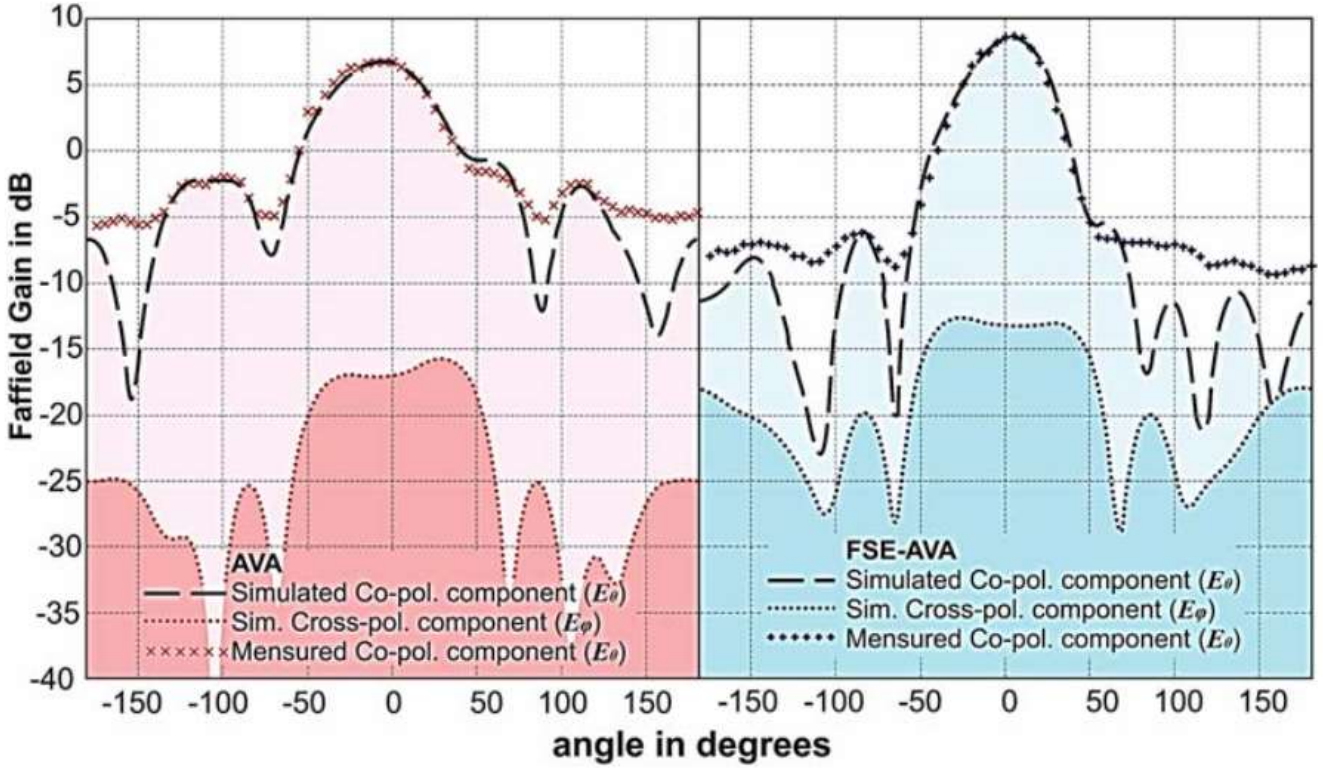

Figure 9 Measured and simulated gain pattern at 7 GHz of the AVA (left) and FSE-AVA (right). [Color figure can be viewed at wileyonlinelibrary.com]

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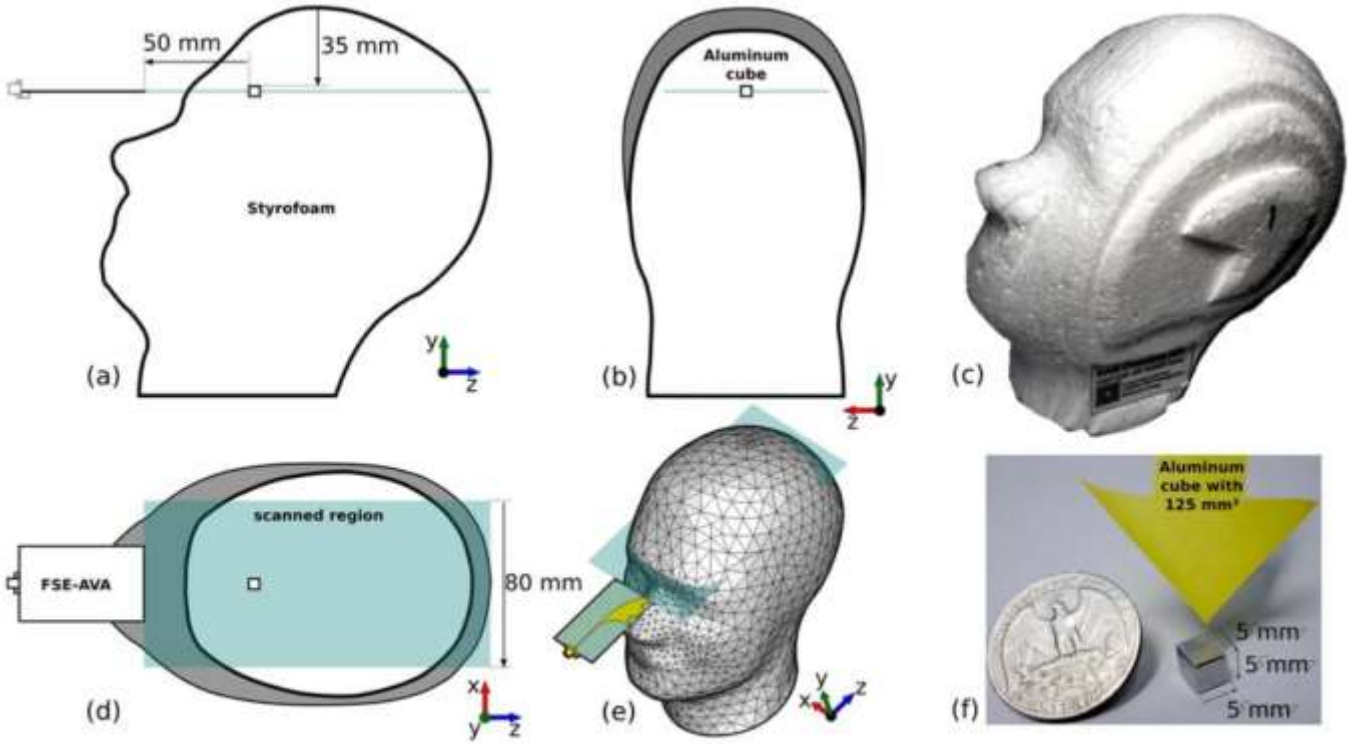

Figure 12 Testing environment consists of a non-realistic infant Phantom with the addition of an aluminum cube (target) with volume of 125 mm^3. Detail of the target location in side view with a longitudinal section (a), in cross-sectional front view (b), Phantom photograph produced, cube detail in the top view in section (d), 3D illustration of the position FSE- AVA in front of the Phantom with the detail of the scanned area (e), and finally, the cube used as a target in detail (f). [Color figure can be viewed at wileyonlinelibrary.com]

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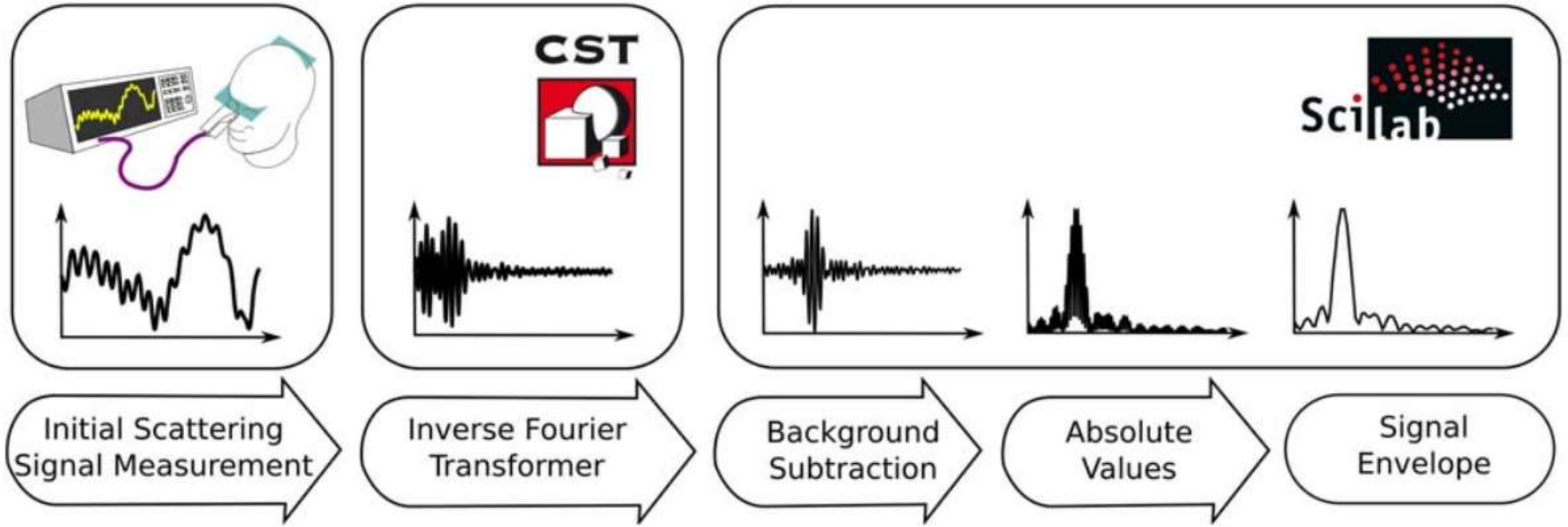

Figure 15 Data processing methodology for FSE-AVA near-field microwave imaging conceptual proof. [Color figure can be viewed at wileyonlinelibrary.com]

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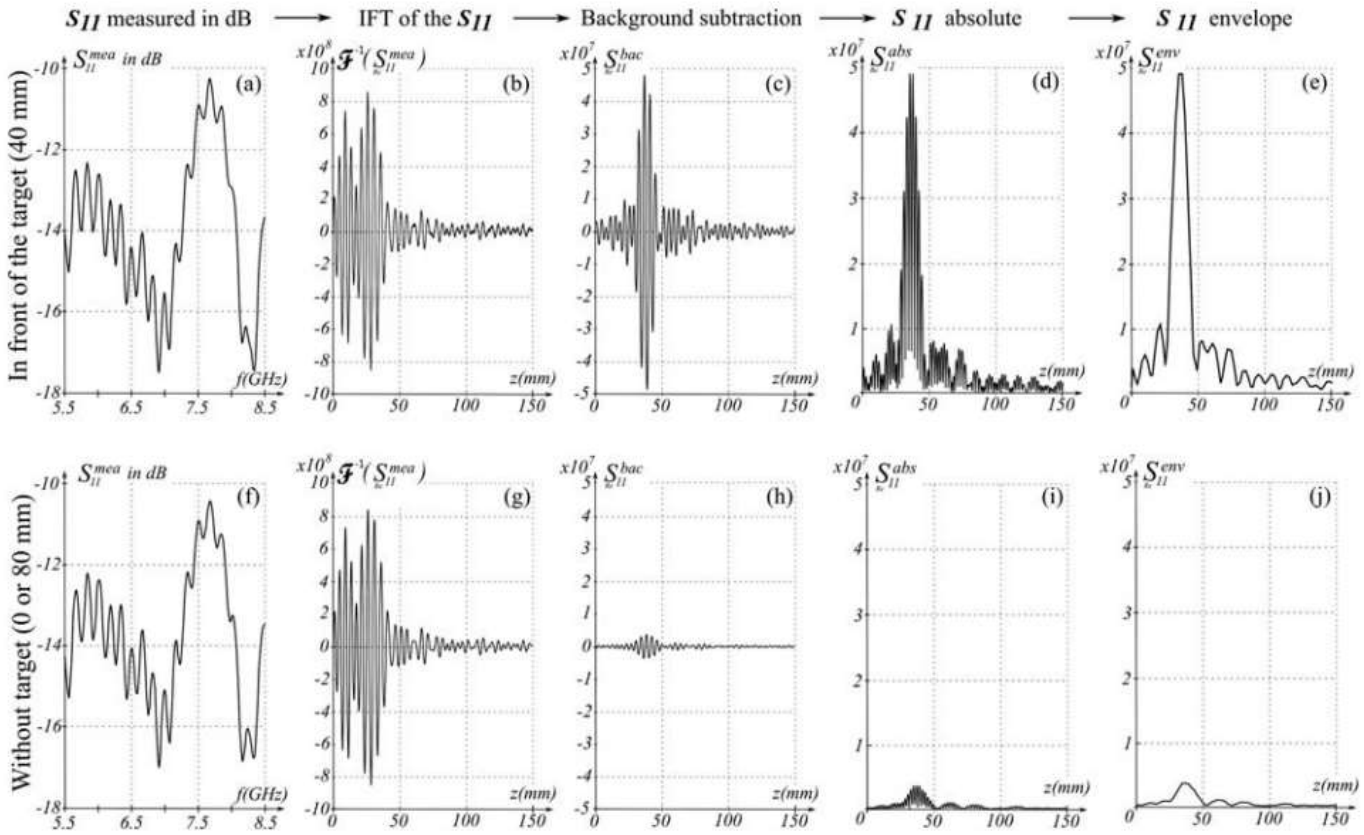
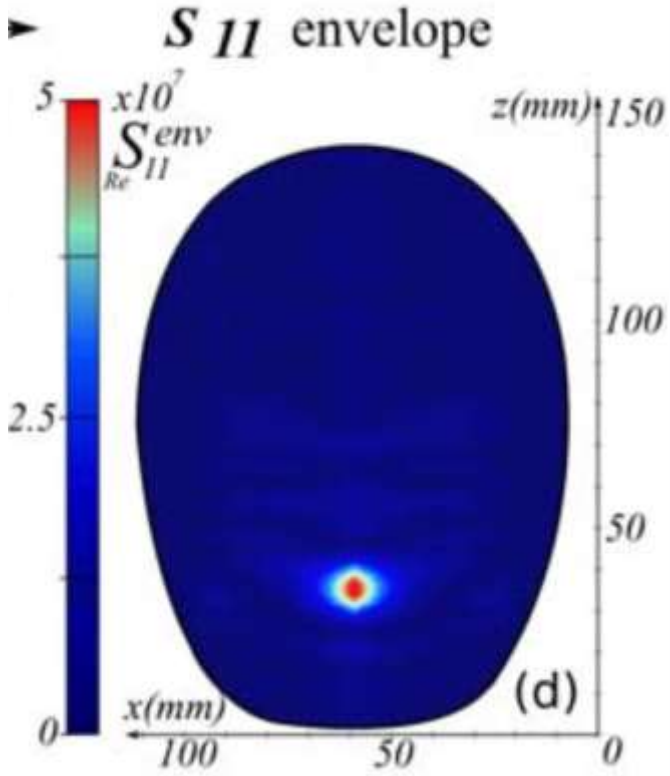


Figure 13 S_{11}-parameter with the FES-AVA in two positions: In front of the target, in the center of the scan area (40 mm), in dB, in the frequency domain (a) in time domain, with the application of IFT (b), with removal of background (c), absolute values (d) and the envelope (e); At the extreme of the scan area (position 0 or 80 mm) in dB, in the frequency domain (f), in the time domain, with the application of IFT (g), with the removal of the background (h), absolute values (i) and finally the envelope (j)



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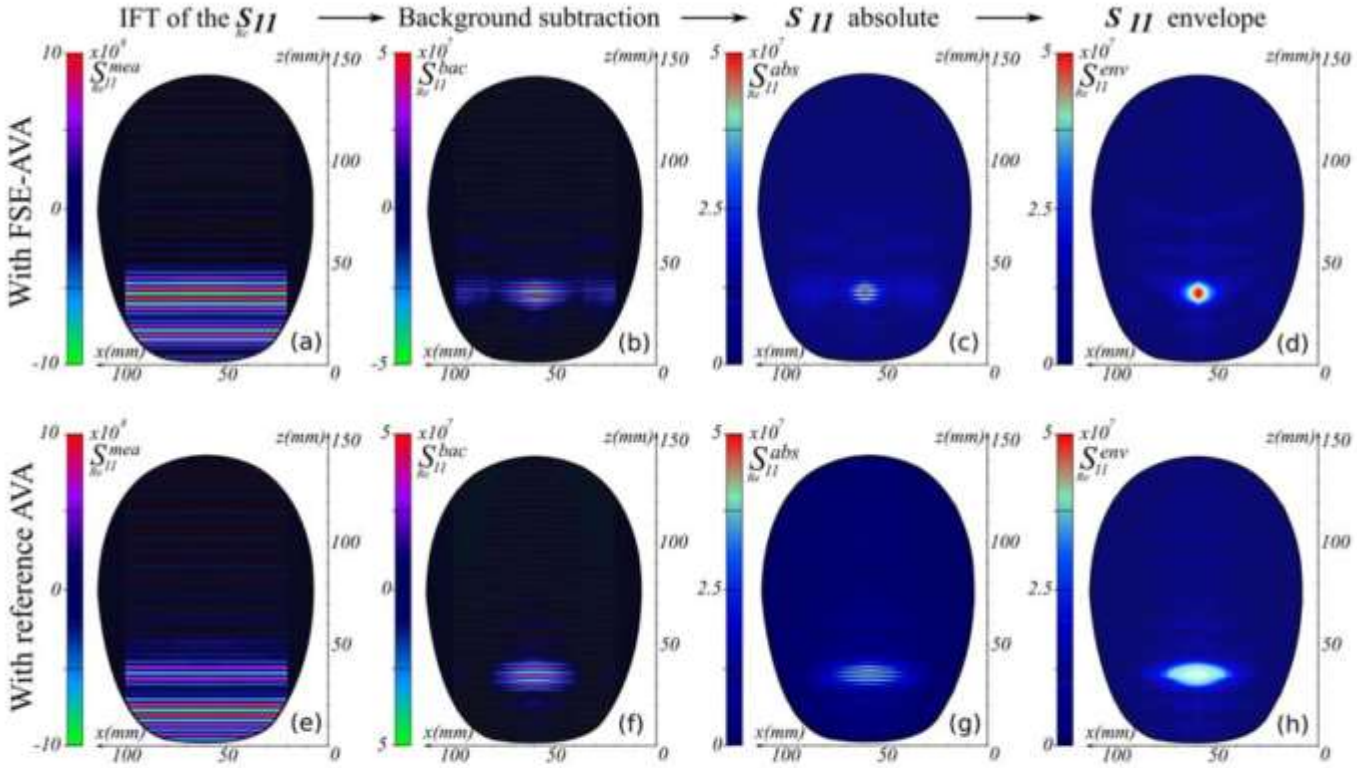
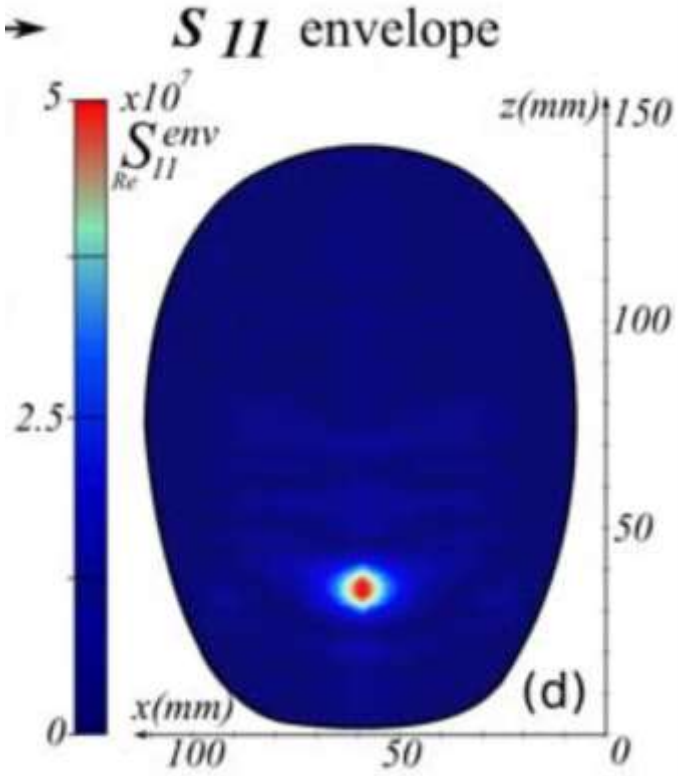


Figure 14 Two-dimensional head tumor scan maps with FSE-AVA in (a, b, c, and d), and with reference AVA in (e, f, g, and h). In (a, and e), the measured S_{11} map appears. In (b, and f), the map without background. In (c, and g), the map in absolute values. And finally in (d, and h), the final near-field microwave image obtained by applying the envelope of the previous map. [Color figure can be viewed at wileyonlinelibrary.com]



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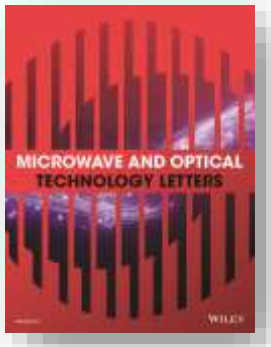

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RESEARCH ARTICLE

Palm tree coplanar Vivaldi antenna for near field radar application

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Abstract

... antenna is an ultra-wideband device that has ... radiation pattern. This paper ... regular and ... that derives the best side lobe level, which confirmed the possibility of applying the Palm Tree technique to coplanar Vivaldi antennas, in addition to the antipodal ones, as originally proposed.

KEYWORDS
antipodal, coplanar, exponential slot, radiation pattern, Vivaldi

1 | INTRODUCTION

Vivaldi antenna is a simple and robust planar device, which has been the focus of recent intensive research, mostly due to its superior unique properties, it is compact, easy to manufacture, with small dimensions and high gain, and could be integrated directly in a circuit board.[1] As a result, it is suitable for many ultra-wideband (UWB) microwave applications. There are many applications for L and S bands, such as cell phone and wireless communication,[2] ground penetrating radar,[3] software defined and cognitive radios,[4] medical imaging and on-body telemetry,[5,6] astronomy,[7] satellite communication, surveillance and amateur radio. All such application needs reliable system mainly for antenna optimization as front end of telecommunication device.

Despite such features, the Vivaldi antenna still carries many shortcomings. The original antenna design has limitations, particularly on directivity and gain, such that a design optimization procedure is generally required for a specific application. In the last few years, many strategies have been developed to improve those properties, for example by adding transmitting lens,[8] using double antipodal structures,[9] and metamaterial ... all those solutions compromise the main ... increasing the final antenna dimens... Therefore, it is ...

