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Research Article

Isolation Comparison of j Shape and t Shape Junction Mikrostrip 3db for Coastal Radar Application

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Abstract

For a region, City Branding is an image pertained to a particular area to gain a respectful position to be known worldwide. Many cities in Indonesia have tried to implement this strategy, but there are only few of them successfully built the brand. This research attempted to determine possible City Branding strategies to be implemented by stakeholders as an effort to develop tourism image. In carrying out this research, primary data were used and analyzed using Analytic Hierarchy Process (AHP). The results emphasized an idea for the success of City Branding to promote tourism, namely improving and providing safe and comfortable infrastructure for tourists, particularly the transportation control. It implies that there should be readiness for the local physicality and resources as the priority prior to promotional activities. Therefore, stakeholder synergy and cooperation are the key to brand the city as a tourist destination. With regard to these findings, this research provides a new contribution for the development of tourism economic theory in which it confirms that tourism development can be supported through marketing and promotion through city branding.

Keywords

Analytic Heararchy Process, City Branding, Participation, Tourism

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Introduction

Indonesia is a maritime country with a very wide area, the territory of Indonesia in the form of its waters is very wide. To carry out the task of security and surveillance of the islands in Indonesia, a very large number of apparatus and equipment are needed. The ability of the TNI and Polri to monitor Indonesian territory is very limited so that Indonesian waters are prone to fishing theft, territorial violations by foreign ships, ship hijacking and smuggling. Problems that arise such as the lack of sea surveillance by Indonesian maritime soldiers, rampant theft of fish by foreign ships with Indonesian flags, piracy and smuggling of Indonesian marine products by foreign ships and collisions between ships that want to dock. Because of these problems, a Coastal Radar Radar was made with High Gain Antenna where with the provisions of the antenna subsystem (Kuo & Hwang, 2014), high antenna, working frequency and bandwidth, antenna array and patch antenna types which are more developed than the previous ones ever created. One way to improve the ability of government officials to monitor and secure Indonesian waters is to use coastal surveillance radar. Radar with high power (high power) on ships or around the coast can be used to monitor marine areas up to the Exclusive Economic Zone (EEZ). This radar is used to monitor the movement of ships so that actions that can be detrimental can be prevented and can also prevent ship collisions if they are about to be docked at the port. In Al-Hiti (2019) the radar system, the antenna is a very crucial component because it can determine the work of the entire radar system, especially for processing the received signal, so that the signal processing work is not heavy (Balanis, 2016). The radar system has an antenna that is used for transmitting wave pulses and receiving their reflections (Kumar, Islam, Sen, Parui, & Das, 2018). The thing that must be considered is the separation between the transmitted signal and the received signal (Barnadi, Agustian, & Hasan, 2018). The coupler function on the RF Radar is designed to separate the transmitted signal from the received signal. In the hybrid coupler there are two outputs that have the same value with a 90° phase difference. This phase difference is used as a separator between transmitter and receiver Hybrid coupler is one of the telecommunications equipment and plays an important role in various applications in microwave devices. The hybrid coupler is basically a four-port passive device that has 4 symmetrical arms to be able to produce an output signal that is 90 phase different in phase (Al-Hiti, 2019). In this study a 3 dB Hybrid coupler as part of the antenna that functions as a separator between the transmitter and receiver (Acheghaf, Touhami, Boussouis, & Maouhoub, 2019). This microstrip antenna has many advantages, so this antenna is used in many studies, be it as a GSM frequency receiver, wifi, GPS and others (Barnadi, Istambul, Mayang, & Sgalih, 2019). Previous research Kumar et al. (2018) made a prototype of a long-range surveillance radar that works at the S-band frequency for maritime needs. This radar prototype works with a transmit power of about 5 W. Another study Barnadi et al. (2018) designed an antenna that can be used to support the work of coastal surveillance radar. This antenna is designed using a microstrip antenna where the characteristics of this antenna must have a wide bandwidth (Moradian, 2015). In planar channels such as microstrips to obtain strong coupling between the two coupled channels, very narrow spacing is required between the two (Maheswari & Jayanthy, 2014). balanced mixed, balanced amplifier, quadrature modulator The hybrid coupler 3 dB is a coupler with a phase difference of 90° at the two