Université de Lille

Microwave Engineering :

Design of Patch Antenna

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M1-ETECH

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Outline

- Introduction and Objectives
- Pre-computation for sizing
- Software simulation with CST
- Practical realization
- Applications
- Conclusion

Introduction and Objectives

Introduction

Patch antennas are becoming increasingly useful because they can be printed directly onto a circuit board. Micro strip antennas are becoming very widespread within the mobile phone market. Patch antennas are low cost, have a low profile and are easily fabricated.

Objectives

Design of a patch antenna

Constraint

- Operating frequency : 2Ghz
- Matched for 50Ω power sources

Pres-computation for sizing

All of the parameters in a rectangular patch antenna design (*L*, *W*, h, *permittivity*) control the properties of the antenna.

The length of the patch *L* controls the resonant frequency.

The width *W* controls the input impedance.

The height of the substrate *h* also controls the bandwidth.

Higher values of permittivity allow a "shrinking" of the patch antenna.

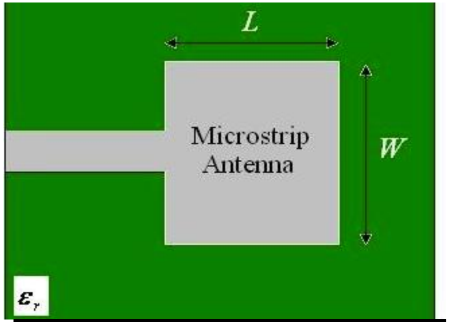

Figure 1: Patch Antenna

Feeder line dimensions :

- Width of feeder line

w_{line}=2,42mm

- Length is deduced from CST
- Minimum far field distance
- d_{min}= 29mm

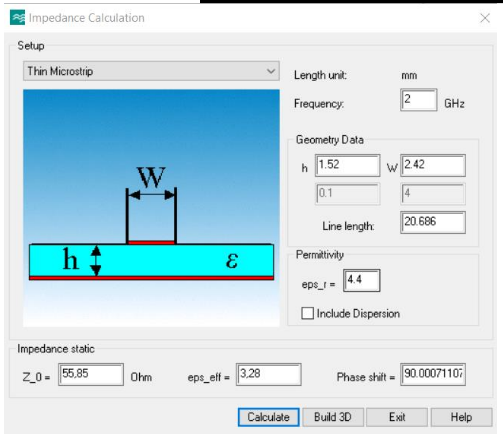

Figure 2: deduction of Length of the feeder live on Macro

Software simulation with CST

Antenna dimensions(30x35mm)

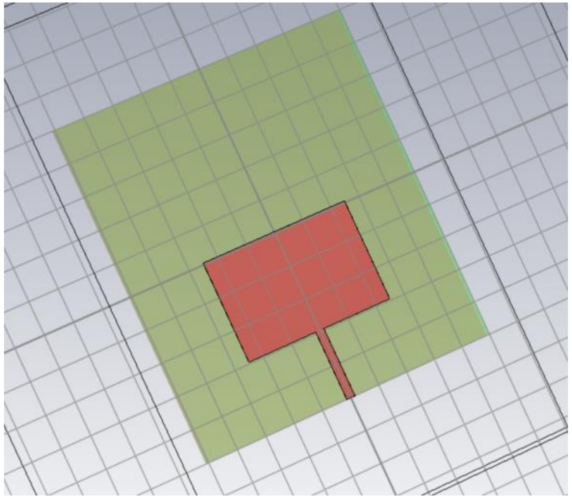

Figure 3:Patch antenna with given value (30x35mm)