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(A) (B) (C) (D)

(E) (F) (G) (H)

FIGURE 12 Fabricated antennas: A, R-AVA front view; B, R-CVA front view; C, R-CVA back view; D, ESE-AVA front view; E, ESE-CVA front view; and F, ESE-CVA back view. ESE-AVA, exponential slot edge antipodal Vivaldi antenna; ESE-CVA, exponential slot edge coplanar Vivaldi antenna; R-AVA, regular antipodal Vivaldi antenna; R-CVA, regular coplanar Vivaldi antenna [Color figure can be viewed at wileyonlinelibrary.com]

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2018-2019

Palm tree coplanar Vivaldi antenna for near field radar application

N. Nurhayati | Alexandre M. De Oliveira | João F. Justo | Eko Setijadi | Bagas E. Sukoco | E. Endryansyah

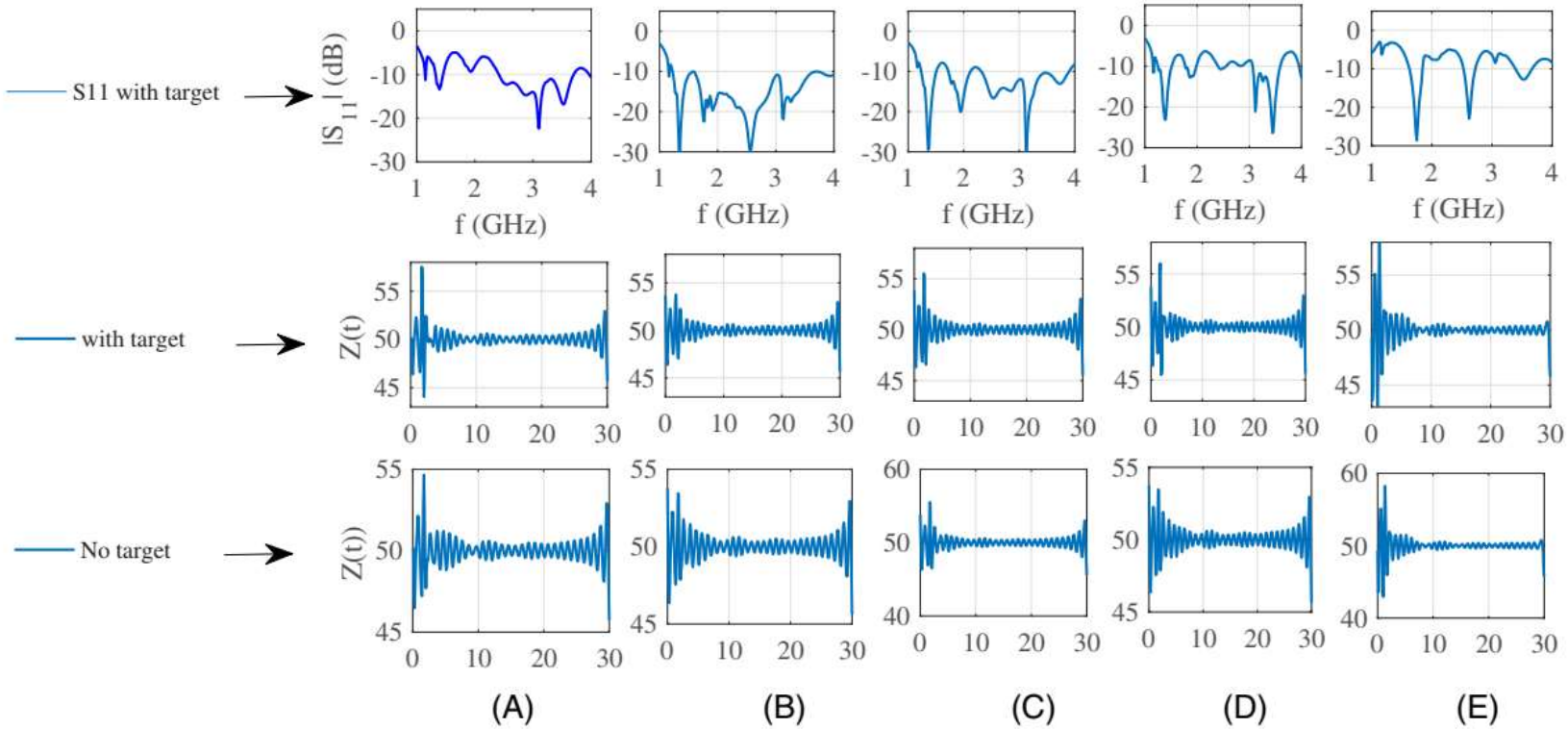

FIGURE 13 Measurement result of S11 with target in the first row, TDR signal for object with target in the second row, TDR signal for object without target in the third row, Substraction object with target and without target in fourth row and the magnitude of the substraction in the fifth row for object:: (A) CVA with thin board, (B) CVA with head phantom from styrofoam, (C) CVA with thick wood, (D) CVA with thin styrofoam, and (E). AVA with head phantom from styrofoam. AVA, antipodal Vivaldi antenna; CVA, coplanar Vivaldi antenna; TDR, time domain reflectometry [Color figure can be viewed at wileyonlinelibrary.com]

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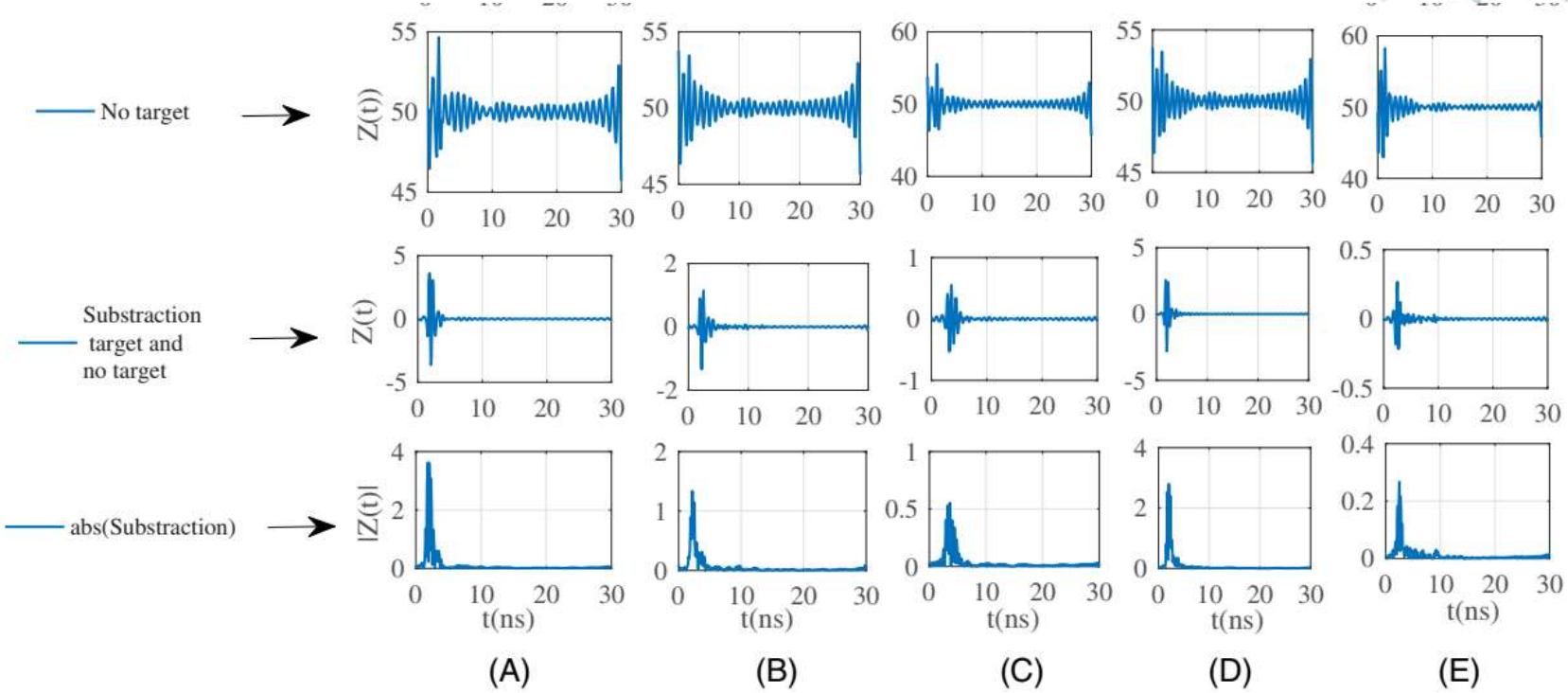

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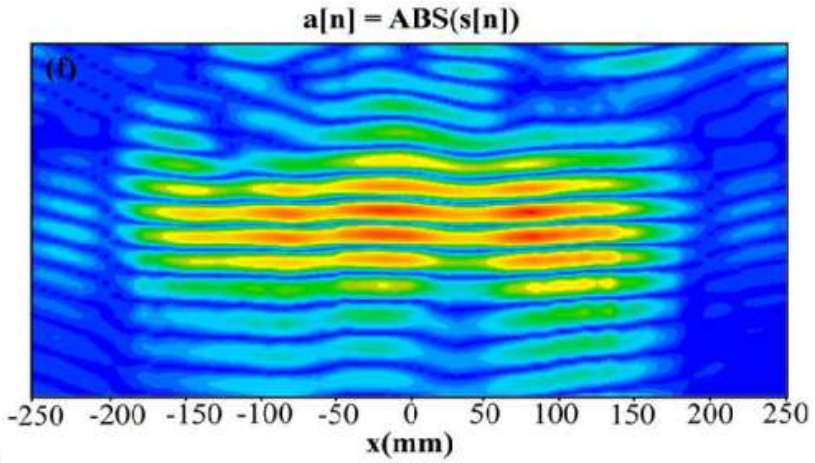

A Vivaldi Antenna Palm Tree Class with Koch Square Fractal Slot Edge for Near-Field Microwave Biomedical Imaging Applications

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***Abstract*— This article presents the modeling of an antipodal Vivaldi antenna (AVA), Palm Tree Class, with radiating fractal slot edge (FSE), in the form of a Koch Square Fractal (SK), labeled as SK-FSE-AVA. The surface currents of the proposed antenna are analyzed, as well as the return loss, directivity, squint, side lobe level (SLL), and Main Lobe (ML) gain. Improvement on directivity is observed when compared to an AVA, with 8.41 dB of gain in the main lobe at 4 GHz, SLL of -11.70 dB, and the squint of 0.10°. SK-FSE-AVA has 9.23 dB of gain in the main lobe at 4 GHz, SLL of –13.50 dB, and the squint of 0.2°. This antenna could be used in ultra-wideband (UWB) systems for applications on Near-Field Microwave Imaging (NMI). To show the feasibility of this application, a 3D numerical simulation of a model containing lung tissue with a malignant tumor is presented, using the proposed antenna and the respective imaging results.**

Keywords—Ultra Wide-Band (UWB), Vivaldi Antennas, fractal slot edge (FSE).

1. INTRODUCTION

Any biological tissue has a dielectric constant (ε), be it tissue or a malignant foreign body [1], such that, when electromagnetic radiation, such as antenna, cause different reflections that, when captured and

fungi, and bacteria [10]; radar [1], [2], [7], [8], [10]; medical images [1], [2], [7]; radio telescopes [2], [7], [8]; 5G communication [6]; and remote sensing [5], [8].

Several construction techniques have been proposed on the AVA, improving Fairfield characteristics (gain, SLL) [2], [7], [10]. These improvements come at the expense of geometrical modifications, incurring larger sizes, for instance, parasitic director [1], [8], with dielectric lenses, metamaterial lenses[6], [8], and polylactic (PLA) substrate lenses[10]. Other techniques, such as tapered slot edge (TSE) and regular slot edge (RSE) of cavity resonators [2], [5], [7], preserve the original dimensions but presents smaller efficiencies due to the confined (non-radiating) fields trapped in the cavities [2], [7], [11]. The ones with radiant exponential [7], [10], [12] and fractal (FSE) [2] slot edge cavities function as parasitic antennas at its edges and control the currents by directing them to the main radiator (Palm Tree Class), which reduces SLL, increasing gain and ML, simultaneously improving directivity and squint [2], [7], [12].

We proposed here a new antenna design, based on the work of [2] and [11], however, using Koch's square fractal to improve gain, directivity, and squint, in addition to decrease SLL and increasing ML. The goal is to provide more stab in antenna radiation, reducing external interference improving its ability to track images [1], [2].

This article is oriented as follows: Section II pres and the respective fractal, while Se results of the antenna. In Se processing a

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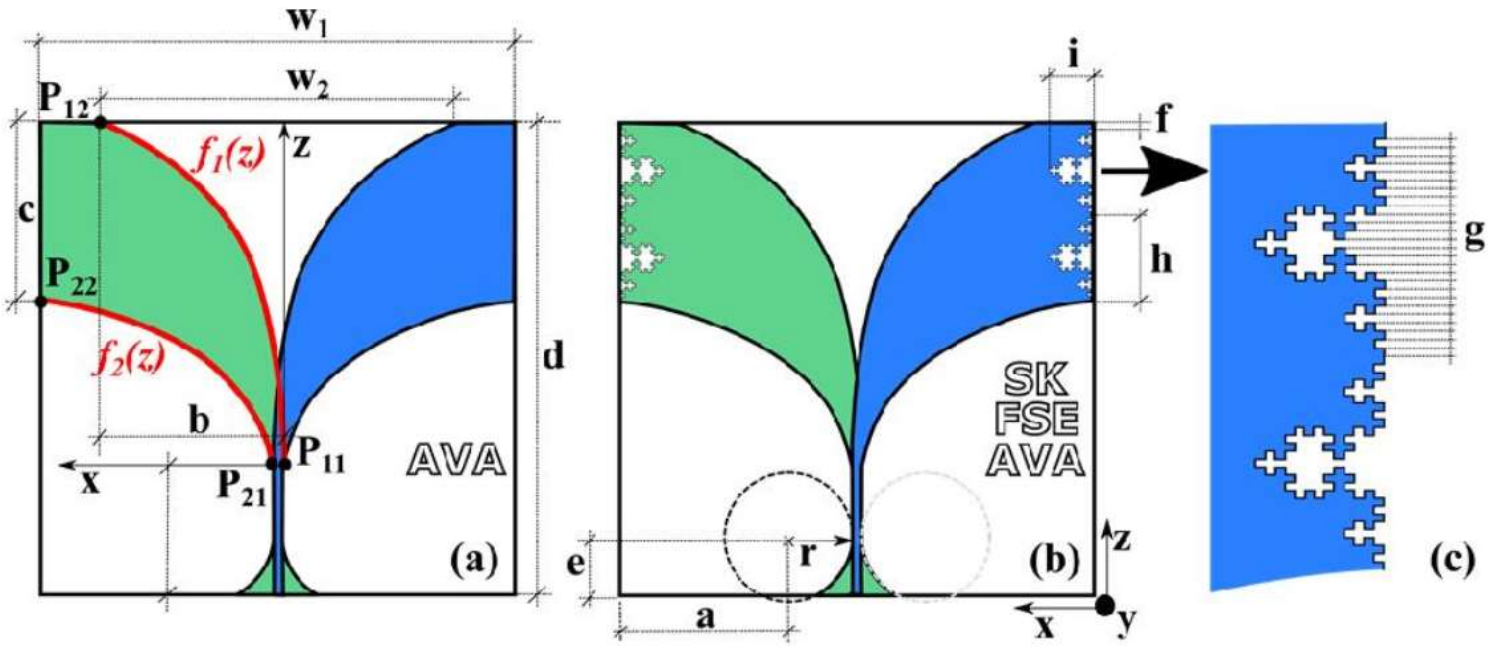

Fig. 1. Dimensions of AVA (a), SK-FSA-AVA (b), and fractals of SK-FSE-AVA (c).

$$f(z) = c_1 e^{Rz} + c_2 \quad (1)$$

$$c_1 = \frac{x_2 - x_1}{e^{Rz_2} - e^{Rz_1}} \quad (2)$$

$$c_2 = \frac{x_2 e^{Rz_2} - x_1 e^{Rz_1}}{e^{Rz_2} - e^{Rz_1}} \quad (3)$$

$$W(A) = \bigcup_{n=1}^{N} w_n(A) \quad (4)$$

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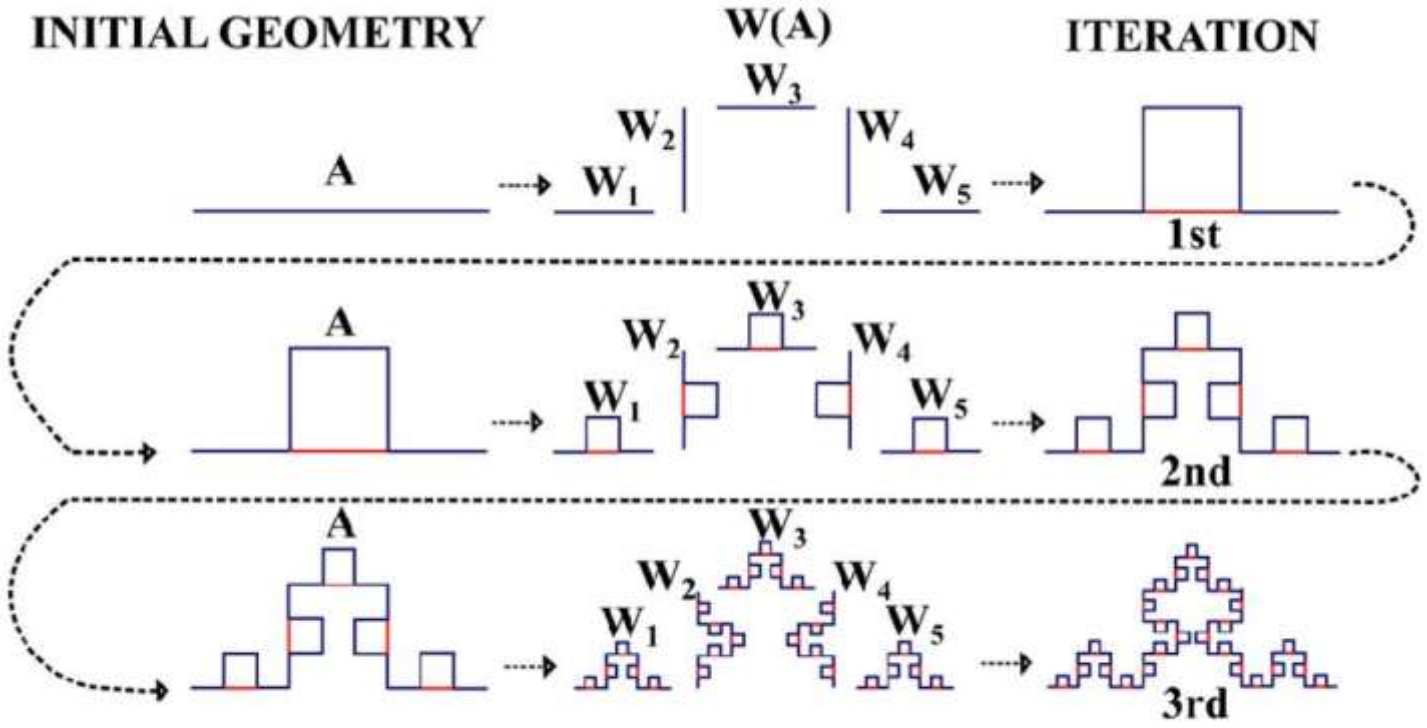

Fig. 2. Development of Koch's Foursquare Fractal using IFS.

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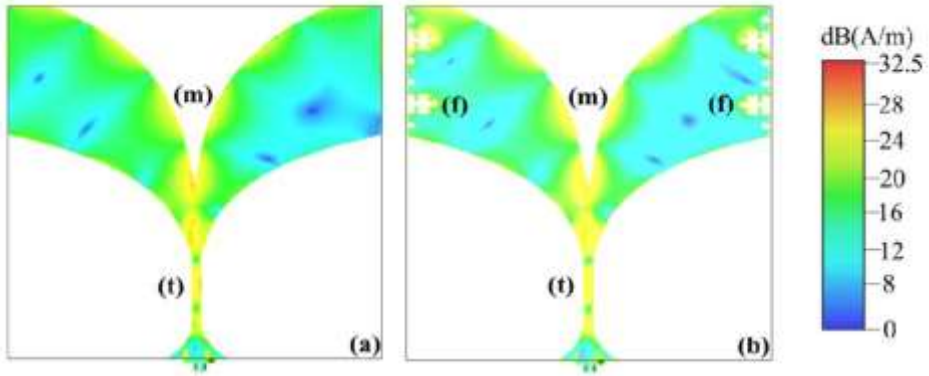
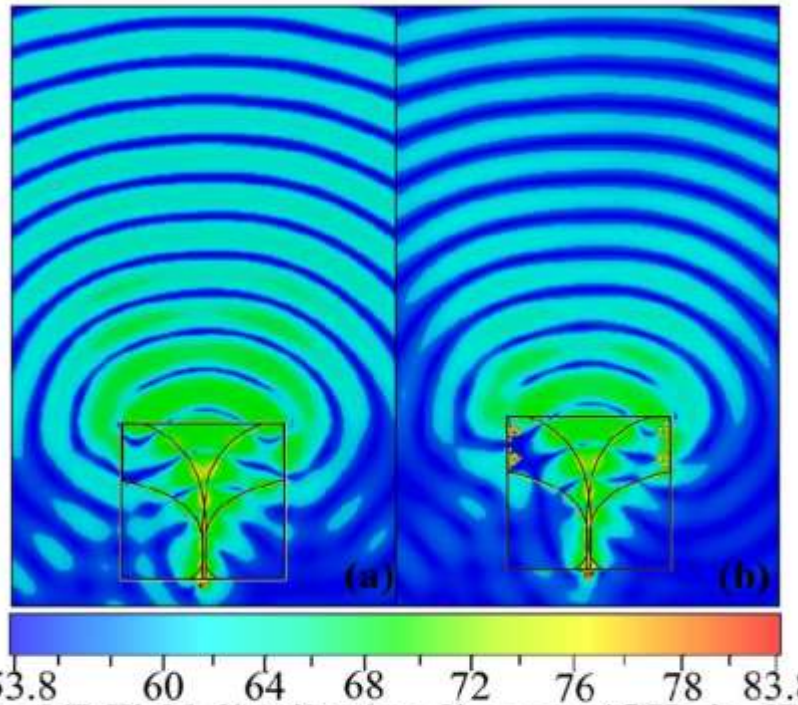


Surface current of AVA (a) and SK-FSE-AVA (b) at 4GHz in dB (A/m)

Fig. 7. Surface current of AVA (a) and SK-FSE-AVA (b) at 4GHz in dB (A/m)



Normalized E-Field distribution diagram 4GHz in dB (V/m)

Fig. 8. E-Field of AVA (a) and SK-FSE-AVA (b) at 4GHz in dB (V/m)

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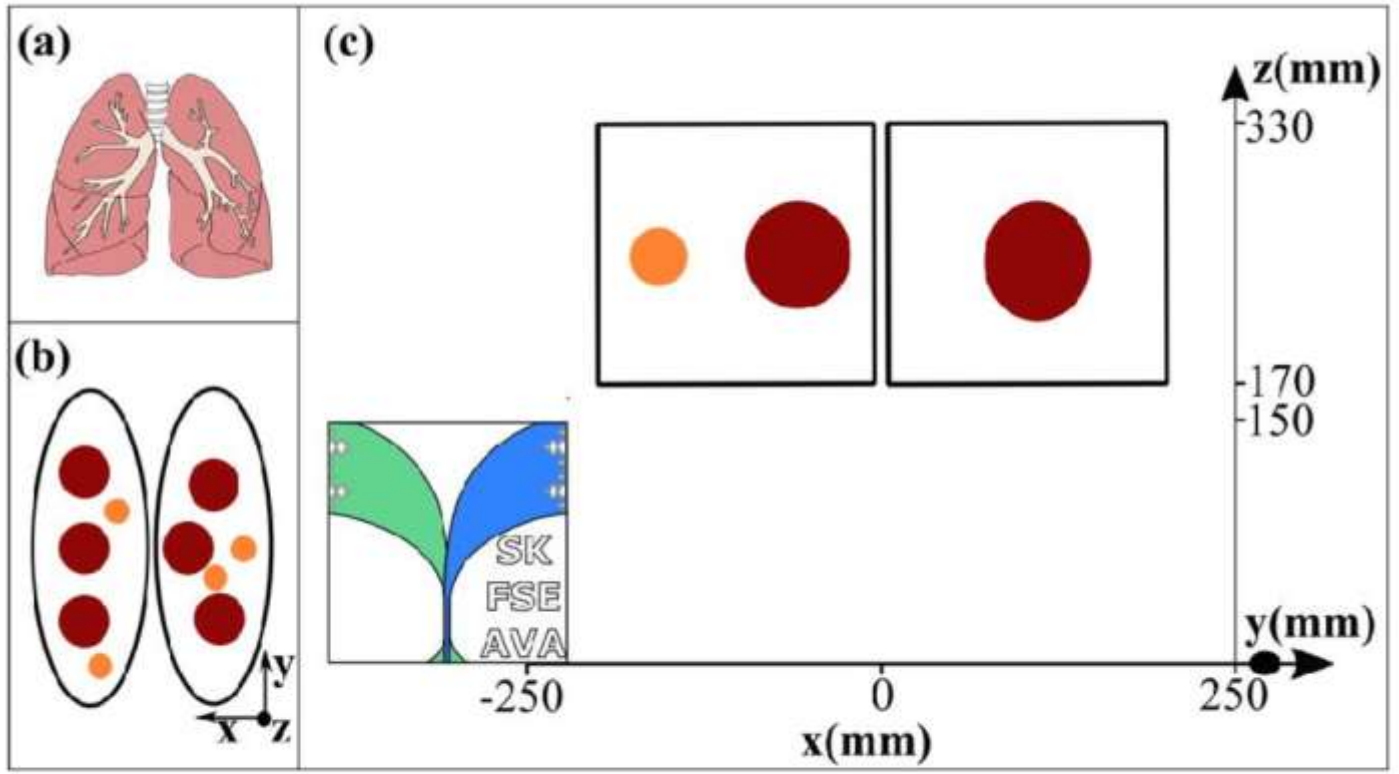

Fig. 9. Lung (a), representation of the lung with tumors for simulation purposes (b), and SK-FSE-AVA running in the x-axis (c).