outputs, namely port through and port coupled (Pozar, 1998). In the 3 dB hybrid coupler, the insertion coefficient and the coupling coefficient have the same value, meaning that the 3 dB hybrid coupler will divide the power equally on the direct terminal and the coupled terminal. The quadrature modulator requires two signals that are in different phases while there is only one oscillator, for that a 90o phase shift is needed. So the oscillator signal is usually divided into two by the same power divider and the phase is the same (Moradian, 2015). To distinguish the phase of the two signals on one of the ports of the power divider, λ /4 channel is added as a phase shifter. In reality this phase shift will dampen the signal so that the output and the two ports will be different in magnitude Hybrid coupler has several designs, namely using microstrip / stripline and some are using waveguides. Types of hybrid couplers that use microstrip/stripline are Coupled-Line Directional Couplers, Lange Irrectional Couplers, Hybrid Rings, and Branch-Line Hybrid Couplers. The branch-line hybrid coupler functions to equally divide the input signal (-3 dB) by 90° phase shift to the output port or combine two signals while maintaining high isolation between them. The Branchline Hybrid coupler can divide high power signals well, so that the system or device connected to it can be protected from reflected signals that can damage the system or equipment by not having to have a phase shift anymore. It's just that the Branchline Hybrid coupler.conventinal has a narrow bandwidth and large size, resulting in large attenuation as well. To get a wide bandwidth, with a relatively small size and small attenuation, some conventional branchlines need to be cascade by providing a capacitive load. The best substrate used to produce good antenna performance is a thick substrate and has a small dielectric constant, because it will produce good efficiency, large bandwidth Microstrip antennas have several advantages compared to other antennas, such as physically thinner microstrip antennas, smaller, lighter, lower cost of manufacture, can be done linear and circular polarization with simple feeding, and so on. However, microstrip antennas also have limitations compared to other antennas, including having a narrow bandwidth, low gain, and having a surface wave effect. Because it has a compact shape and size, microstrip antennas have the potential to be used in various applications that require antenna specifications that are small in size, can be easily carried portable and can be integrated with other electronic circuits such as ICs, active circuits, and passive circuits. In this study, a comparison of the isolation values of the 3 dB microstrip coupler with different shapes, one H shape and the other with a t - Junction working at a frequency of 3 GHz with both loss values for (Tx) and (Rx) is 3 dB and different 90° phase. The steps taken are to perform a simulation by changing the length and width values for each impedance line, either impedance Zo=50 Ω (transmission line of A and B) or Zo= 35.35 Ω (transmission line of C) Several methods Kuo and Hwang (2014) have been carried out to improve the isolation for example with a microstrip array consisting of a feeding network operating at 9.35 GHz with a bandwidth of 100 MHz, dielectric constant = 2.2, loss tangent 0.0009.In Kumar et al. (2018) by reducing the size of the substrate of dielectric. constant r = 3.2, thickness h = 0.787 mm and loss tangent of 0.002 is obtained The return loss is -18.2 dB, the isolation is -17.8 dB In planar channels such as microstrips to obtain strong coupling between the two coupled channels, very narrow spacing between them is required. Tight coupler (tight coupler), especially 3dB coupler which is widely used in practical circuits such as balanced mixed, balanced amplifier, quadrature modulator, multiplexer/duplexer In Acheghaf et al. (2019) the quadrature modulator requires two signals that are in different phases while there is only one oscillator, for that a 90o phase shift is needed. So the oscillator signal is usually divided into two by the same power divider and the phase is the same. To distinguish the phase of the two signals on one of the ports of the power divider, a channel of / 4 is added as a phase shift. In fact, this phase shift will dampen the signal so that the output and the two ports will be different in magnitude (Barnadi et al., 2019). The purpose of this research is to design and analyze a microstrip antenna that works at a frequency of 3 GHz to be used in the S band frequency system. In Acheghaf et al. (2019) the quadrature modulator requires two signals that are in different phases while there is only one oscillator, for that a 90o phase shift is needed. So the oscillator signal is usually divided into two by the same power divider and the phase is the same. To distinguish the phase of the two signals on one of the ports of the power divider, a channel of / 4 is added as a phase shift. In fact, this phase shift will dampen the signal so that the output and the two ports will be different in magnitude (Barnadi et al., 2018). The purpose of this research is to design and analyze a microstrip antenna that works at a frequency of 3 GHz to be used in the S band frequency system