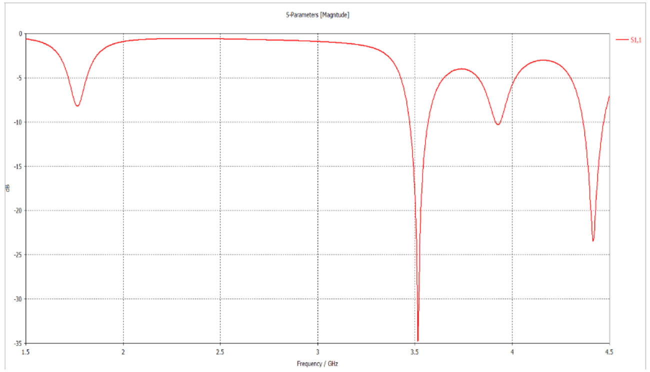

Figure 5:Result of S11 for 30x35mm

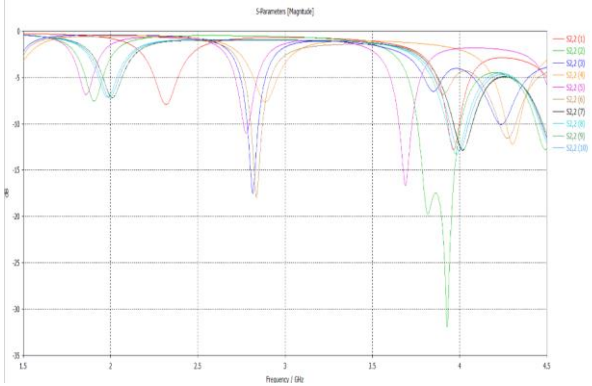

Figure 6:Result of S11 by varying the dimensions

- Resonant frequency lower than 2Ghz
- Multi-band properties
- Higher width higher S11 amplitude

Software simulation with CST

Antenna dimension(70x60mm)

- Resonant frequency at 2Ghz
- Impedance matching not reached
- Directive radiation pattern