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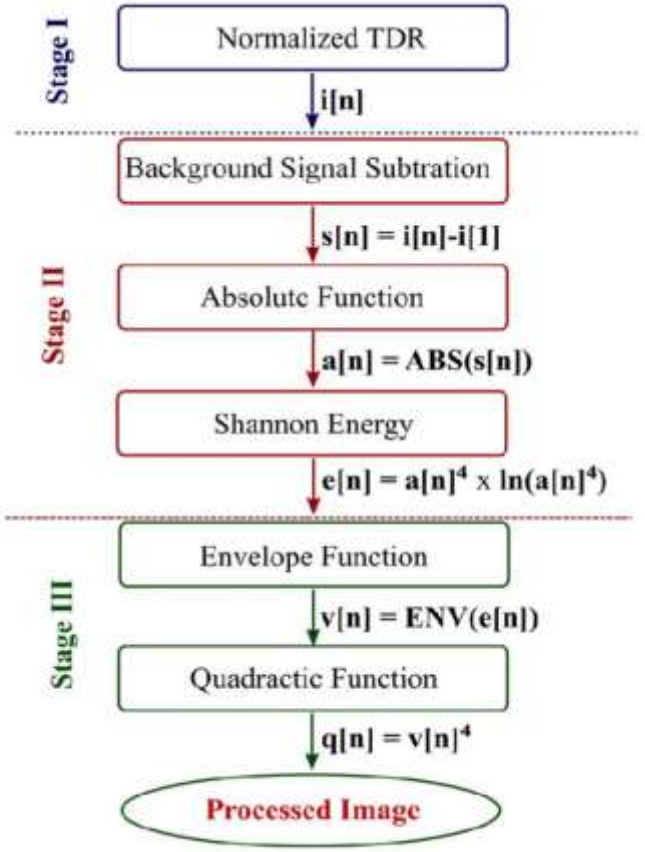

Fig. 10. Flowchart of image processing.

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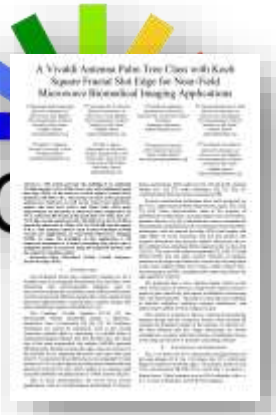

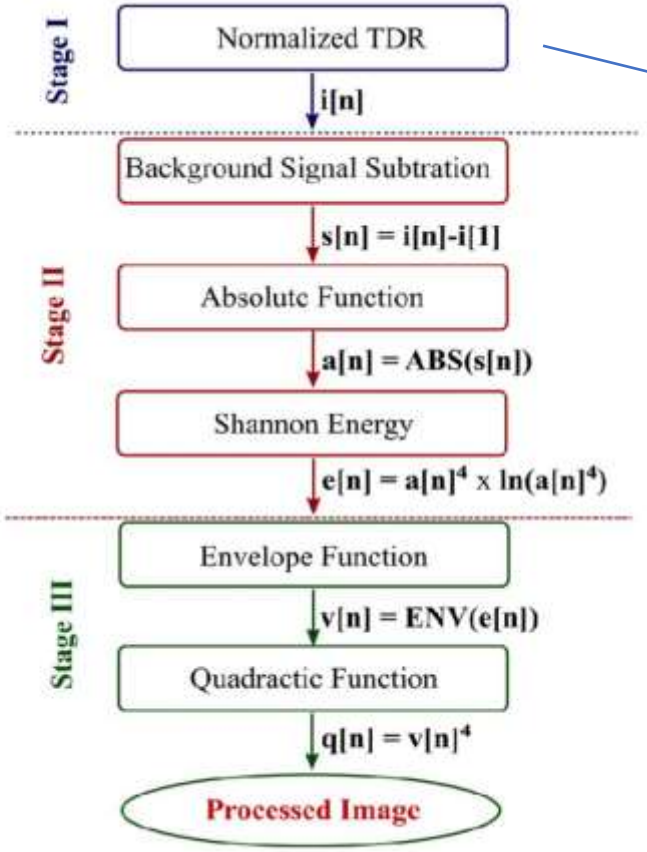

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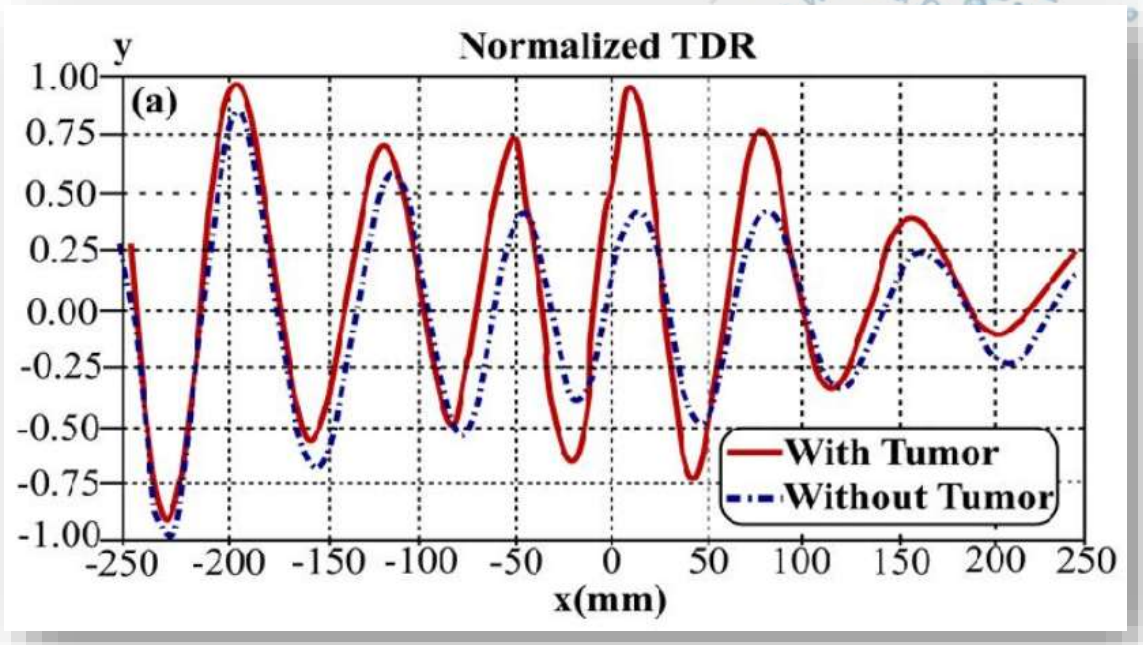

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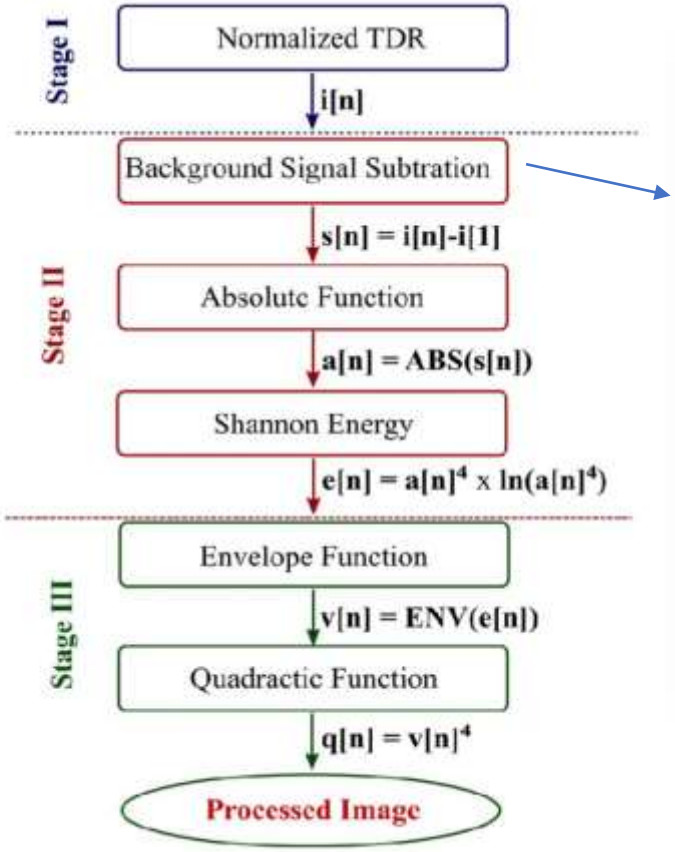

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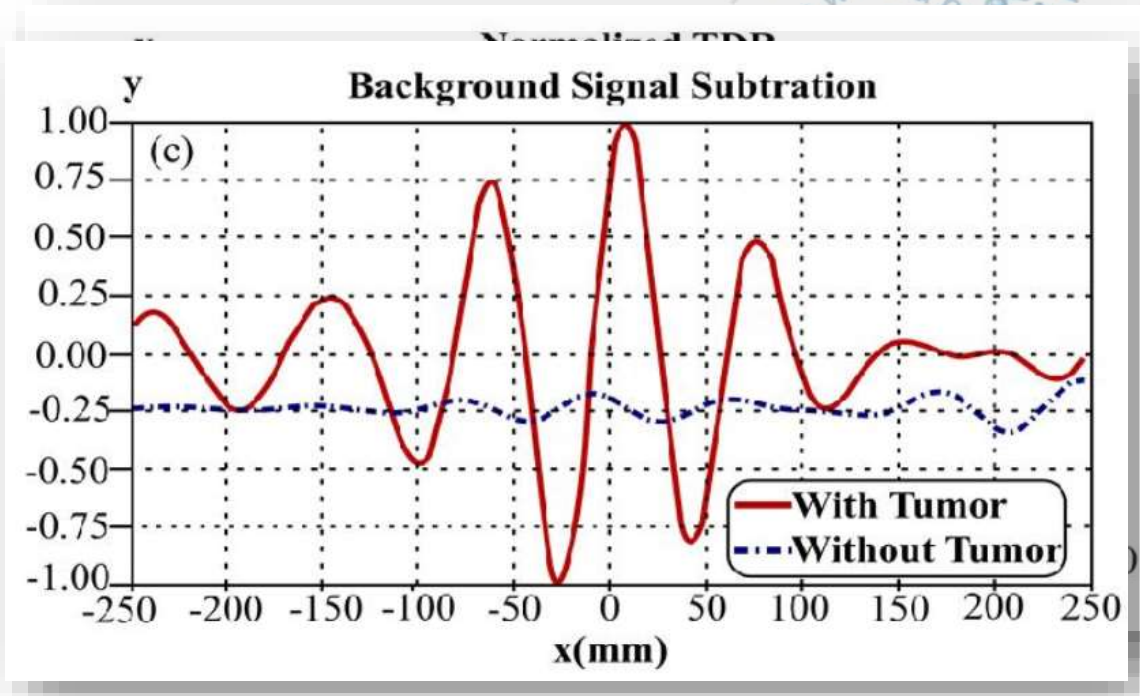

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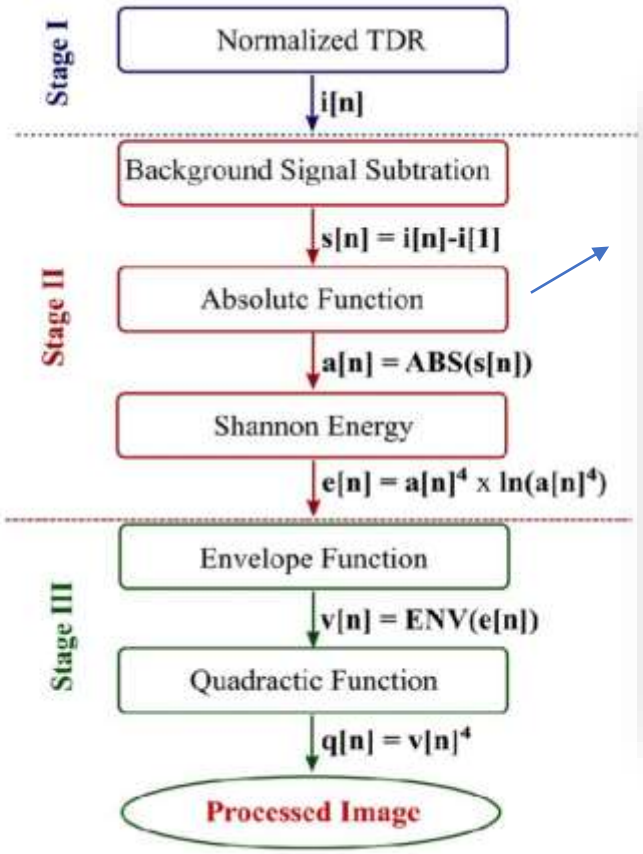

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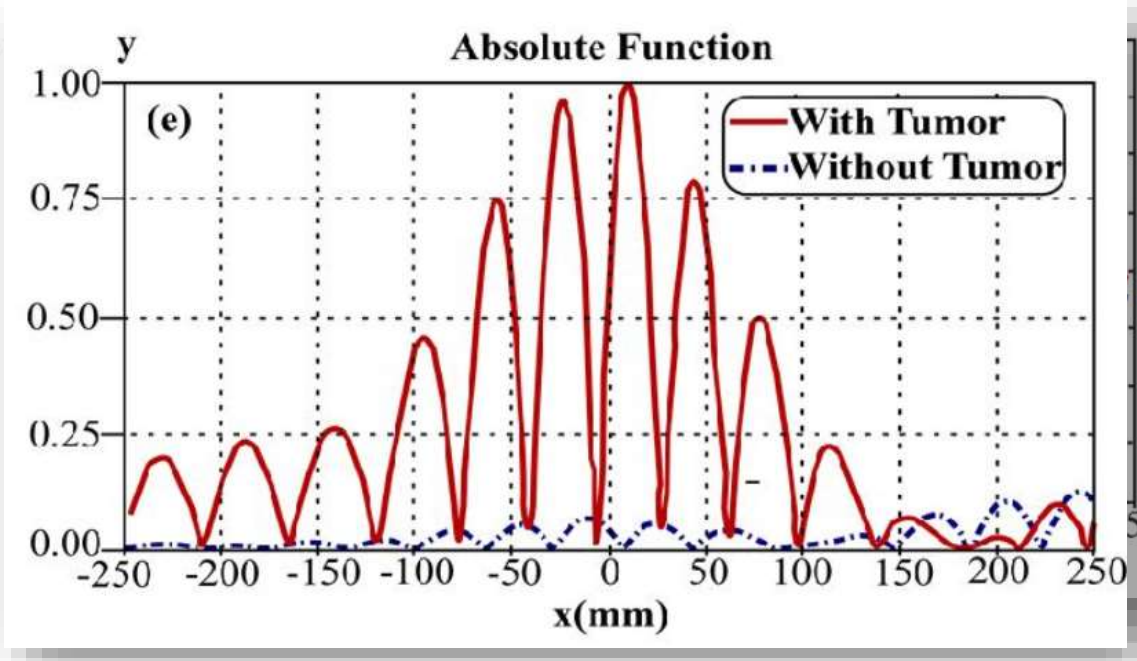

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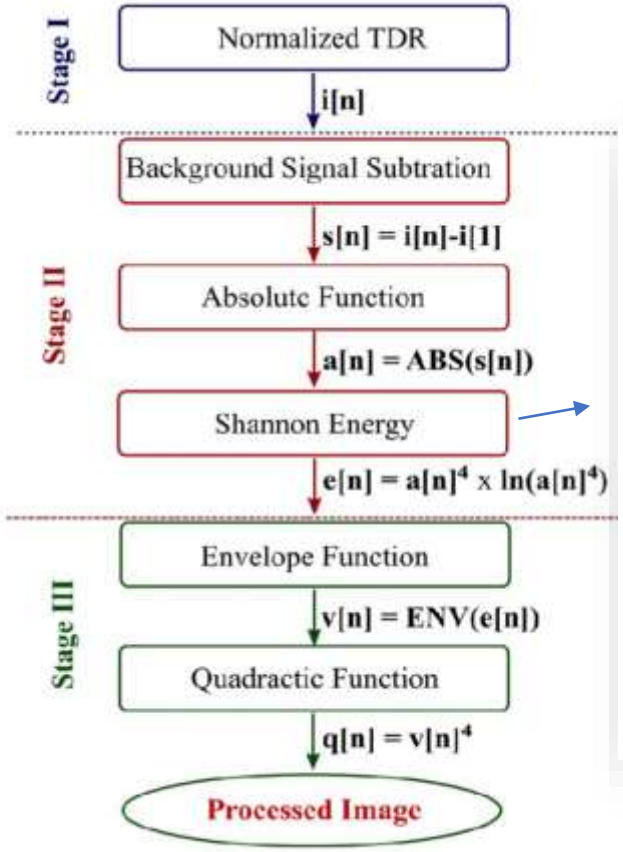

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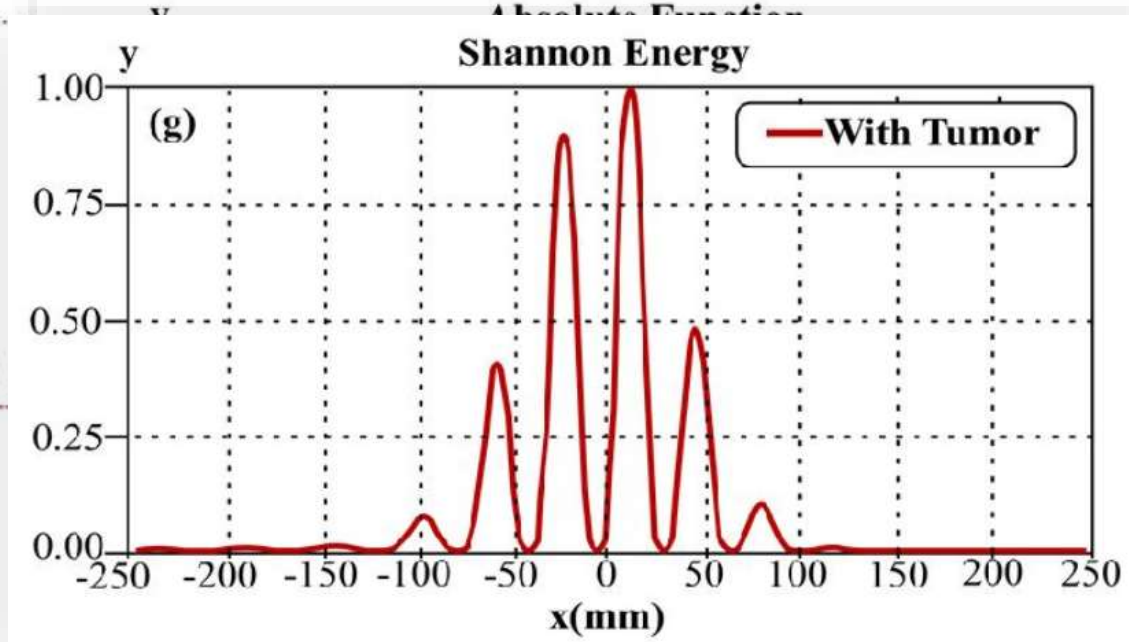

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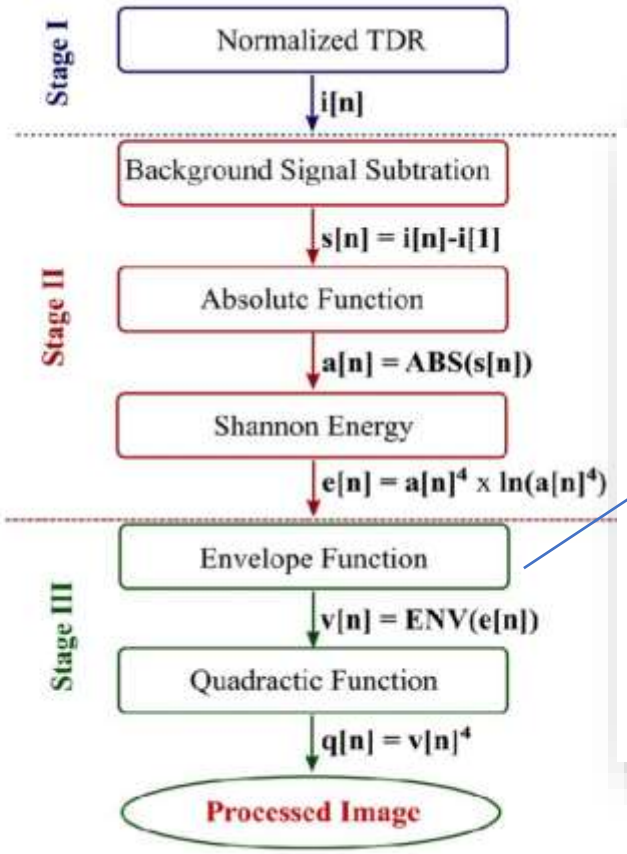