Research Method

Design

This flow chart aims to clearly describe the stages in the process carried out. There are two flow diagrams, namely research flow diagrams and system flow diagrams.

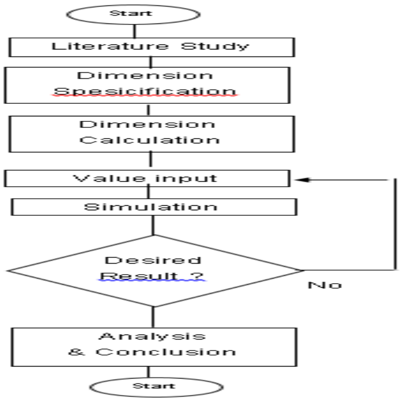

Fig1. Flow chart Desain Research Mehode

Penentuan Spesifikasi Awal Perancangan Antena

The initial specifications in the design of this antenna are determined according to the standards aimed at the antenna being designed to radiate properly.

1) Isolation < -20 dB
2) The frequency used is 3 GHz
3) Return Loss ≤−10 dB.
4) VSWR ≤ 1.5
5) The substrate used is FR-4 which has a relative permittivity of material (εr) = 4.3 and has a thickness (h) = 1.3 mm
6) Input Impedance Z_0 = 50 Ω.
7) Factor coupling ≤ -3 dB
8) .Insertion loss ≤ 1 dB

The first simulation is carried out using the size of the calculation results obtained and then optimized by changing the width and length of TLA, TL B and TL C. This change in size greatly affects the parameters of Isolation, Return Loss, Bandwidth, VSWR

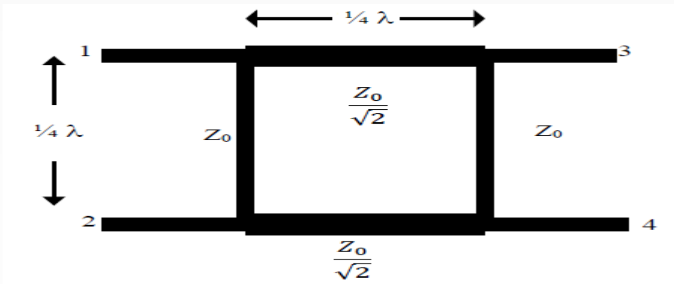

Fig2. Pengkopel hibrid 3 dB (Pozar, 1998)

The way the hybrid coupler works is as follows, if all ports are matched, the power entering port-1 is divided equally between port-2 and port-3, with a 90° phase shift between the two outputs. No power is coupled to port-4 (isolated port). The matrix [S] for the branch line coupler is expressed by the equation

$$[S] = -\frac{1}{\sqrt{2}}\begin{bmatrix} S_{11} & S_{12} & S_{13} & S_{14} \\ S_{12} & S_{22} & S_{23} & S_{24} \\ S_{13} & S_{23} & S_{33} & S_{34} \\ S_{14} & S_{24} & S_{34} & S_{44} \end{bmatrix} = -\frac{1}{\sqrt{2}}\begin{bmatrix} 0 & 0 & 1 & j \\ 0 & 0 & j & 1 \\ j & 1 & 0 & 0 \\ 1 & j & 0 & 0 \end{bmatrix}$$

The hybride coupler has a high degree of symmetry, so all ports work as inputs. The output port will always be on the opposite side of the input port and the isolated port will always be on the side of the input port.