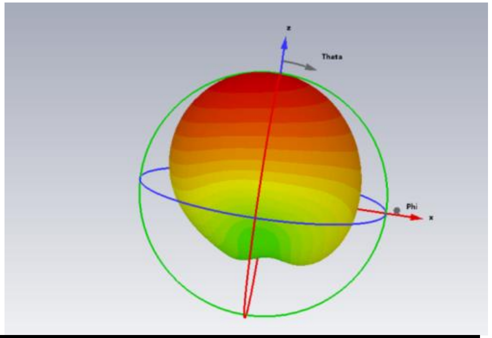

Figure 7:radiation pattern

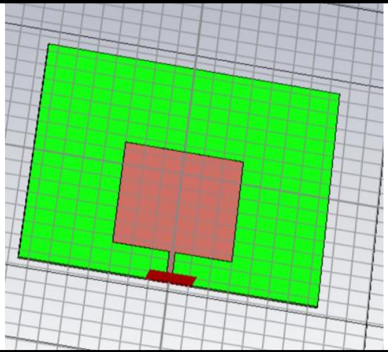

Figure 8: patch antenna 70x60mm

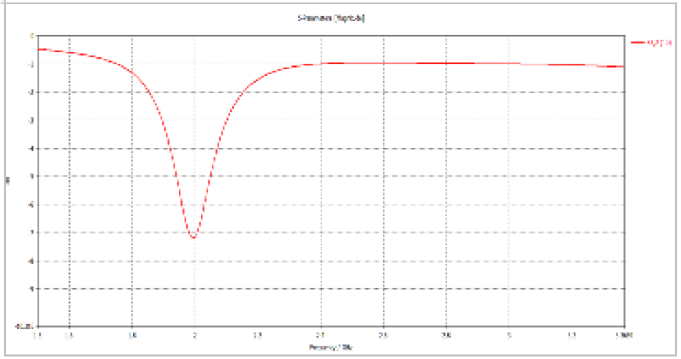

Figure 9:S11 result in dB

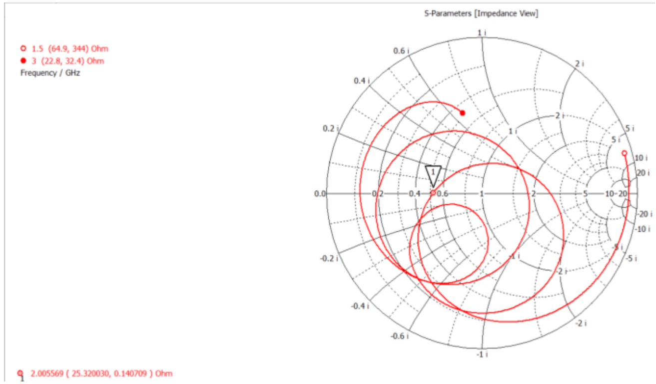

Figure 10:S11 result on smith abacus

- Impedance Matching with single stub

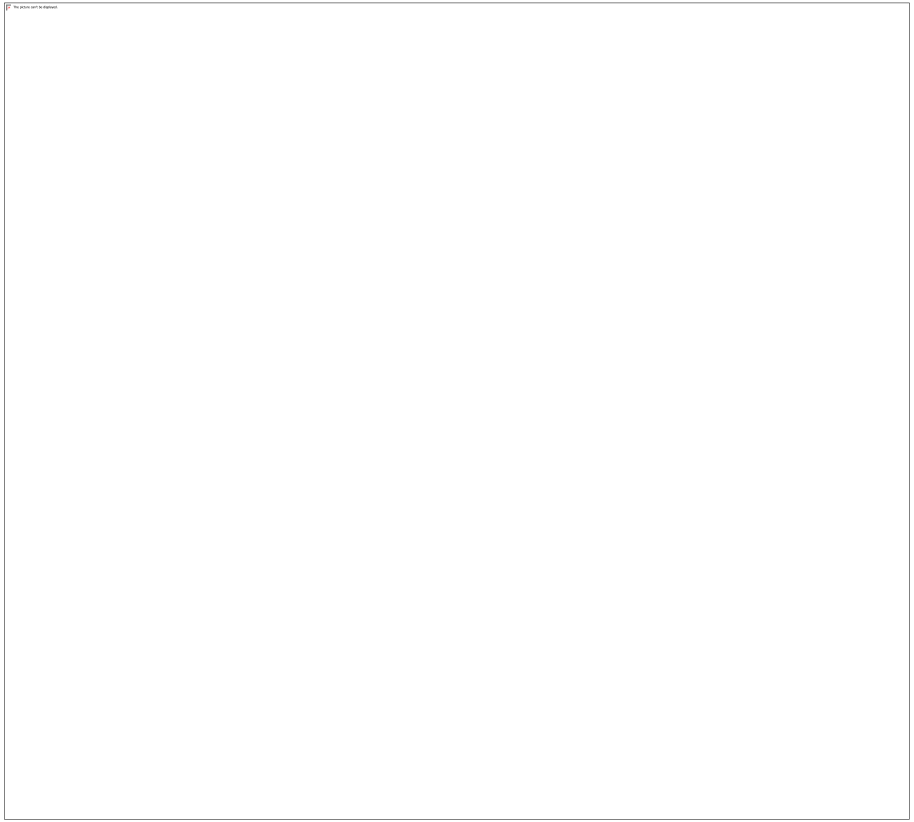

Figure 11:adaptation using smith chart

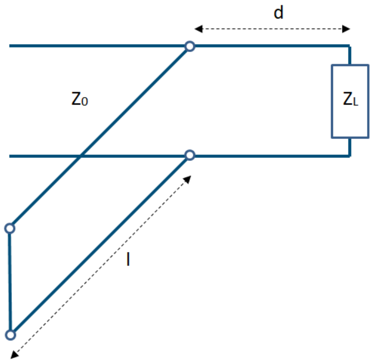

Figure 12:adaptation using single stub method

- $D = 0.26\lambda - 0.175\lambda$
- $L = 0.325\lambda - 0.25\lambda$
- $\lambda = 71.5e\text{-}3m$