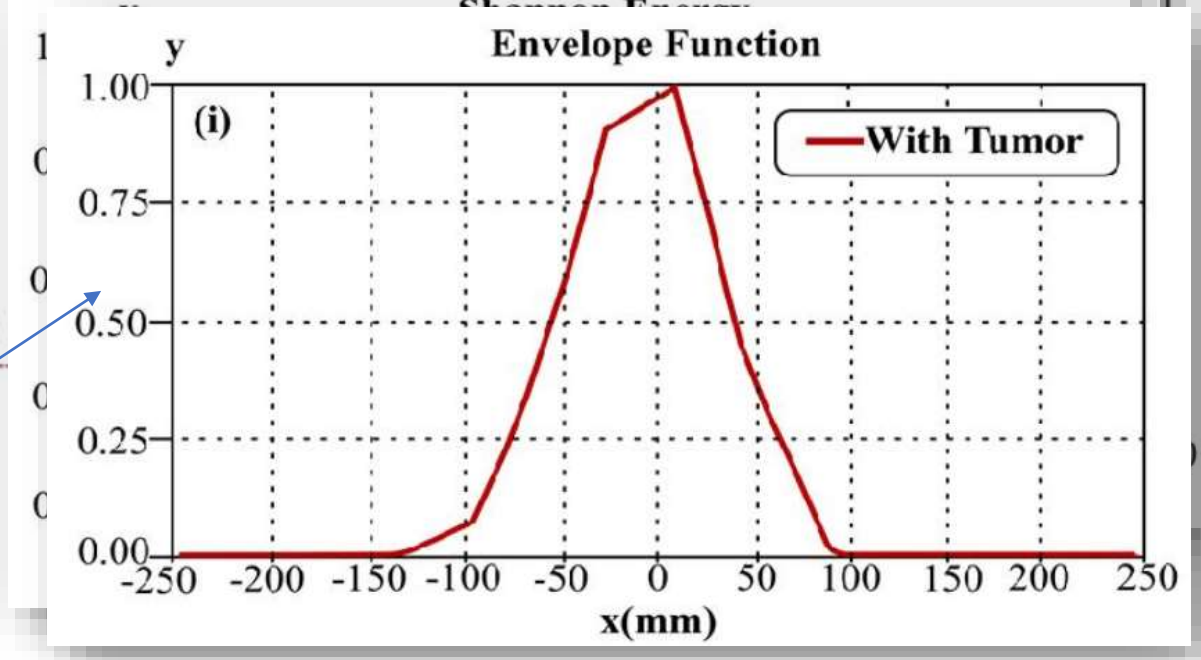

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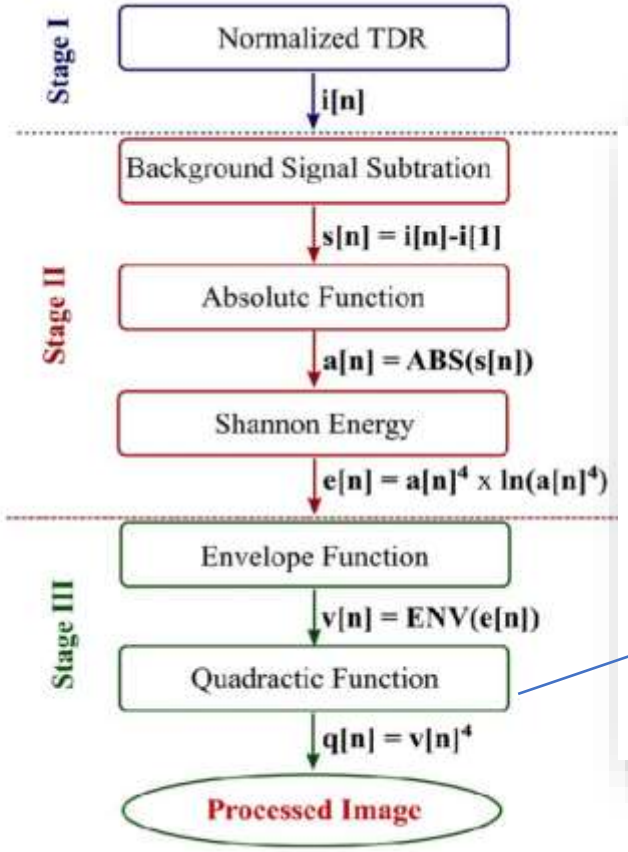

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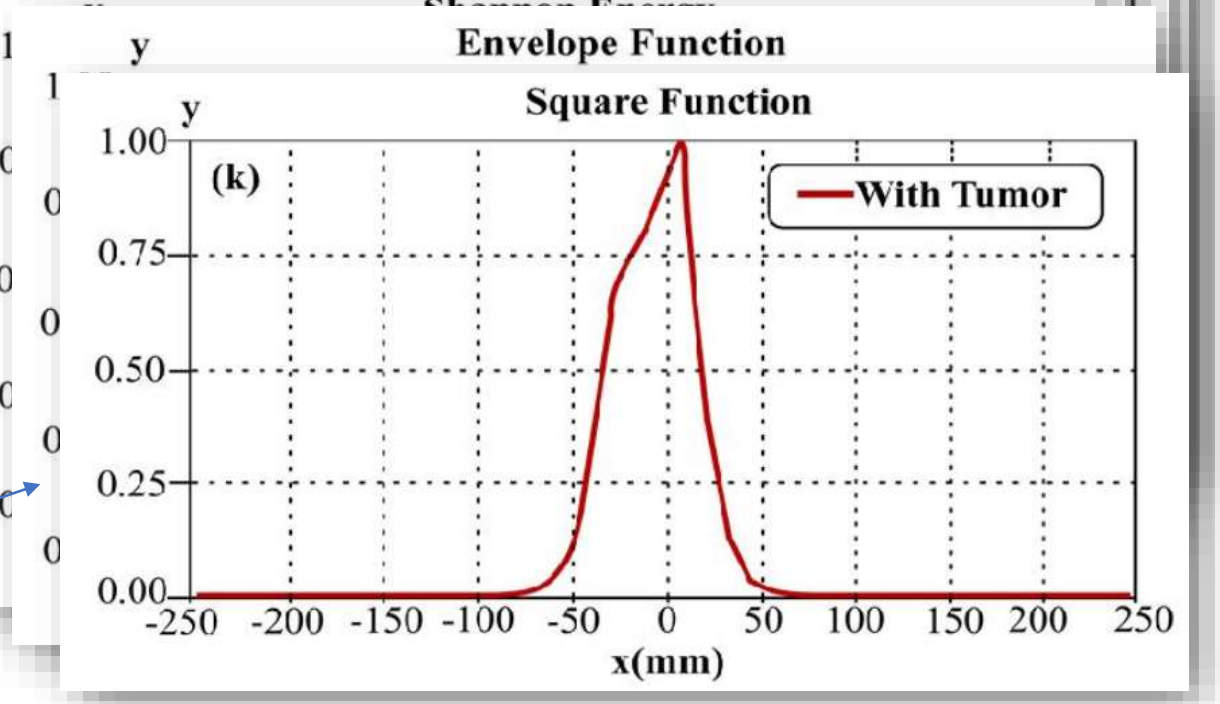

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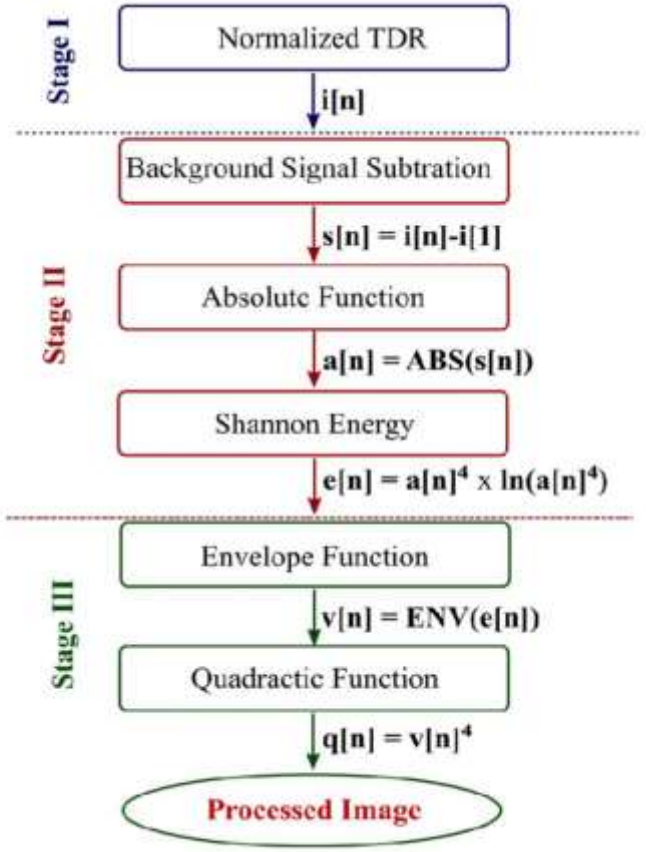

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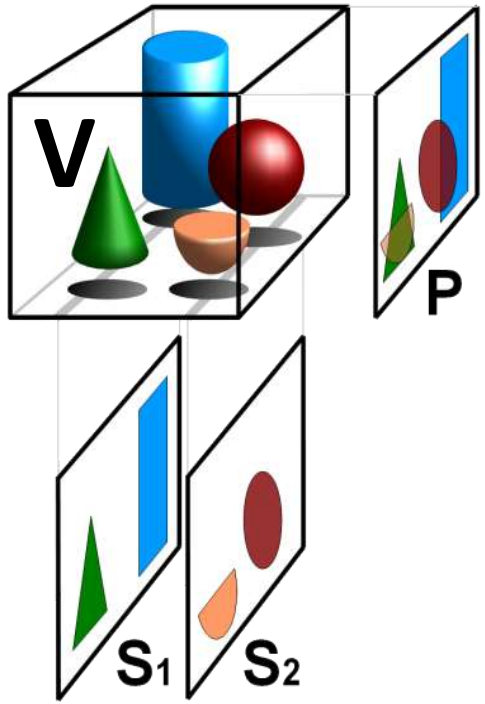

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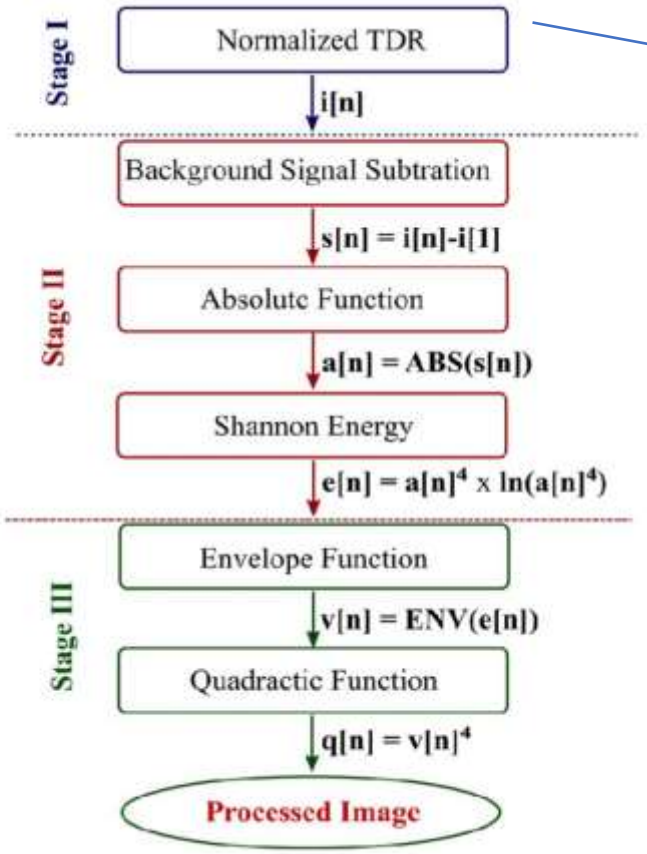

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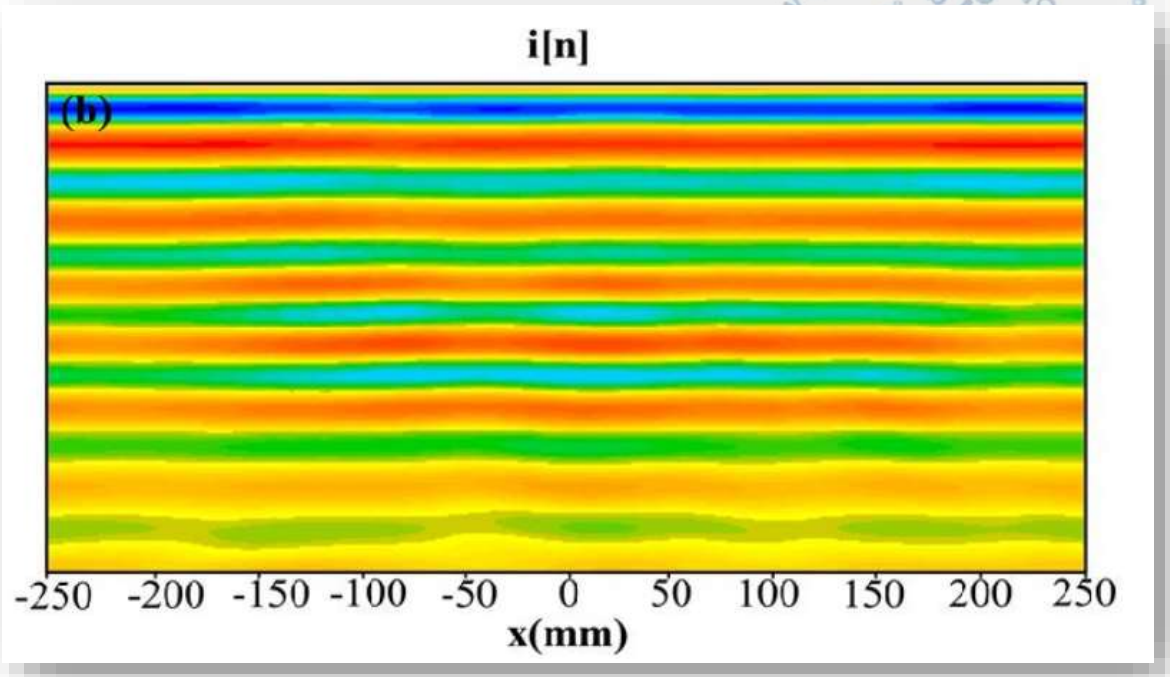

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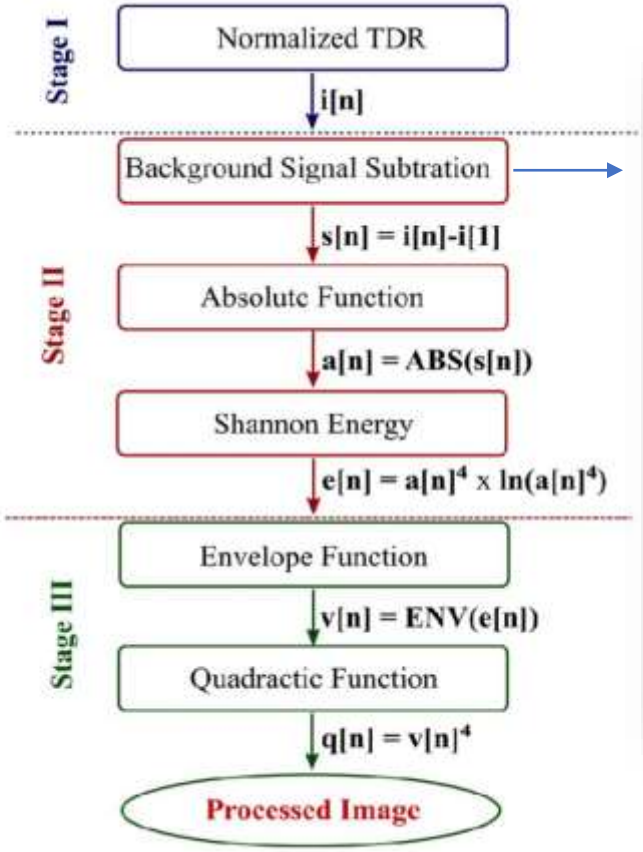

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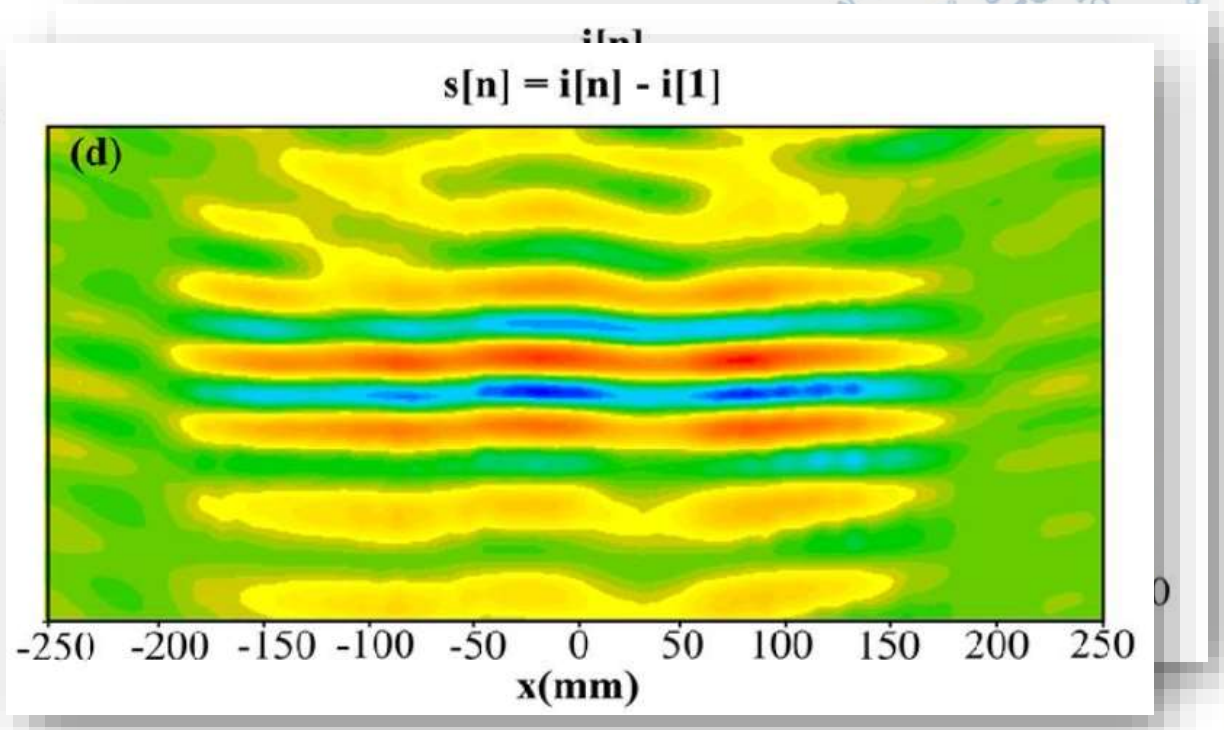

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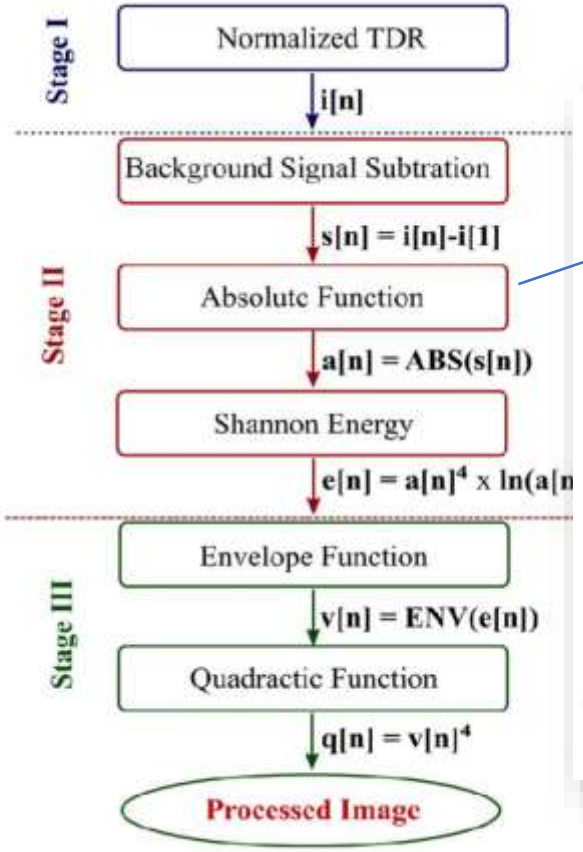

