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"Developing Regional and International Scientific Co-operations"

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PREFACE

On behalf of the Chairman Organizing Committee of The 3rd International Conference on Radar, Antenna, Microwave, Electronics and Telecommunications (ICRAMET) 2014, I would like to thank to all the participants for their participation during the Conference that was held in Batam on May 7 - 8, 2014. We also would like to thank for their contributions to the Conference program and for their contributions to these Proceedings.

I would like to specifically express my gratitude to the Chairman of Indonesian Institute of Sciences (LIPI) Prof Dr. Lukman Hakim, who was officially opened the Conference. To the distinguished speakers : Dr. Teguh Rahardjo, advisor to the Minister of Research and Technology for Defense and Security Affairs; Dr. Timbul Siahaan, directorate general of defense potential, Ministry of Defense Republic of Indonesia; and Mr. Ali Nasheer Ahmadi from Iran Electronics Industries.

This proceeding consists of 40 scientific papers. Some of these papers were presented as oral presentations, and the rests were presented as poster presentations. This Conference would not be hold successfully without contribution of the Speakers, the Authors, the Advisory Committees, and the members of the Organizing Committees. Therefore, I would like to take this opportunity to express my sincere appreciation to all of them for their active participation in The 3rd International Conference on Radar, Antenna, Microwave, Electronics and Telecommunications (ICRAMET) 2014.

Bandung, June 5th 2014

Chairman of the Organizing Committee

Yadi Radiansah

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Simulation of Stacked Patch Antenna by Moment of Method

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Abstract— **Nano Technology advances provide a larger effect on the development of the electronics world, as we have known that electronic products getting small and smaller in dimensions with high reliability for example hand phone. Antenna as supporting the advancement of Telecommunication world growth fast also, in this research focusing in Microstrip antenna for communication application. Microstrip antenna application is very wide from wireless communication, imaging and sensor. The bandwidth of microstrip antenna is quite wide but not enough wide to cover several frequencies that separated too far. In this study applied a case study making a wifi antenna of (802.11a/g) that can operate both at 2.4GHz and 5GHz. The structure of antenna element is rectangular and will be design to work at 2.4GHz, and parasitic element to cover 5GHz.The design of Microstrip antenna is to put parasitic element above the antenna element, the width of antenna element is 85mm, Gap between Ground Plate and Element Antenna is 5.3mm and parasitic element's wide is 62.7mm and varying the heigh of parasitic element are 10.6mm, 15.9mm The result of study shows that the Antenna can covered 2 different bandwidth, but addition Parasitic Element at the antenna Structure does not give significant change to bandwidth.**

Key Words: Microstrip Antenna, Antenna Element,Parasitic Element

I. INTRODUCTION

Telecommunication advances provide a larger effect on society, wireless communication become popular, For daily activity for example handphone until security systems, recently at many public area we can found wifi area easly. In security system area a sensor is commonly use. Either Handphone or sensor there are wireless communications that must be need an Antenna as communication tools.

Antenna as supporting the advancement of Telecommunication world growth fast also, many type of antenna can be design depend on the purpose on it. In this study focusing in Microstrip antenna for communication application.

Microstrip antenna application is very wide from wireless communication, imaging and sensor. The bandwidth of microstrip antenna is quite wide but not enough wide to cover several frequencies that separated too far [3]. To cover that problem one solution is to put parasitic element above the antenna element. By doing this, we can increase variations of current distribution besides antenna element which give the result of broaden the operation frequency as well as the bandwidth.

In this study take a case for a wifi antenna of (802.11a/g) that can operate both at 2.4GHz and 5GHz.

II. LITERATURE REVIEW

The Moment of Method (MoM) is method are usually used to
solved the problem for linear equations, in this study the method are used as follows;

1. MoM in general

If we have linier system equation as below

$$L(f) = g \quad (1)$$

Where:

g : known function
f : unknown to be determined
L : Linier operator

To determine unknown f function we need to discretized as below

$$f = \sum_n \alpha_n f_n \quad (2)$$

Where:

α_n : constant value

f_n : expansion function

From equation above we get,

$$\sum_n \alpha_n L(f_n) = g \quad (3)$$

If we take inner product with test function w_m we can get,

$$\sum_n \alpha_n \langle w_m, Lf_n \rangle = \langle w_m, g \rangle \quad (4)$$

We can rewrite equation above as bellow,

$$[l_{mn}][\alpha_n] = [g_m] \quad (5)$$

Where,

$$[l_{mn}] = \begin{bmatrix} \langle w_1, Lf_1 \rangle & \langle w_1, Lf_2 \rangle & \dots \\ \langle w_2, Lf_1 \rangle & \langle w_2, Lf_2 \rangle & \dots \\ \dots & \dots & \dots \end{bmatrix} \quad (6)$$

$$[\alpha_n] = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \dots \end{bmatrix} \quad [g_m] = \begin{bmatrix} g_1 \\ g_2 \\ \dots \end{bmatrix} \quad (7)$$

Finally by taking invers matrix we can obtain constant value α as below.

$$[\alpha_n] = [l^{-1}{}_{mn}][g_m] \quad (8)$$

I we have obtained α, then we can determine function f.