Impedance Matching

Impedance Matching is one of the existing techniques commonly used to adjust line characteristic impedance (Z0) and load impedance (ZL). The converter of λ//4 is a technique for impedance matching by applying a transmission line impedance (ZT) between two unmatched transmission lines. The length of this λ /4 converter line is

L = $\frac{\lambda g}{4}$..(1)

The 90° phase difference occurs due to the length of each arm . When the power enters terminal 1 to terminal 3, the phase is 90° because it goes through the series arm whose length is , while the power that enters terminal 1 to terminal 4 is 2 x or 180° because it goes through the shunt arm and series arm. Thus the phase difference between S31 and S41 is or equal to 90°. There must be no power entering terminal 2 (isolated port) which means the isolation coefficient value S21 must be

0. This description can be shortened by using the [S] matrix for 3 dB hybrid coupler which is stated by 3 dB hybrid coupler has a high degree of symmetry, so that all terminals can work as input. The output terminal will always be on the opposite side of the input terminal. The isolated port will always be on one side of the input port. This symmetry is reflected in the scattering matrix, where each row can be found by transposing the first row

Dimension Calculation

At this stage the antenna dimensions are determined using manual calculations which will determine the thickness of the substrate (h), patch side (a), patch height (t), feeder width (W), and feeder length (L). The equation used to determine the dimensions of the 3 dB hybrid coupler design is as follows:

Dimension	Formula
The Length of TL A, B and C = 12,055 mm	$\lambda g = \frac{c}{f \times \sqrt{\varepsilon r}}$, εr = 4.3, , c = 3 x 10^8 , f=3x 10^9 λg = 48.22, L= $\frac{\lambda g}{4}$ = 12.055 mm
The width of TL A & TL B = 2.52 mm	$a = \frac{Z_0}{60}\sqrt{\frac{\varepsilon_r + 1}{2}} + \frac{\varepsilon_r - 1}{\varepsilon_r + 1}\left(0.23 + \frac{0.11}{\varepsilon_r}\right)$ Z_0 = 50 Ω $a = \frac{50}{60}\sqrt{\frac{4,3 \quad + 1}{2}} + \frac{4,3 \quad - 1}{4,3 \quad + 1}\left(0.23 + \frac{0.11}{4,3}\right) = 1,52$ $\frac{W}{d} = \frac{8e^{a}}{e^{2a} - 2}$, d= 1.30 mm W= 2.52 mm

It shows from calculation:

The length of TLA=TLB=TLC = 12.055 mm
The width of TLA=TLB =2.52 mm
The width of TLC = 4.31 mm

the length of the transmission line can be obtained using the above equation 1. But the value of must first be calculated using equation 18 then the value of, and after that find g. In this study the substrate used is Teflon, which is an existing material and has a small r so that with a large impedance, the length remains small.

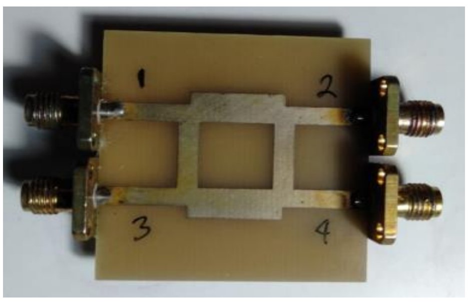

Fig 3. Hybride Coupler 90° J Shape Junction

Hybrid coupler uses a transmission line called a microstrip, which consists of two transmission lines implemented as PCB lines, each of which is formed in the form of a dielectric line. Between the surface of the conductive plate