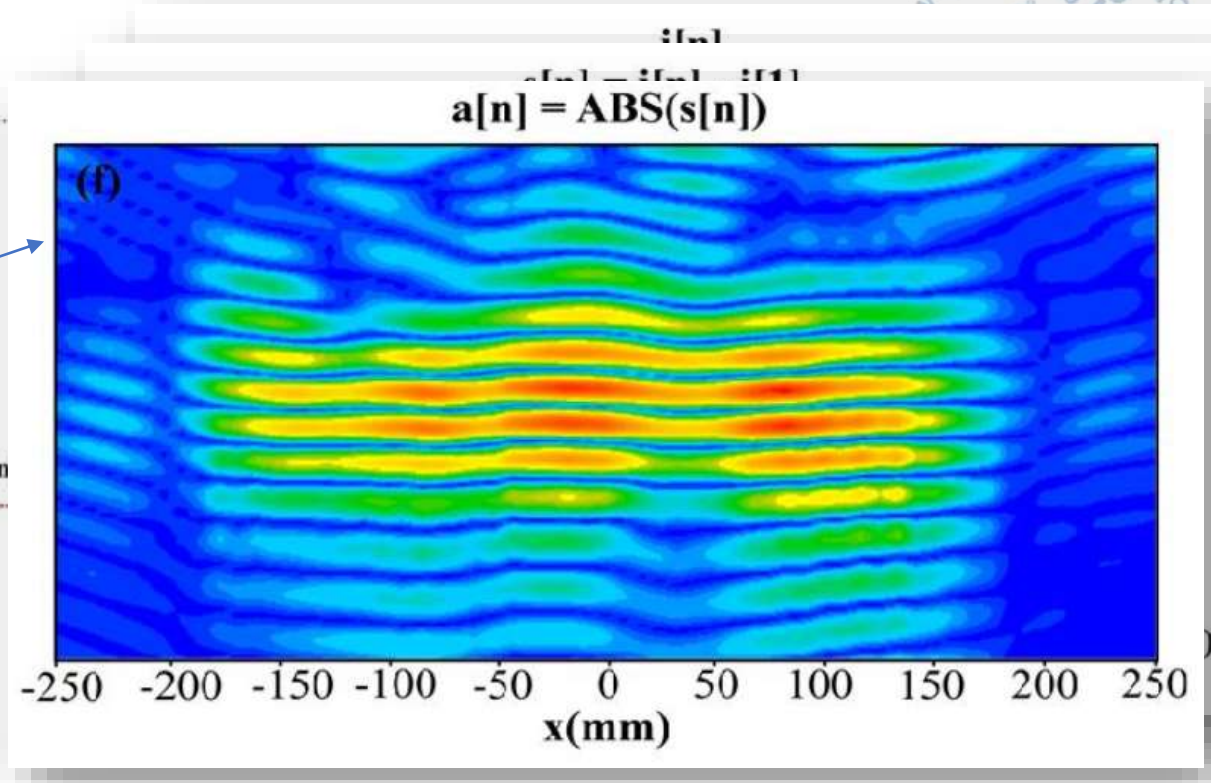

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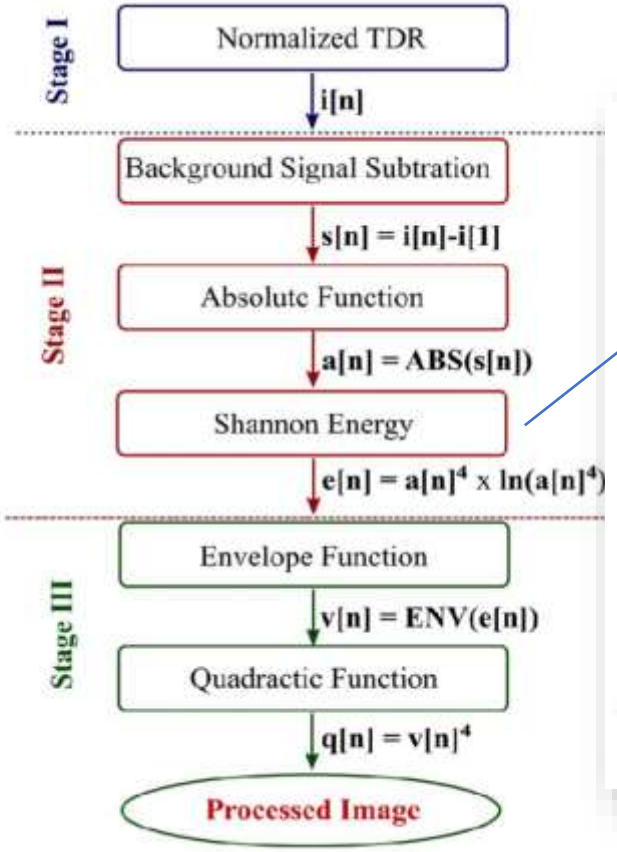

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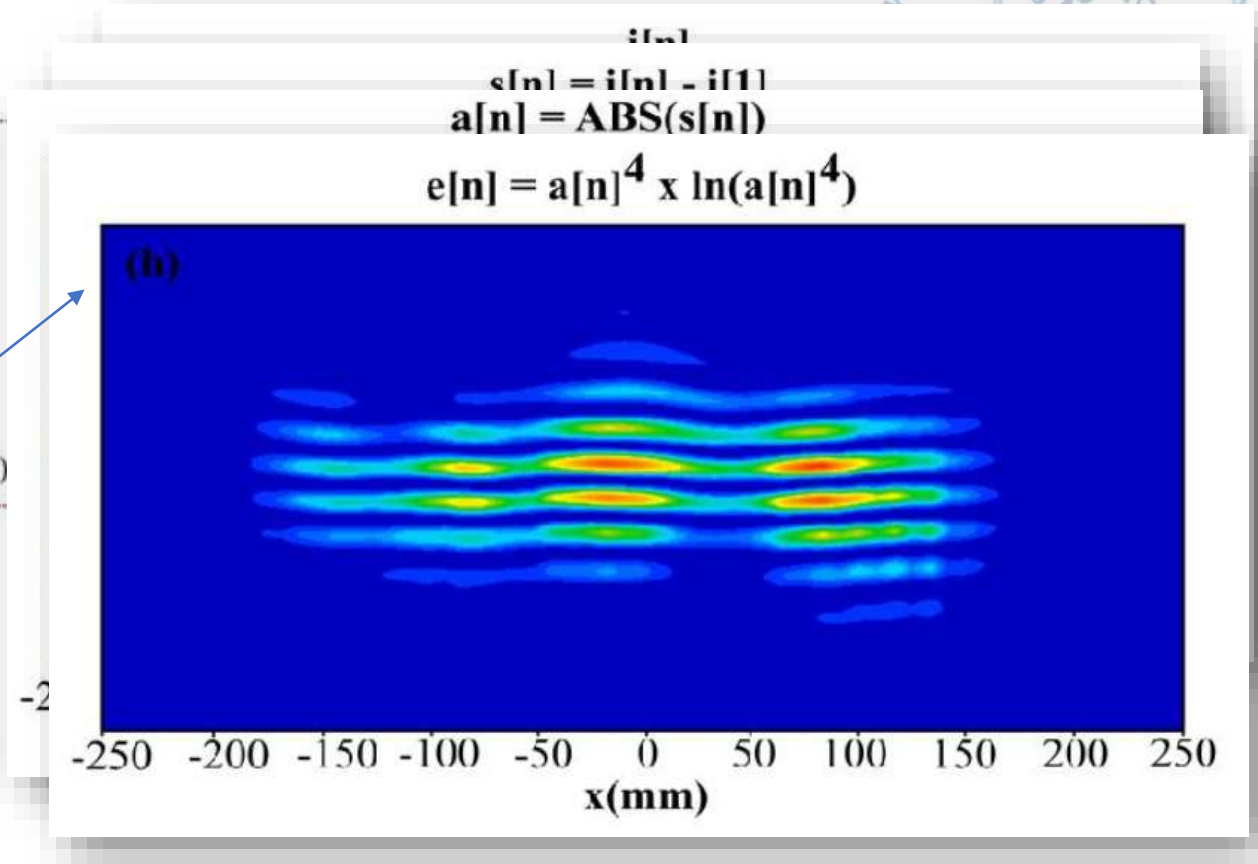

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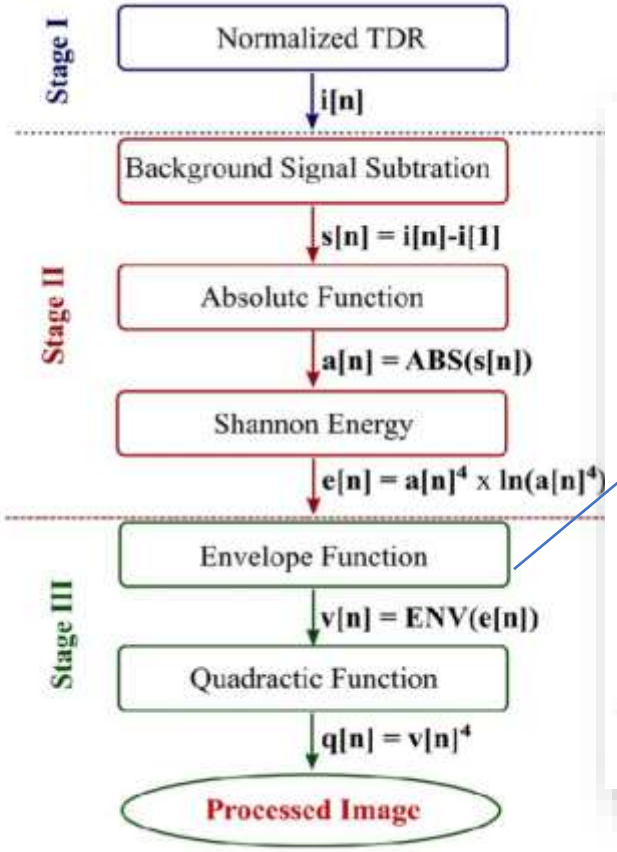
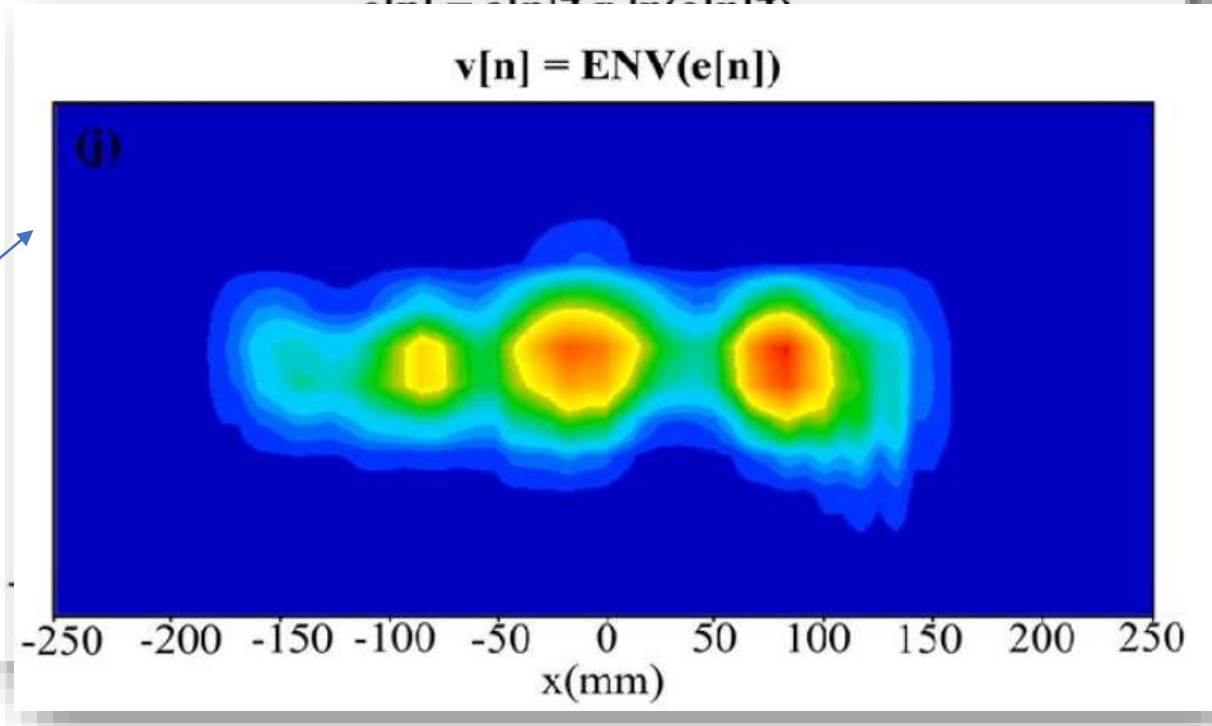


Fig. 10. Flowchart of image processing.



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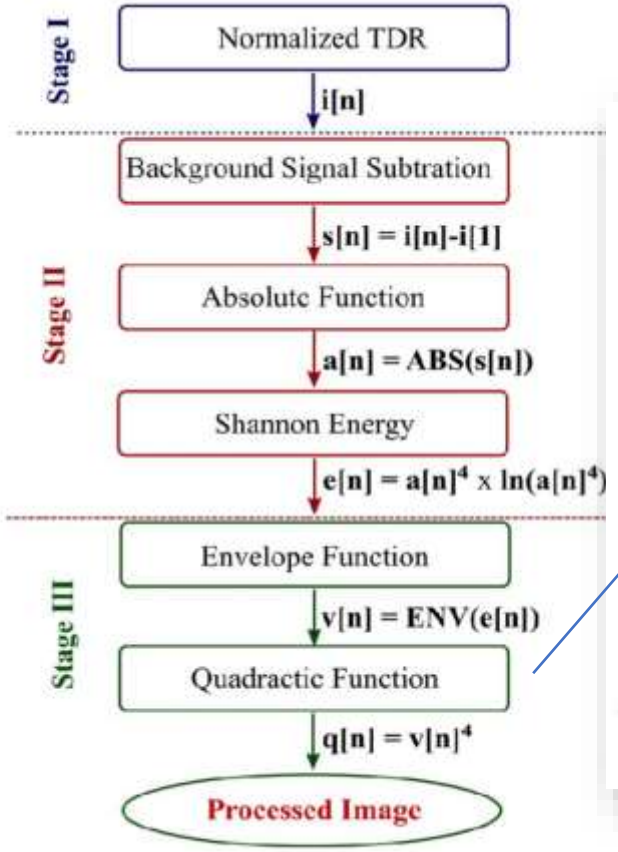

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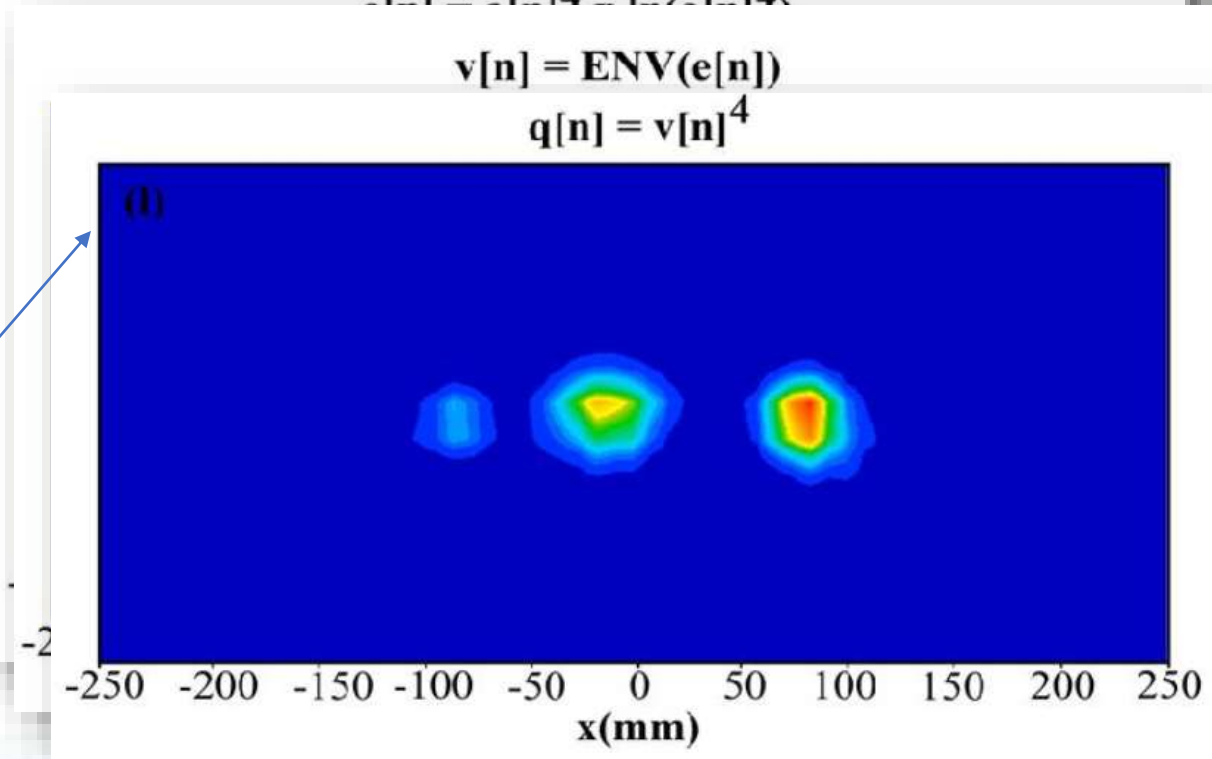

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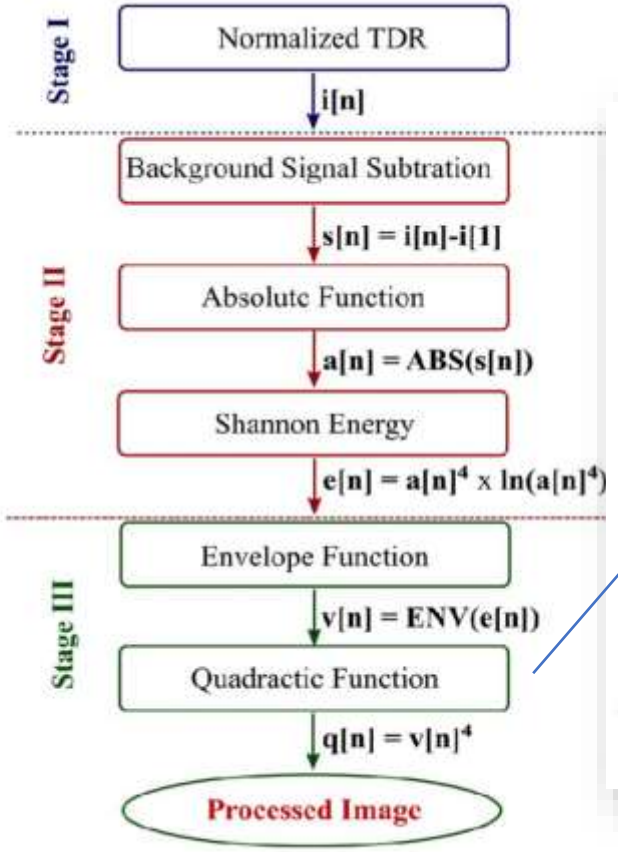

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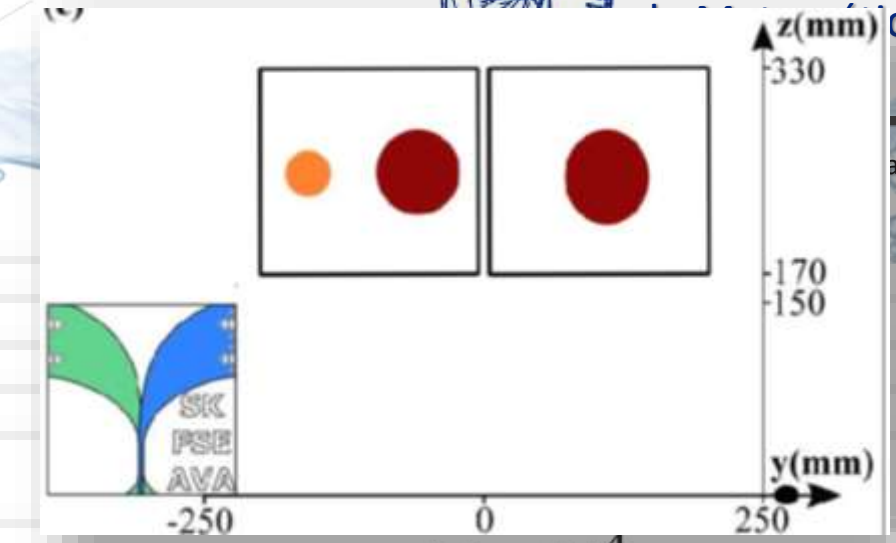
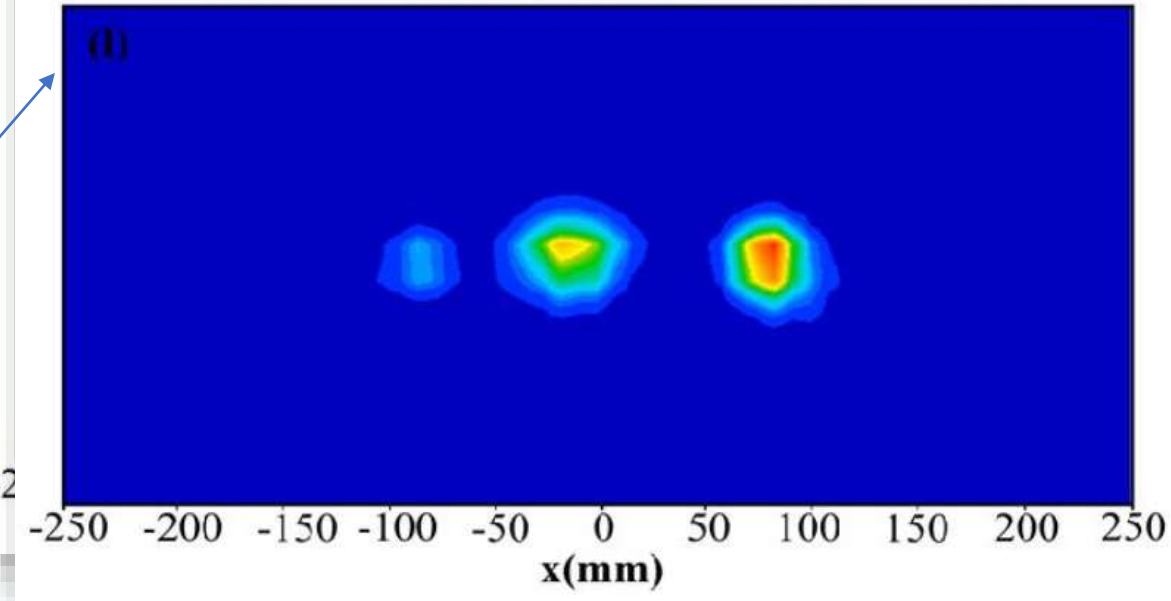


$q[n] = v[n]^4$



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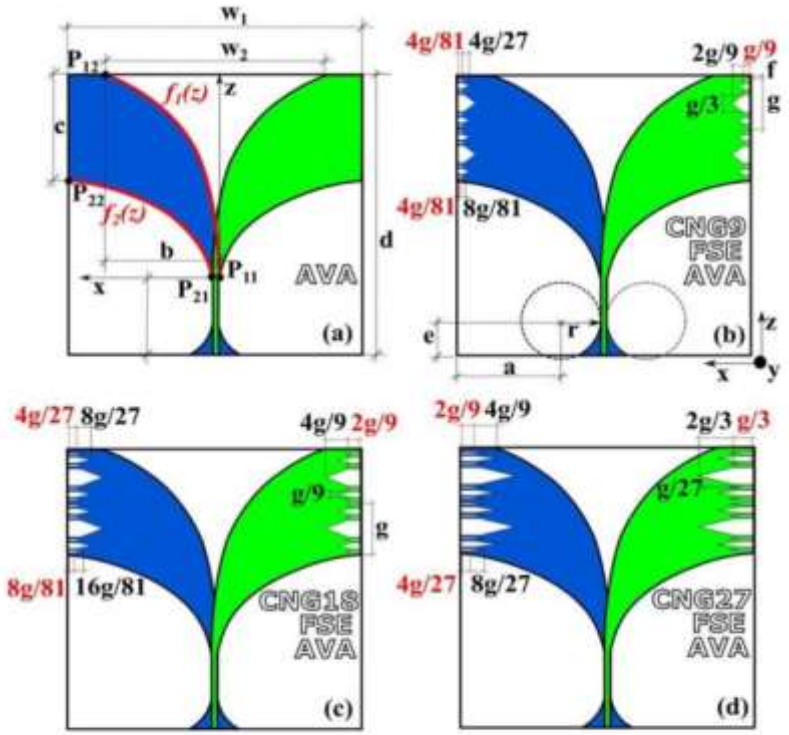

Fig. 1. Parameter and Dimensions: (a) AVA, (b) CNG9-FSE-AVA, (c) CNG18-FSE-AVA, (d) CNG27-FSE-AVA.