2. MoM Formulation Patch Antenna

To obtain current distribution on the antenna via numerical analysis of the moment of method we use equation (9) ~ (12). After discretization of equation (10) and (11), and differentiating equation (9), we substitute them to equation (12). By solving linear system of equation (12) we can get current distribution on antenna [1][2].

$$-j\omega\rho = \nabla \cdot J \quad (9)$$

$$\emptyset(r) = \frac{1}{4\pi\varepsilon} \iint \rho(r') \frac{e^{-jk|r-r'|}}{|r-r'|} dx'dy' \quad (10)$$

$$A(r) = \frac{1}{4\pi\varepsilon} \iint J(r') \frac{e^{-jk|r-r'|}}{|r-r'|} dx'dy' \quad (11)$$

$$-E^i(r) = -j\omega A(r) - \nabla\emptyset(r) \quad (12)$$

From current distribution on the antenna we can obtain input impedance characteristic, return loss, directivity gain of the antenna

III. SIMULATION MODELS

We assumed that patch antenna element is perfect conductor and very thin. Please see figure below for antenna model. The structure of antenna element is rectangular and will be design to work at 2.4GHz, and parasitic element to cover 5GHz. For antenna structure please see fig. 1.

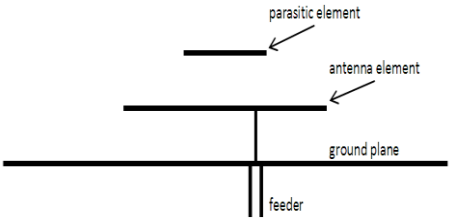

Figure 1. Antenna Structure

Antenna dimension estimation,

- Design of rectangular microstrip antenna:
  Frequency (fr) = 2.4GHz
  Material ε_r = 1 (air)
  Thickness = 0.4mm

We can use formula bellow to determine dimension of rectangular patch antenna [4] [5].

$$f_r = \frac{v_o}{2a_{eff}\sqrt{\varepsilon_r}} \quad (13)$$

$$a_{eff} = a\left\{1 + 0.824\frac{t}{a} \cdot \frac{(\varepsilon_e + 0.3)[(a/t) + 0.262]}{(\varepsilon_e - 0.258)[(a/t) + 0.813]}\right\} \quad (14)$$

$$\varepsilon_e = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + 10\frac{t}{a}\right) \quad (15)$$

By substituting ε_r, t (thickness), we find that the width of antenna element is 85mm.

Gap between Ground Plate and Element Antenna is 5.3 mm, based on calculation and simulation shown that 5.3 mm was the right point to get oscillation at frequency 2.4 GHz. In this study we use 3 models of simulation, 1_{st} model apply Ground Plate and Element Antenna. 2 models apply Ground Plate, Element Antenna and parasitic element and varying the heigh of parasitic element.

IV. RESULT OF SIMULATION AND ANALYSIS

Figure 2. shows the result of simulation for 3 models, where each model have specification as follows;

Series 1 : rectangular antenna with wide of 85.5mm and gap 5.3mm without parasitic element.

Series 3 : rectangular antenna with wide of 85.5mm and gap 5.3mm And parasitic element wide of 62.7mm and parasitic height 10.6mm

Series 5 : rectangular antenna with wide of 85.5mm and gap And parasitic element wide of 62.7mm and parasitic height 15.9mm

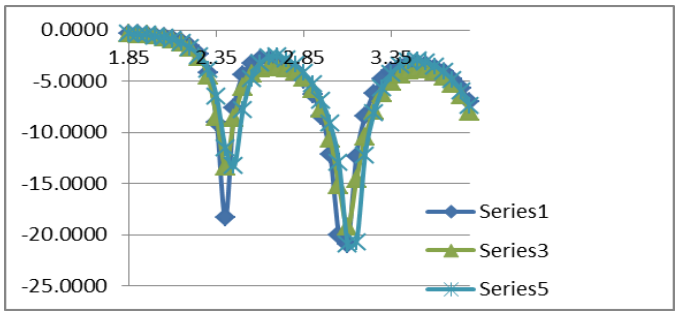

Figure 2. Result of Simulation

X axis is frequency in GHz, Y axis is dB. Based on figure 2 shows that 2 bandwidt can covered by using the antenna models (2.4 GHz and 3.1 GHz).

IV. CONCLUSION

In this simulation parasitic element does not give significant change to bandwidth. However, the antenna has 2 bandwith, one is at 2.4GHz and other at 3.1GHz. We assumed that wideness of feeder give significant contribution with bandwidth.

Next Research how to design Antenna Structure which covered more than 2 bandwidth.

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