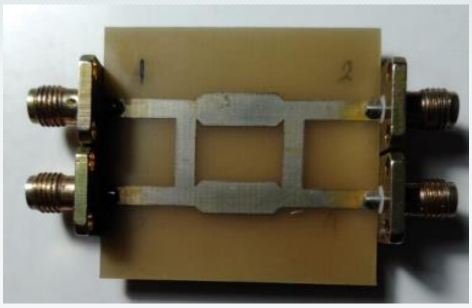

Fig 4. Hybride Coupler 90° T Shape Junction

Widely used 3 dB (branch-line hybrid) coupler. If a 3 dB hybrid coupler is supplied with an impedance of Zo, then the impedance value in the shunt arm = Zo and the impedance value in the series arm = Zo/√2. While the distance between arms /4 is determined by the desired resonant frequency

Simulation

The simulation in this study using the CST Studio Suite 2020 software, the simulation was carried out by entering the value of the manual calculation coupler dimension and the shifted coupler dimension value to get optimal results

Simulation Result from Calculation

The first simulation is carried out using the size of the calculation results by entering the value of the manual calculation coupler dimension

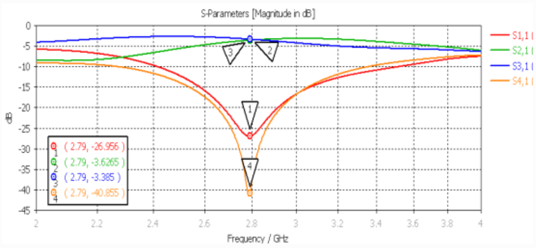

Fig 5. Simulation Result from Calculation Hybrid CouplerH Shape Junction

From the fig.5, it can be seen that there is a shift in the frequency that should be 3 GHz but the frequency is 2.79 GHz and it can be seen that Return loss (S11) = -26.956 dB, Insertion loss (S12) = -3.6265 dB, Coupling Factor (S13) = -3.385 dB, Isolation (S14)= -40,855 dB

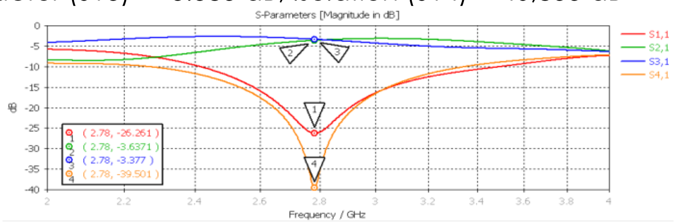

Fig 6. Simulation Result from Calculation Hybrid Coupler T Shape Junction

From Fig.6 it can be seen that there is a shift in the frequency that should be 3 GHz but the frequency is 2.78 GHz and it can be seen that Return loss (S11) = -26.261dB, Insertion loss (S12) = -3.6371 dB, Coupling Factor (S13) = -3.377 dB, Isolation (S14) = -39,501 dB

Simulation Result from Optimation

The below figure is the simulation result of optimizing the dimension value of the coupler to get optimal results

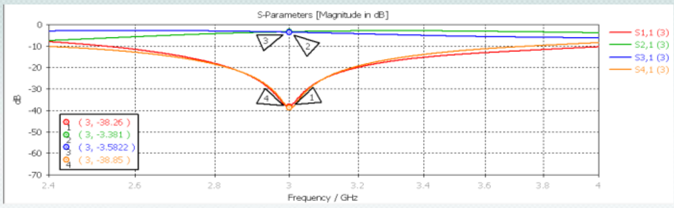

Fig 7. Simulation Result Branch Line Coupler J Shape Junction

Fig7 is simulation result of J junction shows that Return loss (S.11) = -38.26 dB, Insertion loss (S12) = -3.381, Coupling Factor (S13) = -3.5802 dB, Isolation(S14) = -38.85 dB