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VIVALDI ANTIPODAL ANTENNA WITH HIGH GAIN AND REDUCED SIDE LOBE LEVEL USING SLOT EDGE WITH NEW NEOGOTHIC FRACTAL BY CANTOR WITH APPLICATION IN MEDICAL IMAGES FOR TUMOR DETECTION

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Abstract – This article addresses the study of the Vivaldi Antipodal Antenna (AVA) seeking to improve the gain, decrease the Side Lobe Level (SLL) and the squint, to make the antenna more directive and obtain a more stable radiation pattern. Its intended application lies in the generation of biological microwave imaging to detect brain tumors. With this objective, the Fractal Slot Edge (FSE) technique was applied with a new fractal developed and based on the Cantor set. The application of this fractal, called Cantor Neogothic Fractal (CNG), formed different-sized cavities resulting, in this work, in three antennas that were analyzed through numerical computational simulation together with AVA. The antennas, called CNG9-FSE-AVA, CNG18-FSE-AVA, and CNG27-FSE-AVA, in which 9, 18, and 27 define the maximum height that the fractal reached in each antenna, have areas equal to 354.66 mm², 709.33 mm² and 1064 mm², respectively. All antennas achieved the goal, however, CNG27-FSE-AVA presented the best results at 2 GHz, with a gain of 7.84 dBi, SLL -19.80 dB, and squint of -0.10 degree. Additionally, it was proved that the antenna is suitable to generate a near field microwave imaging of tumors in a brain model.

Keywords: Ultrawide band (UWB) system, fractals antennas, slot edge in Antennas Vivaldi.

also favors its wide applicability in ultra-wideband (UWB) as: spacecraft [1], satellites [1], [2]

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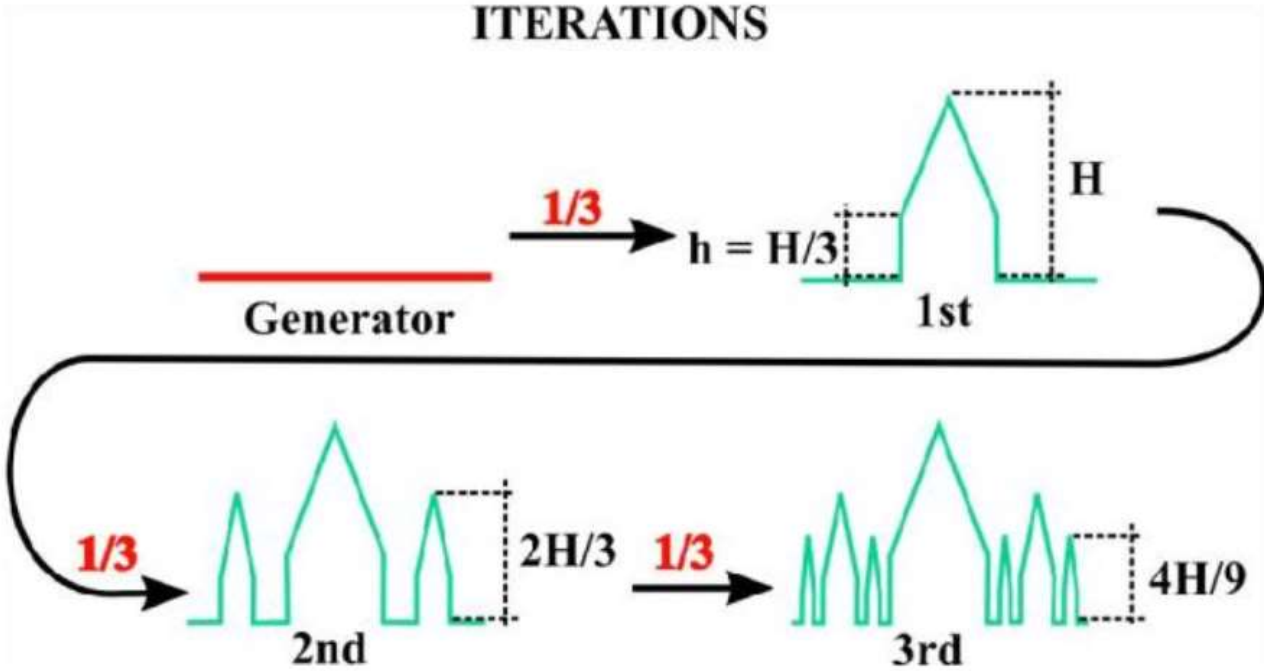

Fig. 2. Iterations new Neo-Gothic Fractal by Cantor.

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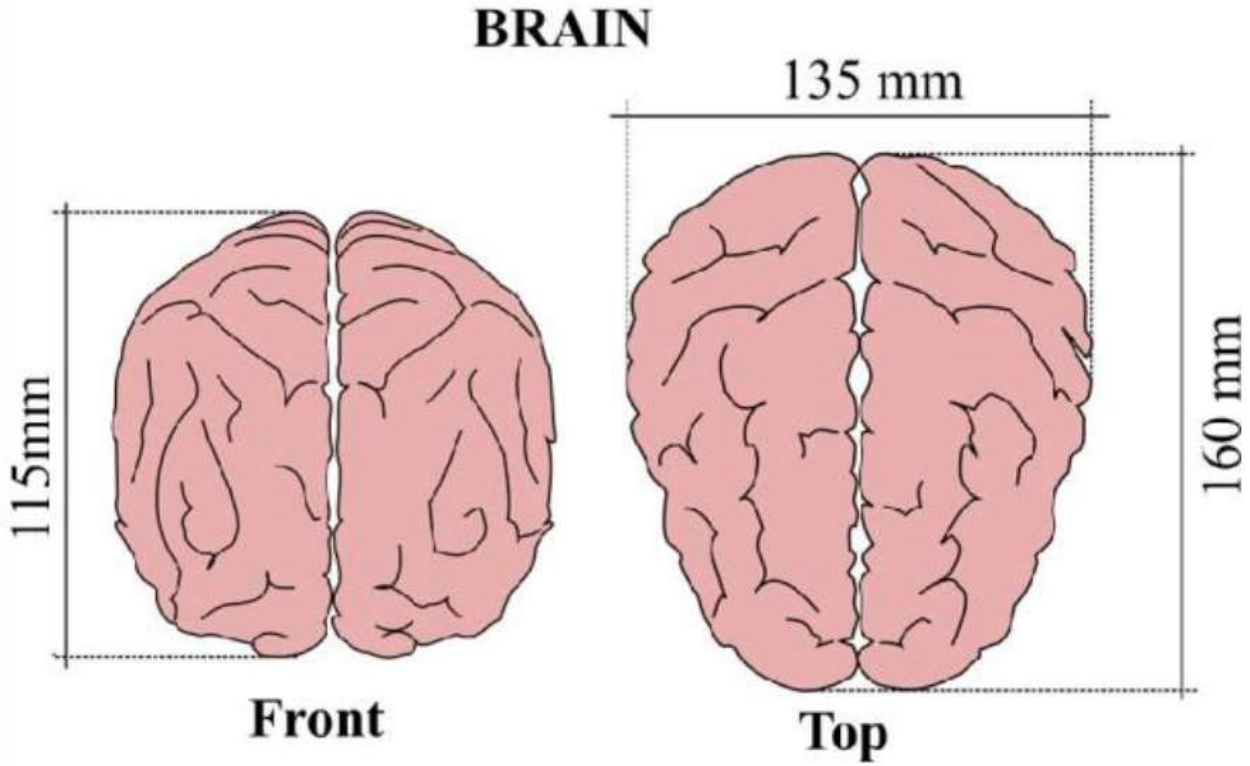

Fig. 7. Dimensions model brain.

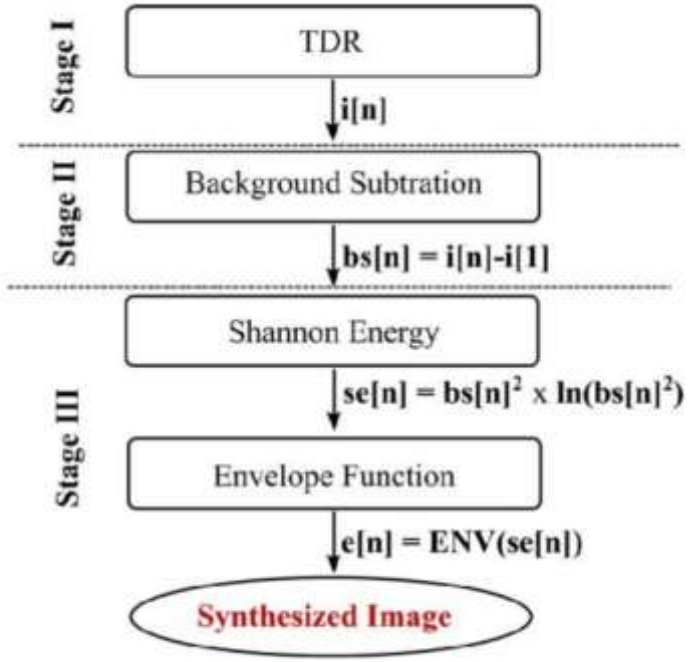

Fig. 8. Image Synthesized Stages.

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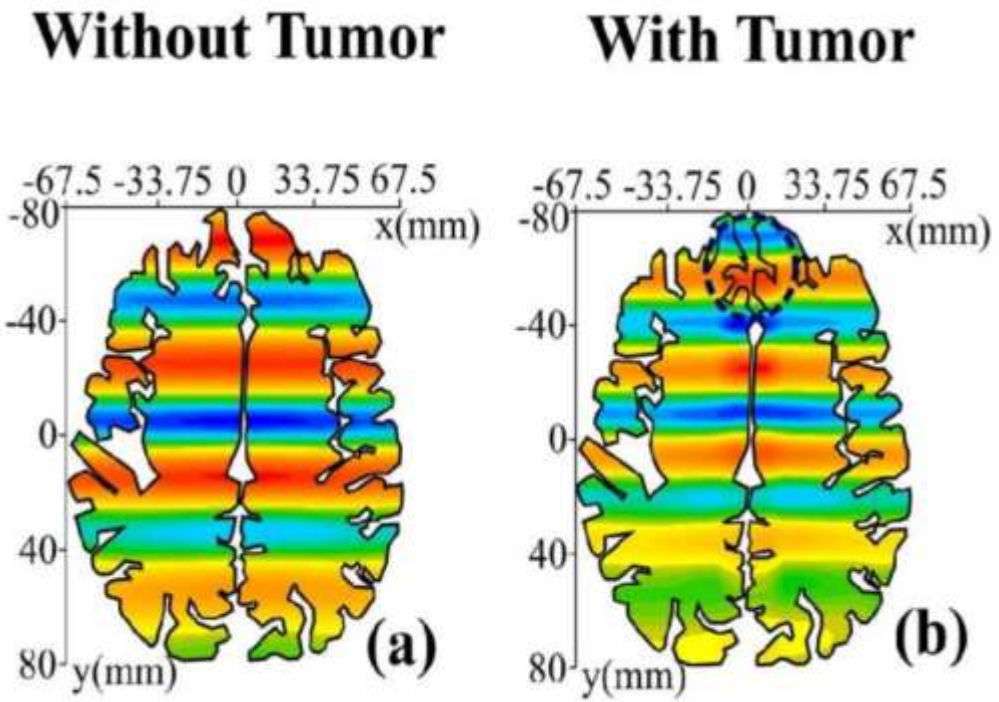

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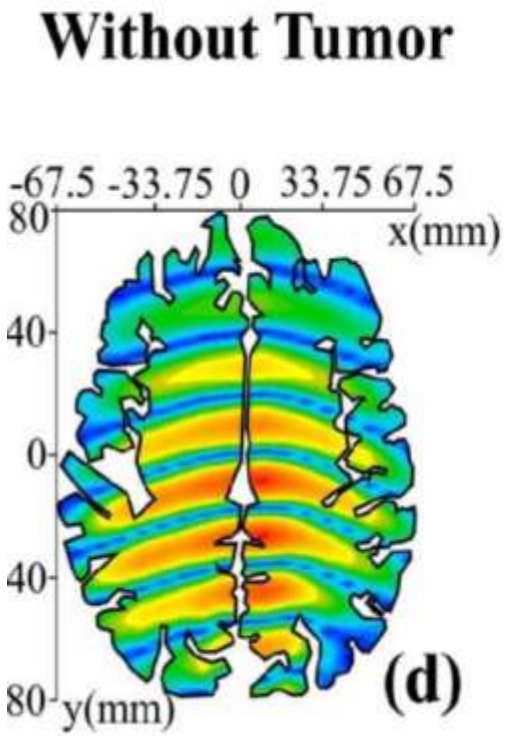

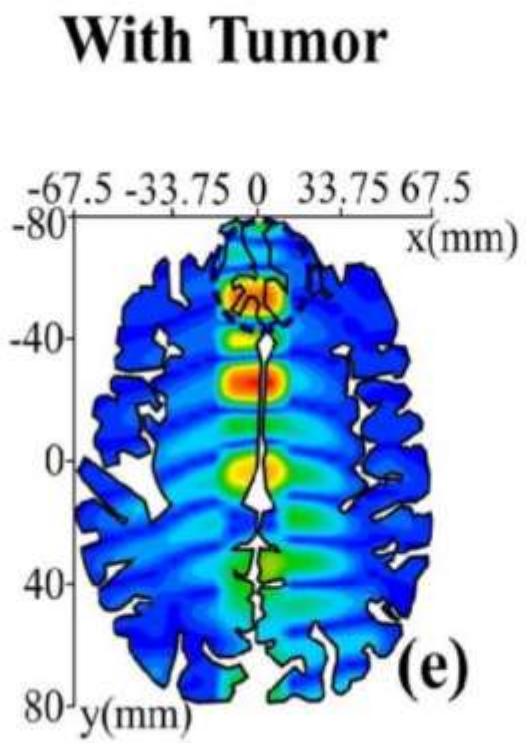

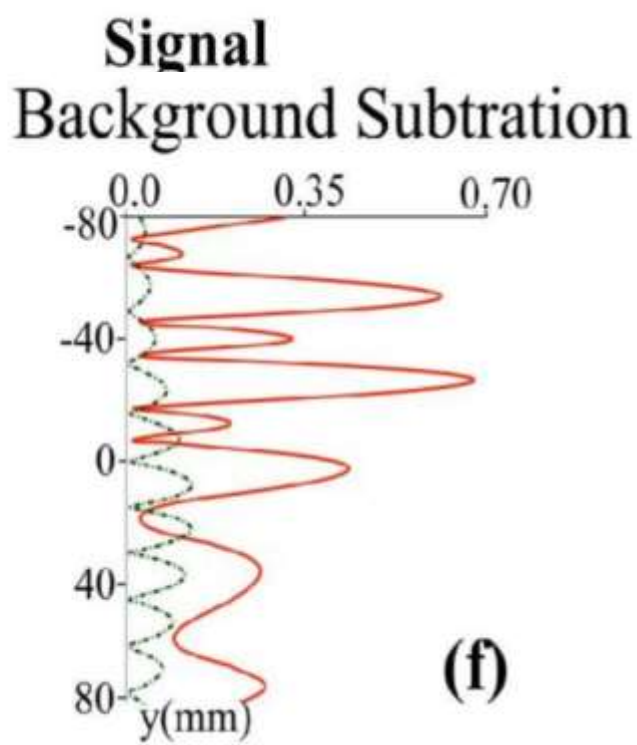

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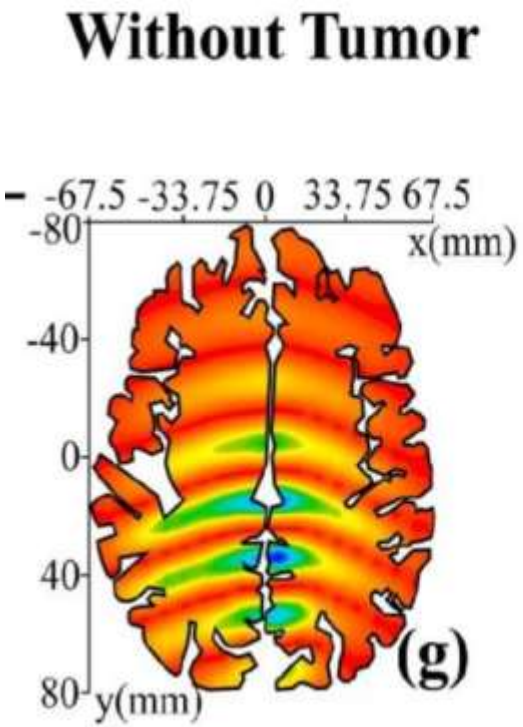

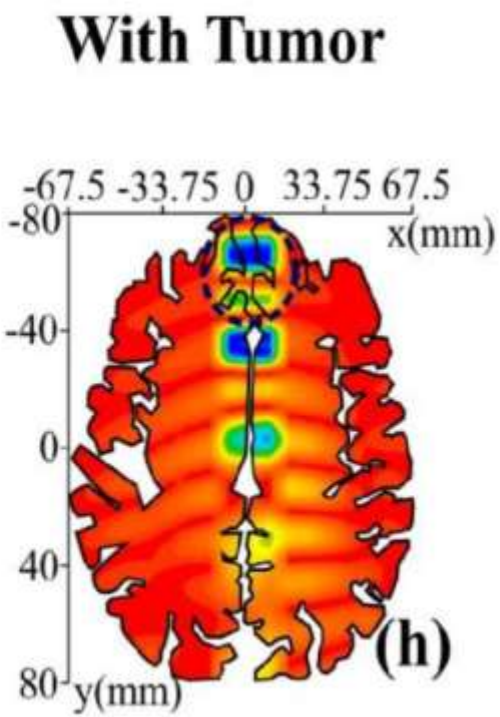

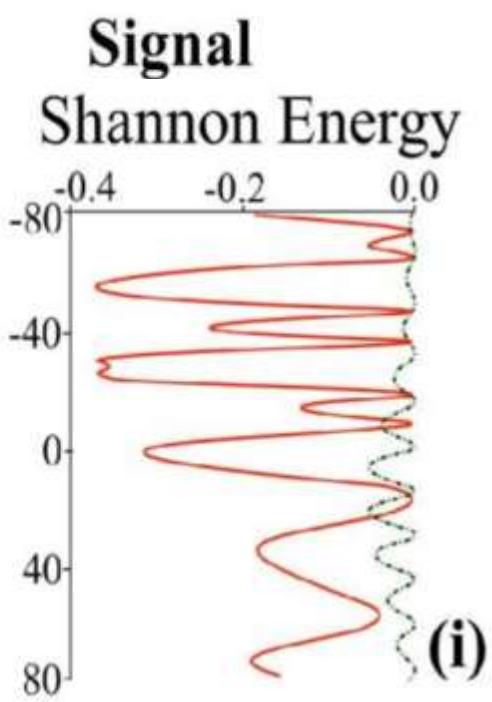

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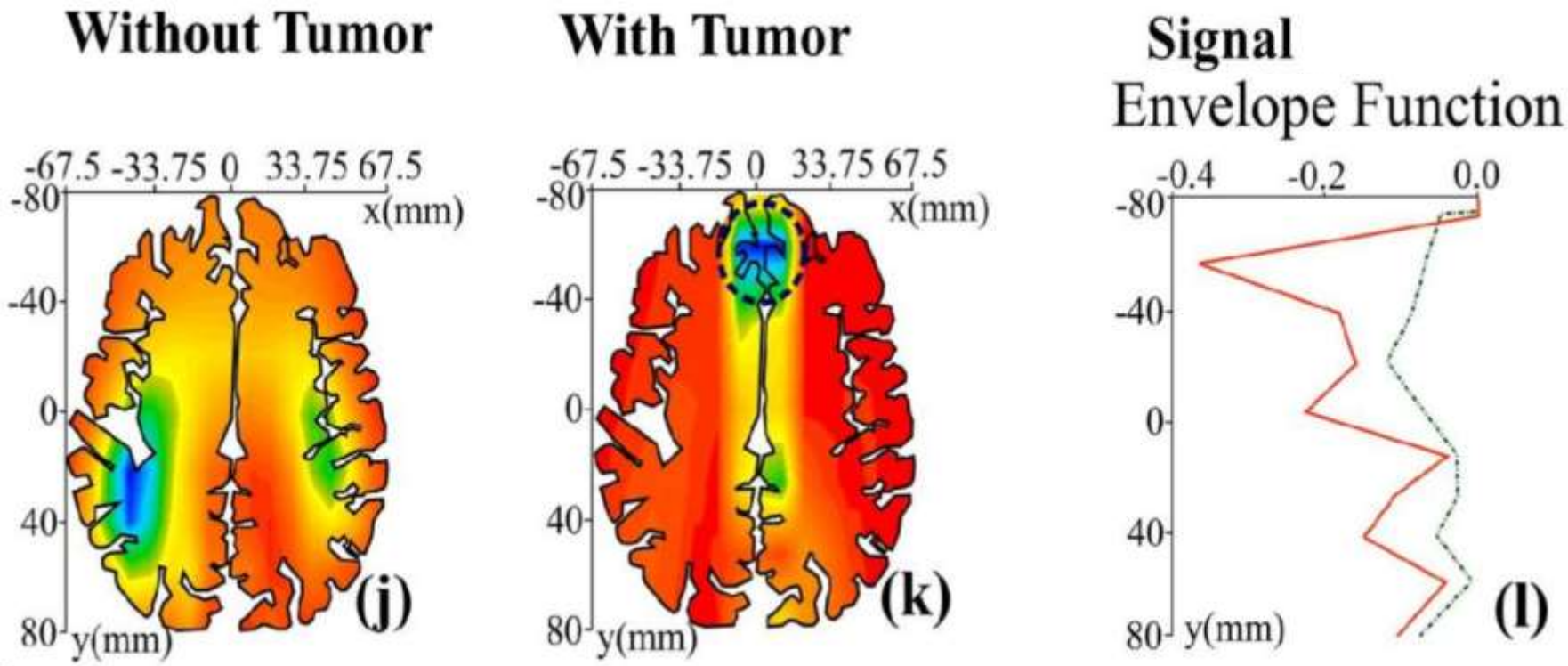

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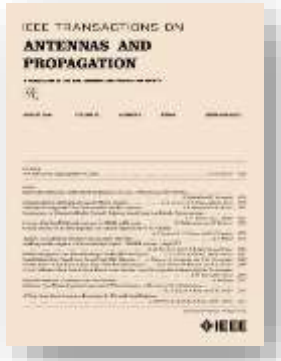