Software simulation with CST

Impedance Matching with single stub

Stub dimensions :d=5,36mm ; L=6,077mm

- Resonant frequency at 2Ghz
- Impedance matching reached

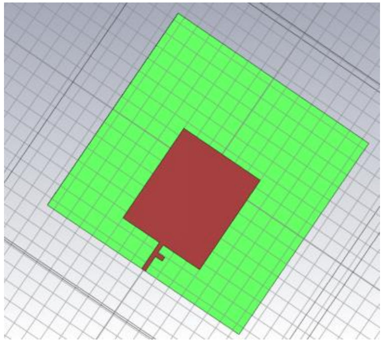

Figure 13:Patch antenna with single stub

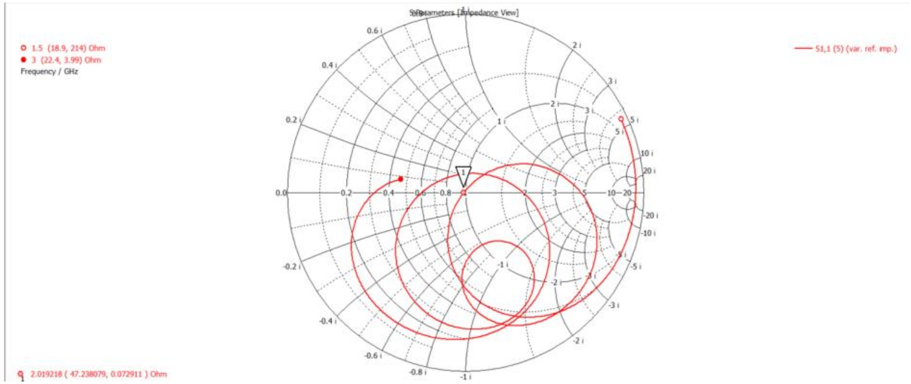

Figure 14:result of S11 on smith chart with single stub

Figure 15:result of S11 in dBwith single stub

Practical realization

Antenna without stub

- Resonant frequency at 2Ghz
- Impedance matching not reached

Figure 15:Real patch antenna without stub

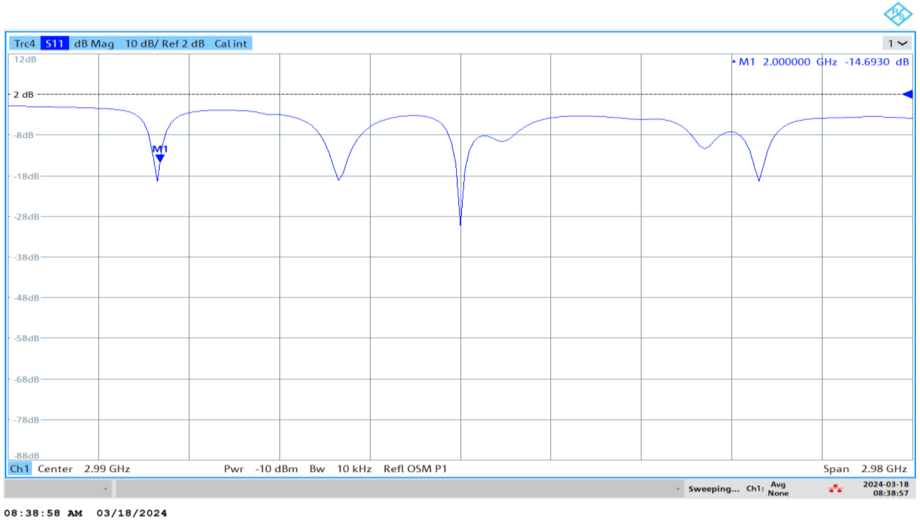

Figure 16:result of S11 in Db without single stub

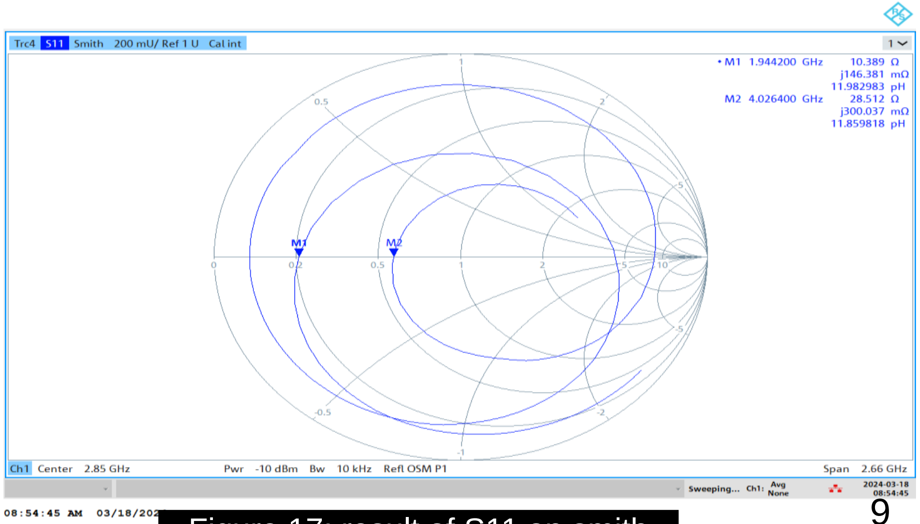

Figure 17: result of S11 on smith chart without single stub

Practical realization

Antenna with single stub

Stub dimensions :d=5,36mm ; L=6,077mm

- Resonant frequency at 2Ghz
- Impedance matching reached

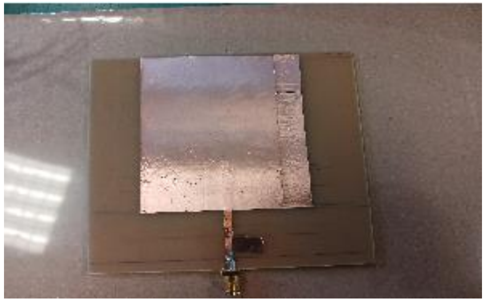

Figure 18: real patch antenna with single stub

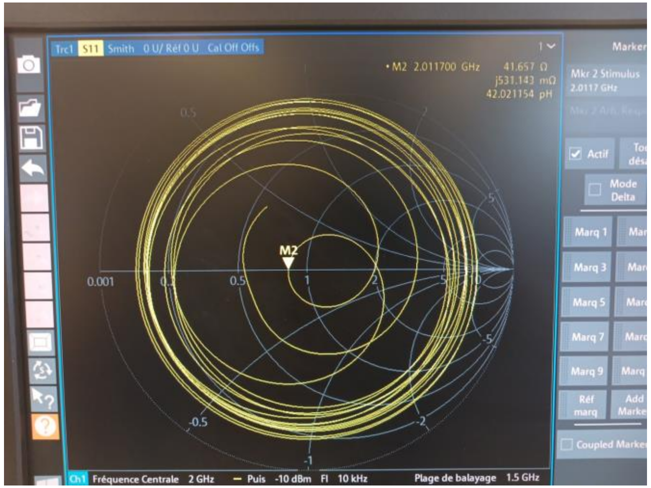

Figure 19:result of S11 on smith chart with single stub

Applications

- **Wireless Communication:** They are extensively used in wireless communication devices like Wi-Fi routers and mobile phones.

- **Spacecraft and Aircraft:** Owing to their low profile and light weight, these antennas find application in space vehicles and aircraft for communication purposes.

- **GPS Devices:** Patch antennas are used in Global Positioning System (GPS) receivers due to their directional radiation pattern and high gain.

- **Radio Frequency Identification (RFID):** They are commonly used in RFID systems for tag detection and data transfer.

Figure 20: Spacecraft and Aircraft communication

Figure 21:GPS Devices

Figure 22: Radio Frequency Identification

Figure 23: Wireless Communication

Conclusion

finally we have exploit many way to adapt antenna, and one that worked best for us, is the single stub.

To finish, this study we can say that we have modeled our patch antenna to be able to emit at 2GHz and to be able to be matched to all to power source of 50 Ω (power source and antenna are well matched).