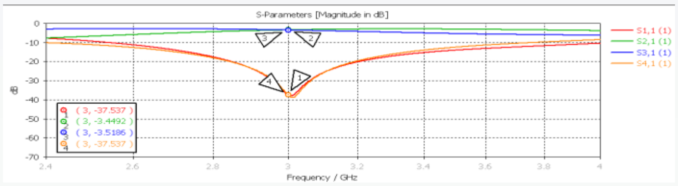

Fig 8. Simulation Result Branch Line Coupler T Shape Junction

Fig.8 Shows Return loss ($S_{.11}$) = -37.537 dB, Insertion loss (S_{12}) = -3.4492 dB, Coupling Factor (S_{13}) = -3.5186 dB, Isolation (S_{14}) = -37.537 dB

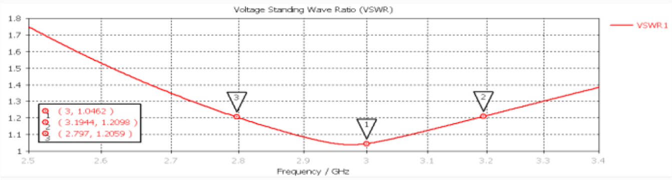

Fig 9. Simulation Result of Vswr J Shape Junction

Fig.9 shows the value of vswr J Shape Junction the value of vswr is 1.0462 .and bandwidth 3.1944 -2.797 = 0.3974GHz = 397.4 MHz. VSWR is the ratio between the maximum standing wave amplitude (|V|max) and the minimum (Vmin).

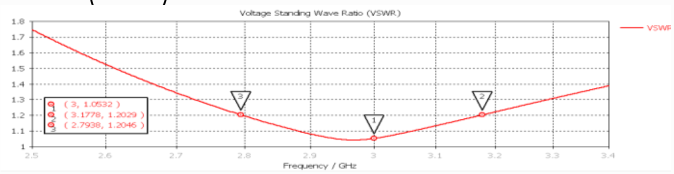

Fig 10. Simulation Result of Vswr T Shape Junction

From fig.10 the value of vswr is 1.0532 .and bandwidth 3.1778 -2.7938 = 0.384 GHz= 384 MHz. The best condition is when the VSWR is 1 (S=1) which means there is no reflection when the channel is in a perfect match state. However, in practice this condition is difficult to obtain. Therefore the standard value of VSWR that is allowed for antenna fabrication is VSWR < 2.

Tabel 1.
The Dimension of the transmission line from the calculation results

Parameter	Calculation (mm)	Simulation (mm)
LTA	12.055	10.35
LTB	12.055	10.36
LTC	12.055	10.25
WTA	2.52	2.78
WTB	2.52	2.86
WTC	4.31	5.068

Where are the abbreviations as follows:

LTA, LTB, LTC = The length of the transmission line A, B

and C (mm)
WTA, WTB, WTC = The width of the transmission line A, B and C (mm)

Tabel 2
The optimized values of the Hybrid Coupler

Parameter	J Shape (dB)	T Shape (dB)
Return loss ($S_{.11}$)	-38.26	-37.537
Insertion loss (S_{12})	-3.381	-3.4492
Coupling Factor (S_{13})	-3.5802	-3.5186
Isolation (S_{14})	-38.85	-37.537
vswr	1,0462	1.032

Conclusion

Simulation results for J shape obtained Return Loss (S.11) = -38.26 dB, Insertion loss (S12) = -3.381, Coupling factor (S13) = -3.5802 dB, Isoltion(S14) = -38.85 dB and the VSWR value is dB. In T shape obtained Return loss (S.11) = -37.537 dB, Insertion loss (S12) = -3.4492 dB, Coupling Factor (S13) = -3.5186 dB, Isolation (S14) = -37.537 dB. From the results above, it can be concluded that the isolation of the J shape Hybride Coupler is slightly better than the T shape type.

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