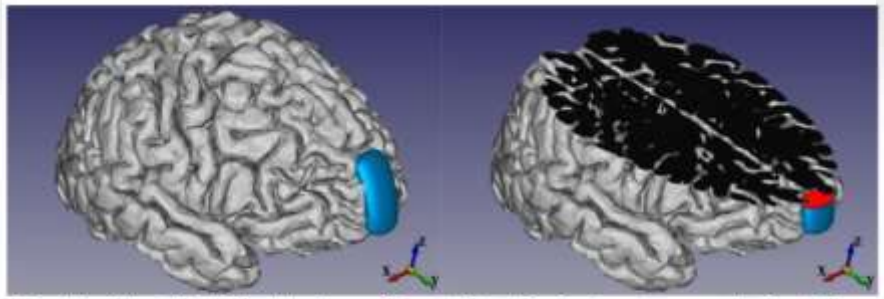
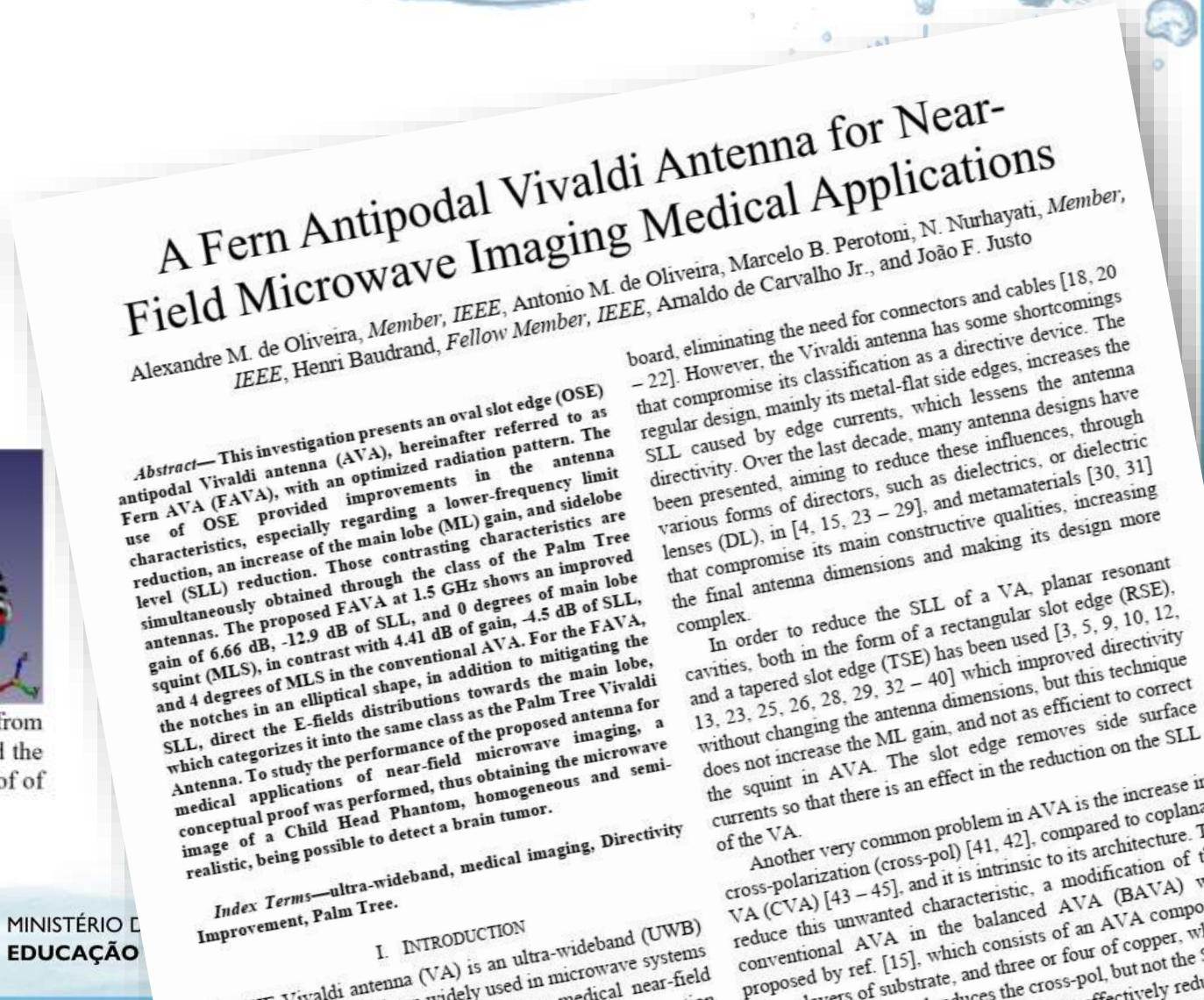


Fig. 10. The 3D digital design of the Infant Brain (gray) was obtained from an MRI and imported into FreeCad 0.16. In detail, the tumor (blue),and the cut of the surface submitted to analysis by microwave image in the proof of concept.



A Fern Antipodal Vivaldi Antenna for Near-Field Microwave Imaging Medical Applications

Alexandre M. de Oliveira, *Member, IEEE*, Antonio M. de Oliveira, Marcelo B. Perotoni, N. Nurhayati, *Member, IEEE*, Henri Baudrand, *Fellow Member, IEEE*, Arnaldo de Carvalho Jr., and João F. Justo

***Abstract*— This investigation presents an oval slot edge (OSE) antipodal Vivaldi antenna (AVA), hereinafter referred to as Fern AVA (FAVA), with an optimized radiation pattern. The use of OSE provided improvements in the antenna characteristics, especially regarding a lower-frequency limit reduction, an increase of the main lobe (ML) gain, and sidelobe level (SLL) reduction. Those contrasting characteristics are simultaneously obtained through the class of the Palm Tree antennas. The proposed FAVA at 1.5 GHz shows an improved gain of 6.66 dB, -12.9 dB of SLL, and 0 degrees of main lobe squint (MLS), in contrast with 4.41 dB of gain, -4.5 dB of SLL, and 4 degrees of MLS in the conventional AVA. For the FAVA, the notches in an elliptical shape, in addition to mitigating the SLL, direct the E-fields distributions towards the main lobe, which categorizes it into the same class as the Palm Tree Vivaldi Antenna. To study the performance of the proposed antenna for medical applications of near-field microwave imaging, a conceptual proof was performed, thus obtaining the microwave image of a Child Head Phantom, homogeneous and semi-realistic, being possible to detect a brain tumor.**

***Index Terms*—ultra-wideband, medical imaging, Directivity Improvement, Palm Tree.**

I. INTRODUCTION

board, eliminating the need for connectors and cables [18, 20 – 22]. However, the Vivaldi antenna has some shortcomings that compromise its classification as a directive device. The regular design, mainly its metal-flat side edges, increases the SLL caused by edge currents, which lessens the antenna directivity. Over the last decade, many antenna designs have been presented, aiming to reduce these influences, through various forms of directors, such as dielectrics, or dielectric lenses (DL), in [4, 15, 23 – 29], and metamaterials [30, 31] that compromise its main constructive qualities, increasing the final antenna dimensions and making its design more complex.

In order to reduce the SLL of a VA, planar resonant cavities, both in the form of a rectangular slot edge (RSE), and a tapered slot edge (TSE) has been used [3, 5, 9, 10, 12, 13, 23, 25, 26, 28, 29, 32 – 40] which improved directivity without changing the antenna dimensions, but this technique does not increase the ML gain, and not as efficient to correct the squint in AVA. The slot edge removes side surface currents so that there is an effect in the reduction on the SLL of the VA.

Another very common problem in AVA is the increase in cross-polarization (cross-pol) [41, 42], compared to coplana VA (CVA) [43 – 45], and it is intrinsic to its architecture. T reduce this unwanted characteristic, a modification of t conventional AVA in the balanced AVA (BAVA) w proposed by ref. [15], which consists of an AVA compo layers of substrate, and three or four of copper, wh reduces the cross-pol, but not the s effectively redu

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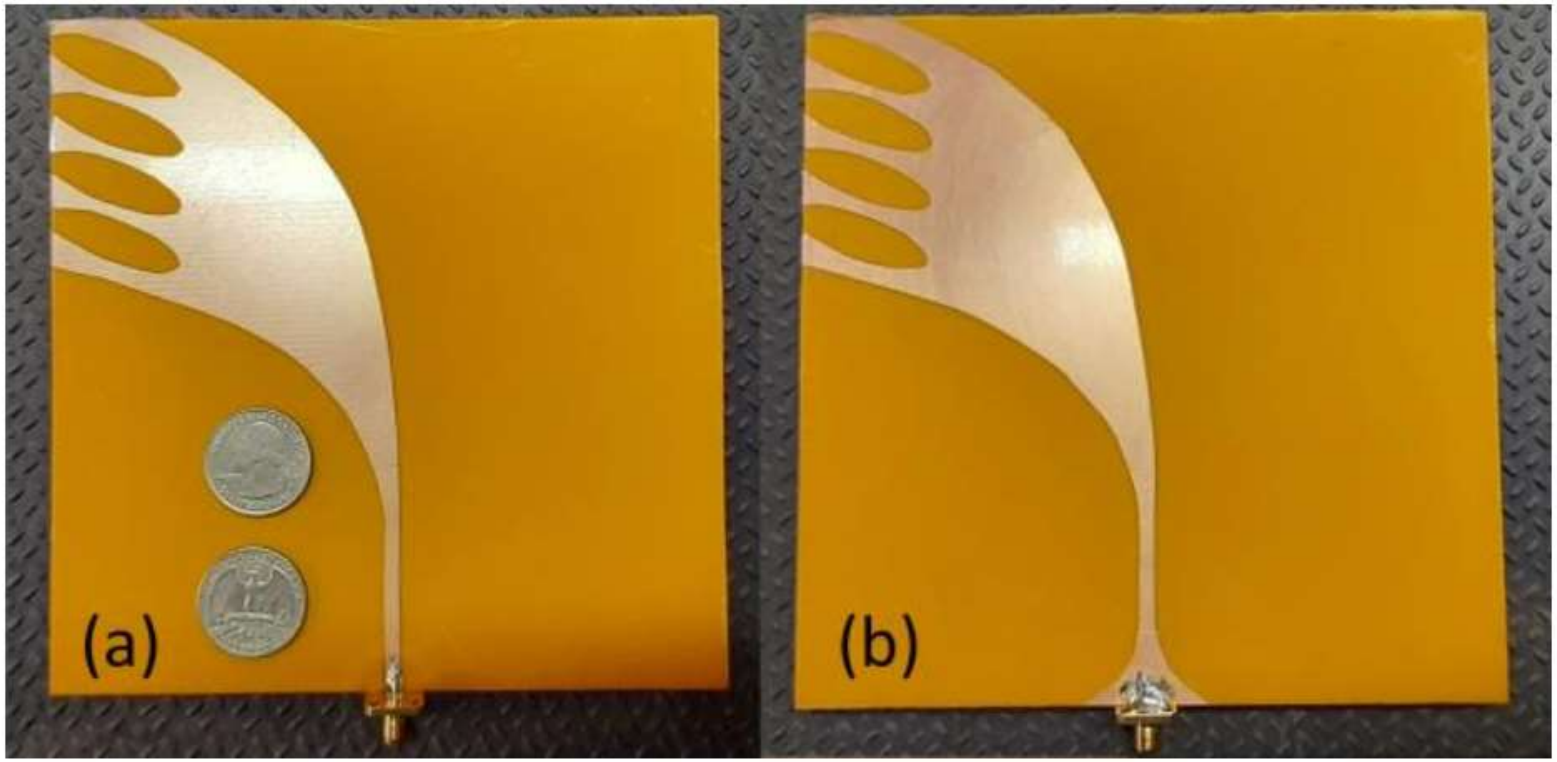

Fig. 2. Fabricated FAVA: (a) top and (b|) bottom views.

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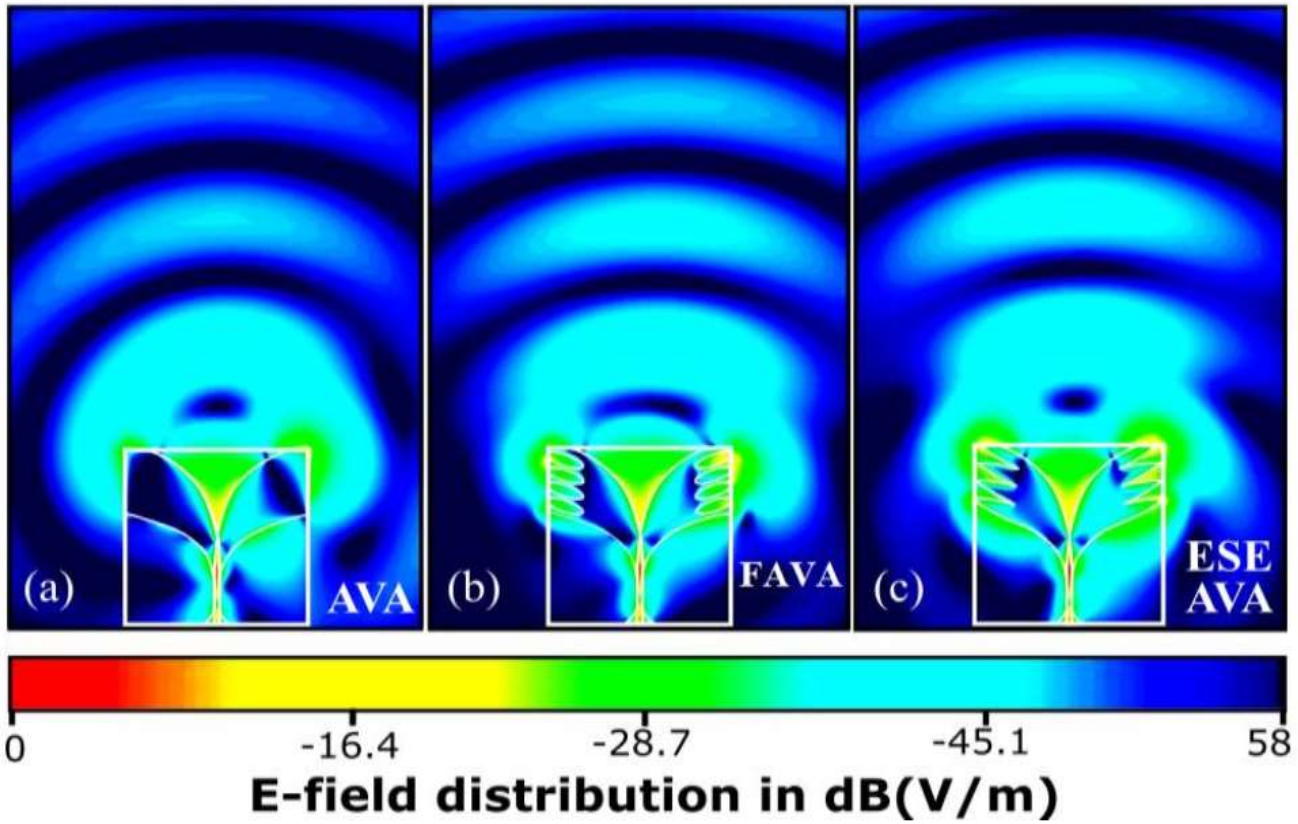

Fig. 6. E-field distribution in *xz*-plane at 1.5 GHz for (a) AVA, (b) FAVA, and (c) ESE-AVA at 1.5 GHz.

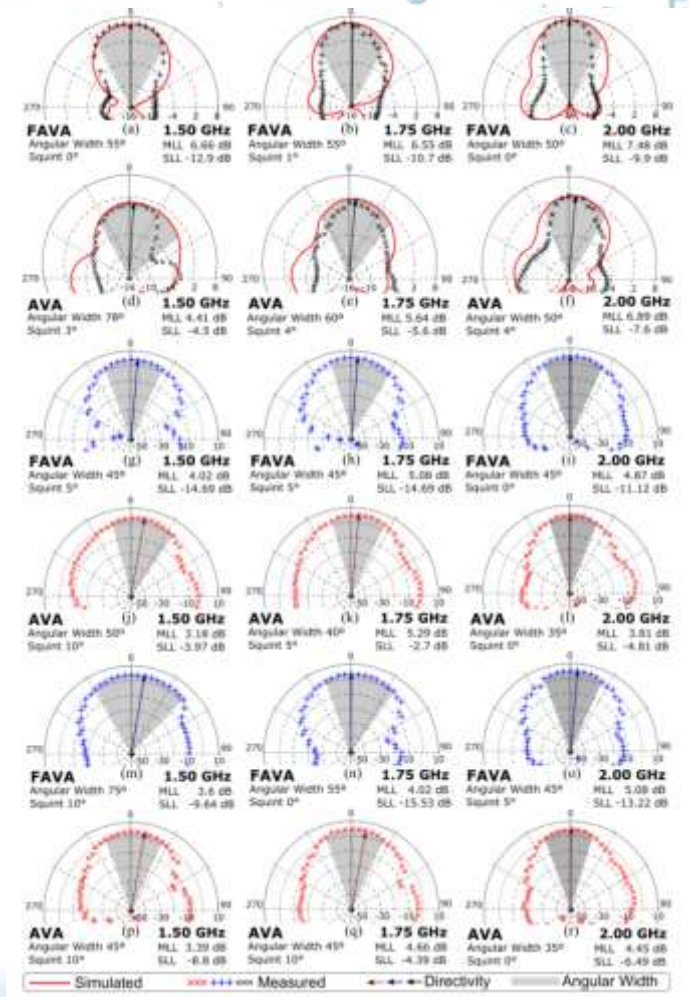

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Fig. 9. A real-word scenario of the Phantom imaged by the FAVA. (a) Semi realistic and homogeneous infant Phantom. (b) Inside the Head Model, mad of Expanded polystyrene (Styrofoam) from Daiso Industries CO., LTD Model YM-18-P6 C028 600 - EPS # 4, Lot # 2009BJ. (c) Infant Brain Mode made with a 3D printer technique using conductive filament, composed o ABS and Graphite. (d) The Tumor Model (frontal position) was modele with a silicone pouch, with walls of 30μm thick, filled with mineral wate (e) Proposed test setup with the Head Phantom on a mobile base controlle by the computer with steps of 1 mm; the FAVA; and the Anritsu Site Maste S331B, operating with the DTF function.

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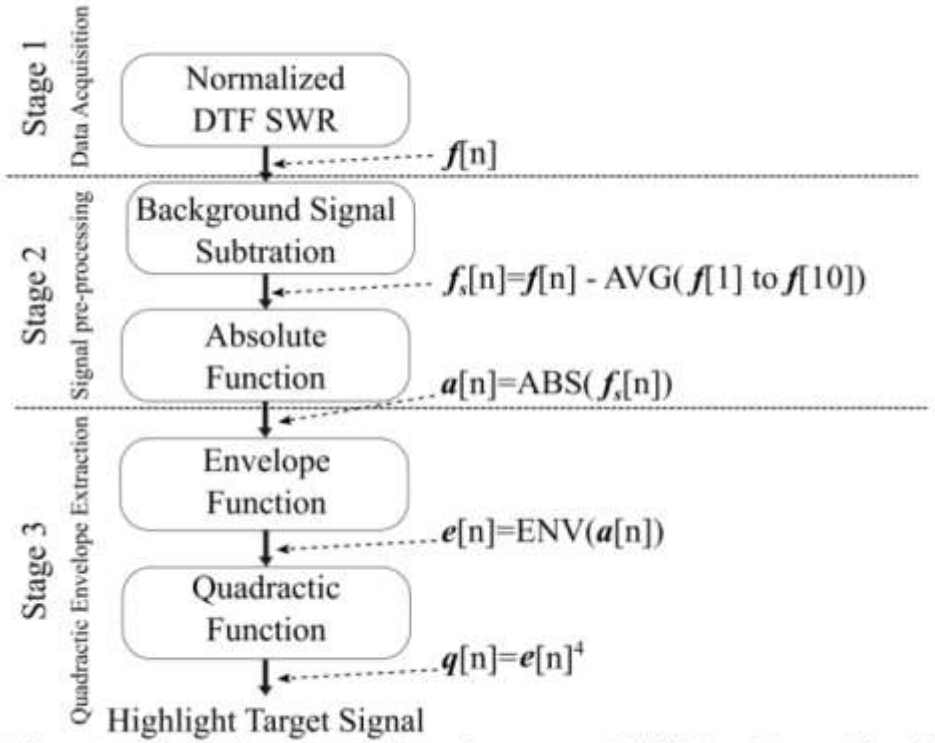
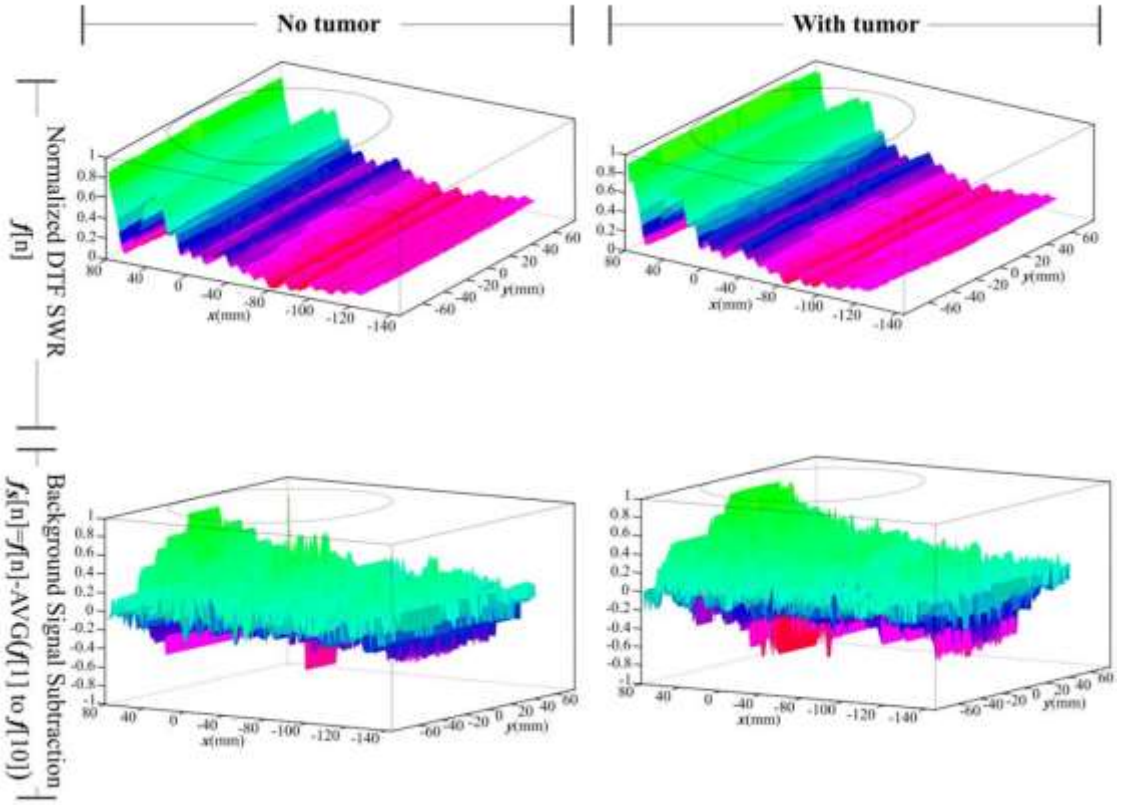


Fig. 11. Block diagram of the three-stage Highlight Target Signal methodology.



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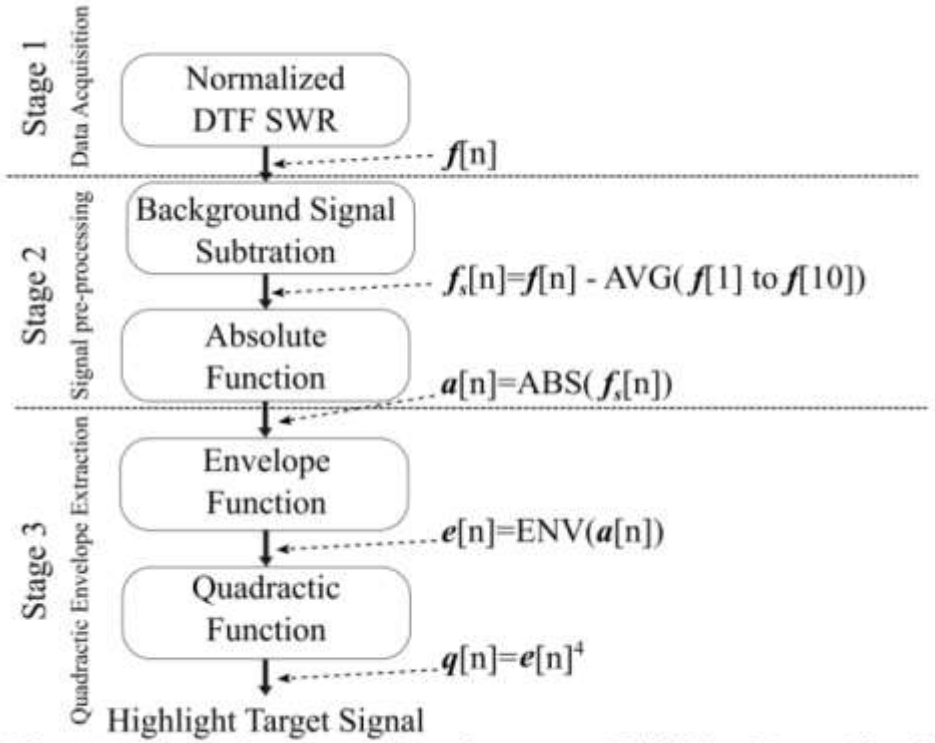

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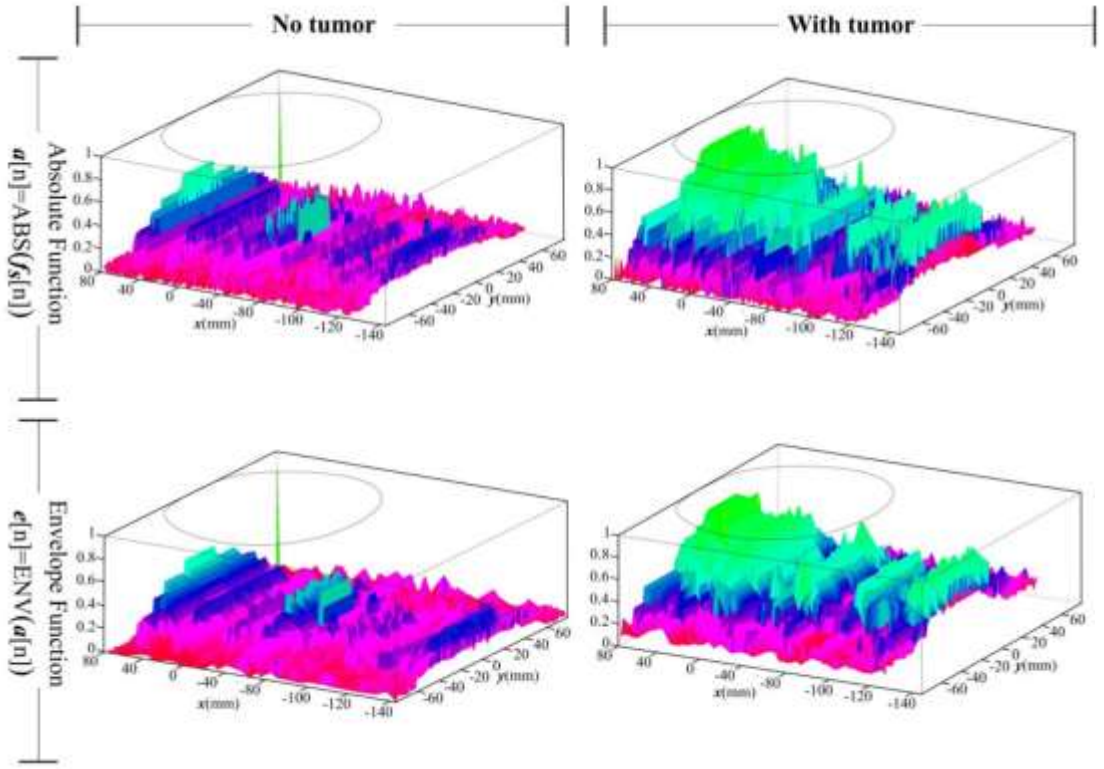

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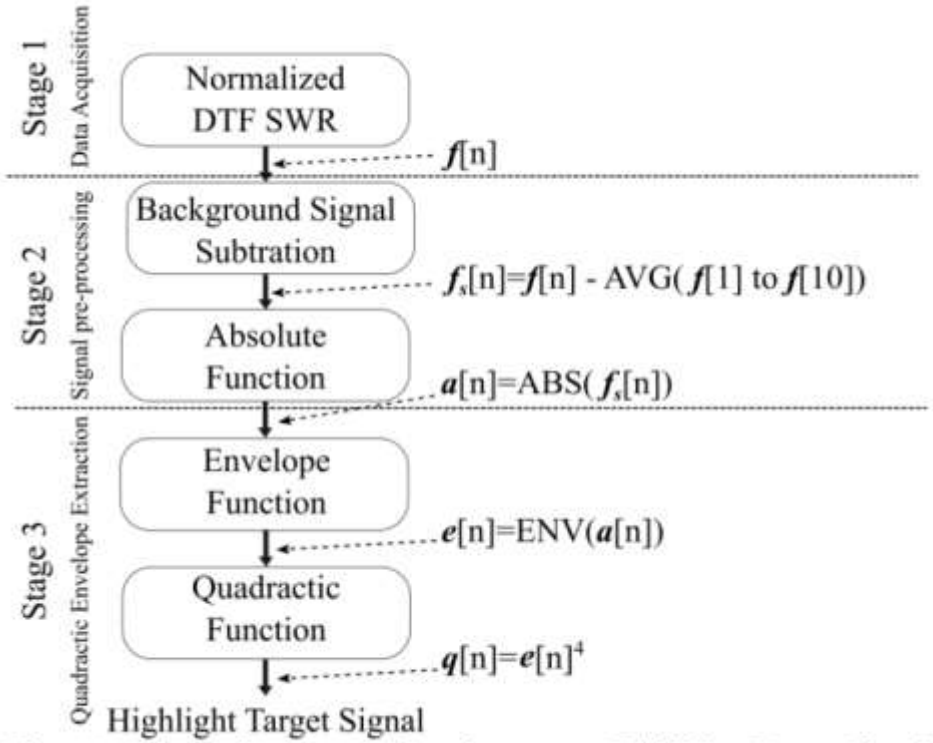

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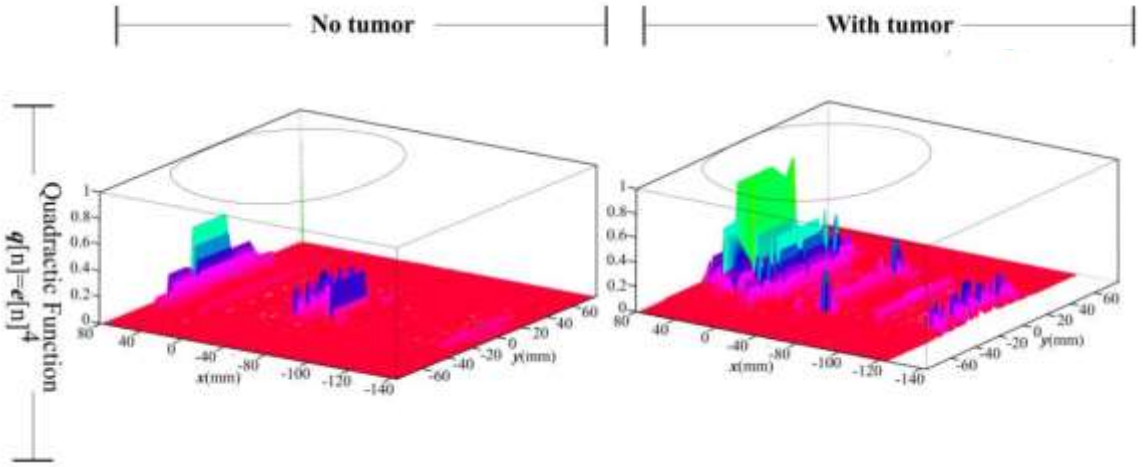

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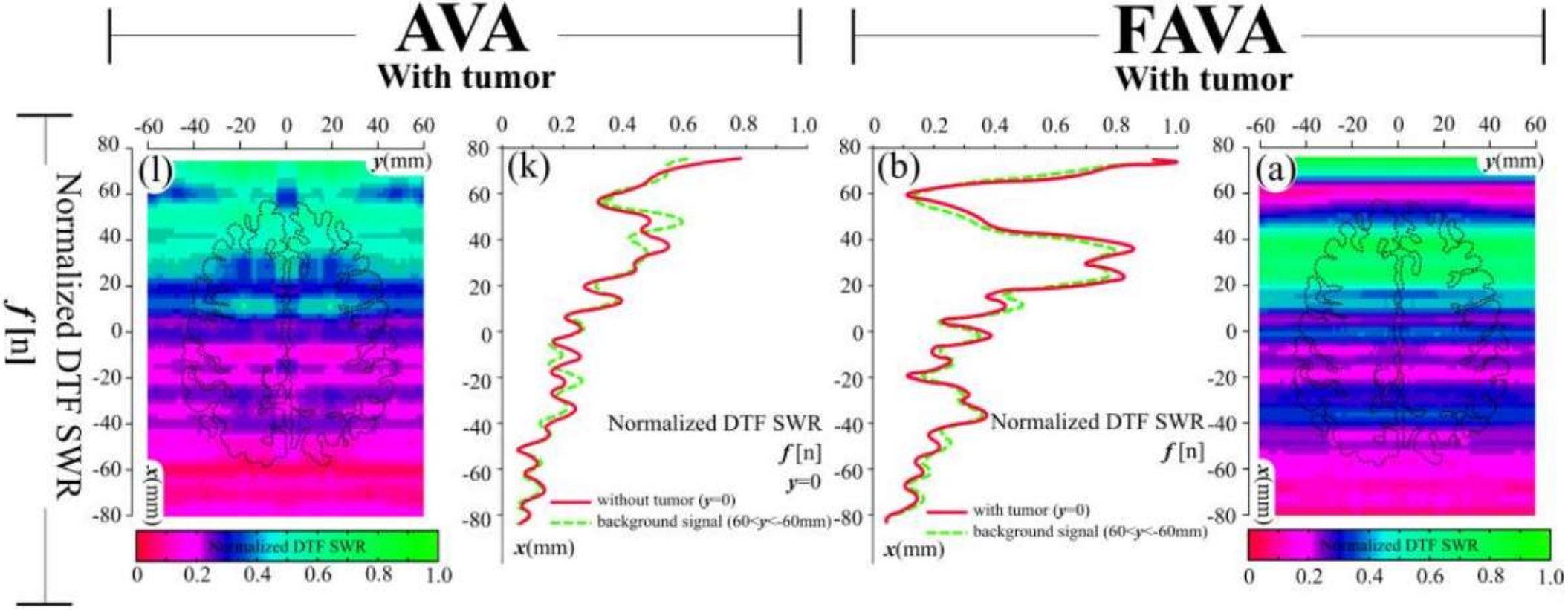

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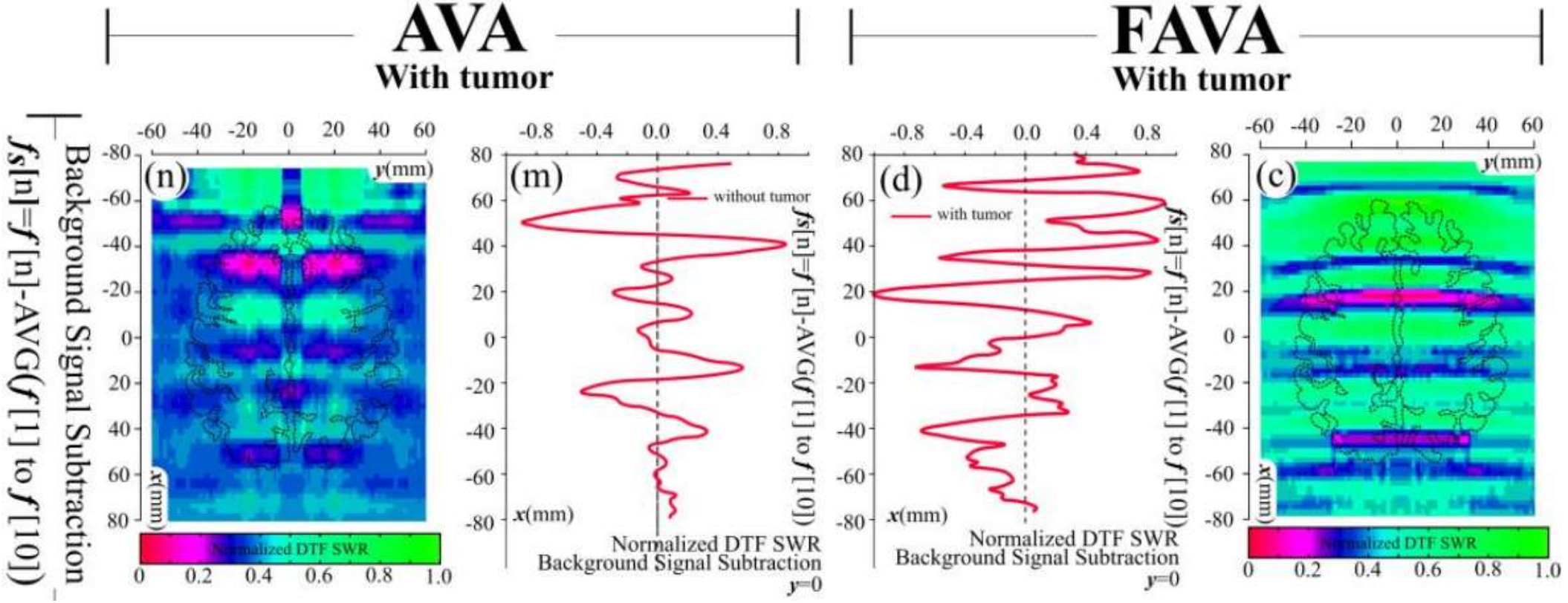

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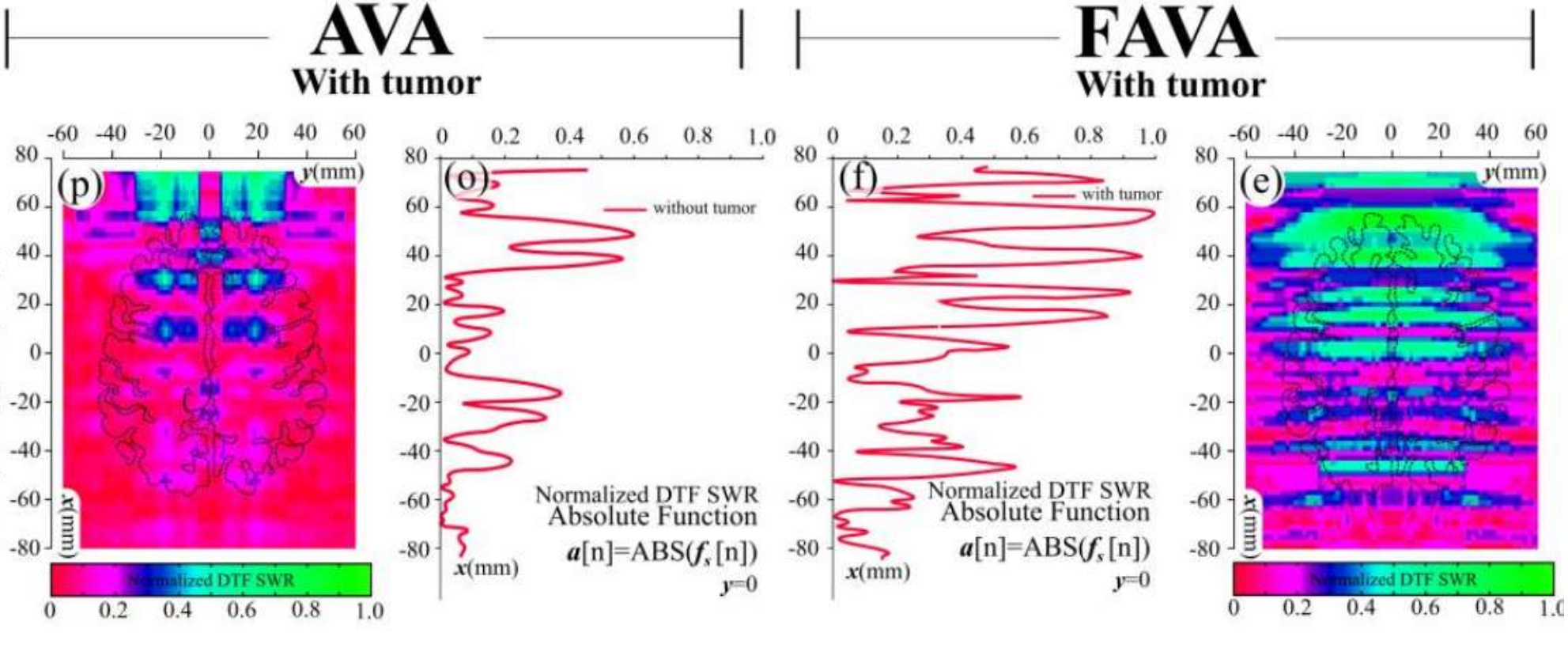

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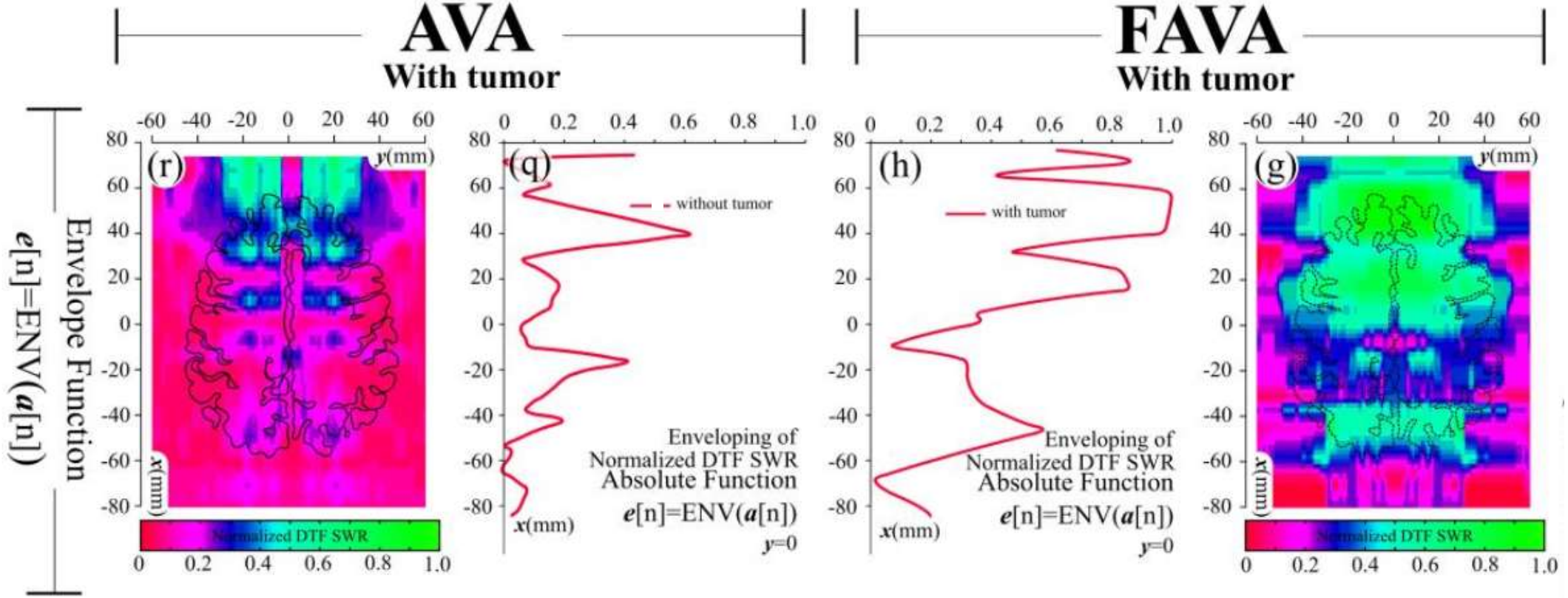

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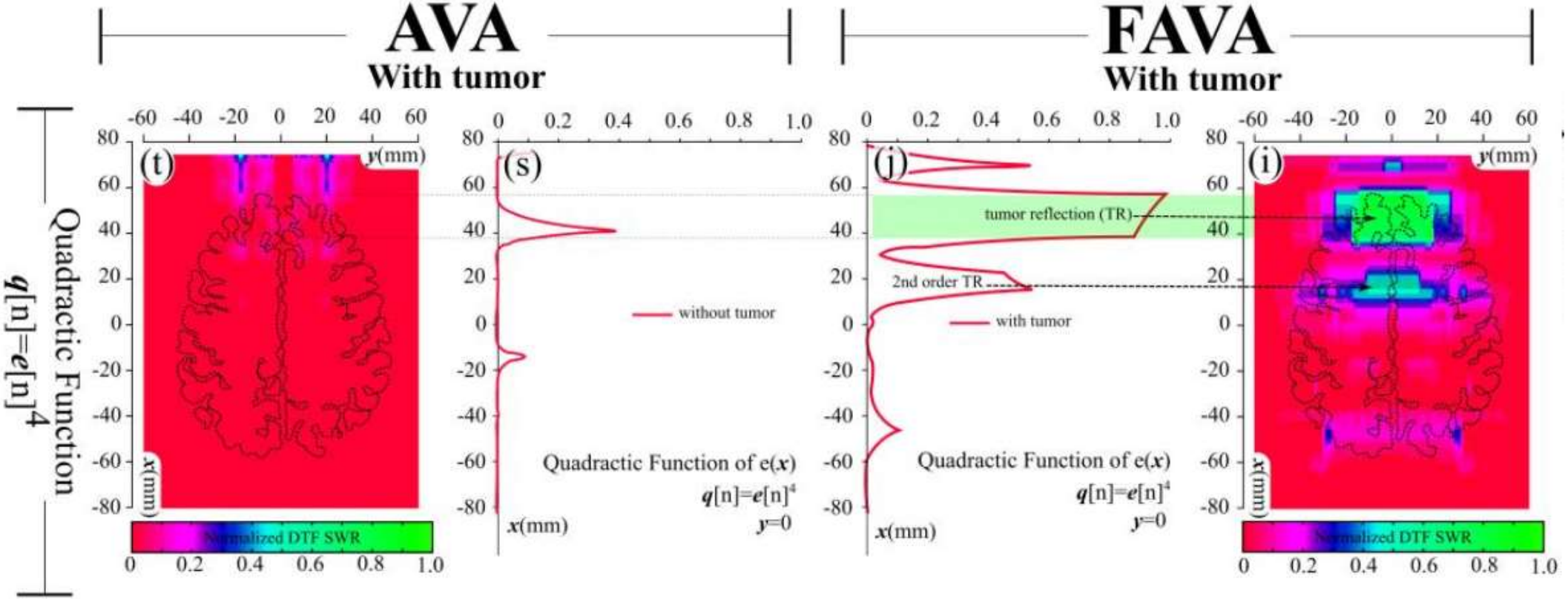

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