



**Pole for Doctoral Studies**  
**Center for Doctoral Studies Sciences and Techniques and Medical Sciences**

## **ANNOUNCEMENT OF DOCTORAL THESIS DEFENSE**



**Ms. JAOUAD Safia**

**Will present their research work with the aim of earning a  
Doctorate**

**Doctoral program: Mathematics, Physics and new Technologies**  
**Discipline: Physics**  
**Specialty: Electronics and Telecommunications**

**On 20/07/2026 at 11H00 at the Thesis Defense Hall, Faculty of  
Sciences of Tetouan, UAE**  
**Under the Theme**

**Performance Enhancement of MIMO Antenna Systems Using  
Metasurfaces**

**Front of the jury composed of :**

<b>First Name &amp; Last Name</b>	<b>Establishment</b>	<b>Designation</b>
<b>Pr. EL MRABET Otman</b>	<b>FS of Tetouan, UAE</b>	<b>President</b>
<b>Pr. OULAD SAID Ahmed</b>	<b>Royal Air Academy of Marrakech, FAR</b>	<b>Reviewer</b>
<b>Pr. ZEKRITI Alia</b>	<b>ENSA of Tetouan, UAE</b>	<b>Reviewer</b>
<b>Pr. KANJAA Mohammed</b>	<b>FS of Tetouan, UAE</b>	<b>Reviewer</b>
<b>Pr. CHARIF Moahmed</b>	<b>ENSA of Tetouan, UAE</b>	<b>Examiner</b>
<b>Pr. AMAR TOUHAMI Naima</b>	<b>FS of Tetouan, UAE</b>	<b>Examiner</b>
<b>Pr. KHALLADI Mohsine</b>	<b>FS of Tetouan, UAE</b>	<b>Co-Supervisor</b>
<b>Pr. AZNABET Mariem</b>	<b>FS of Tetouan, UAE</b>	<b>Supervisor</b>

*Host Research Structure: Intelligent System Design*

## Abstract



The rapid evolution of wireless communication systems, driven by the growing demand for high-speed internet and localization services, has intensified the need for compact and high-performance transceiver devices. As electronic systems continue to shrink in size while requiring higher data capacity and improved coverage, antenna miniaturization has become a critical challenge.

In multiple-input multiple-output (MIMO) systems, closely spaced antenna elements are necessary to maintain compactness; however, this configuration increases mutual coupling, which degrades system performance. To address this issue, metasurfaces have emerged as an effective solution for reducing electromagnetic coupling between antenna elements. Metasurfaces are artificially engineered structures capable of exhibiting electromagnetic properties not found in natural materials, enabling enhanced control over wave propagation.

This thesis focuses on the design and implementation of metasurface-based techniques to enhance the performance of multiple-input multiple-output (MIMO) antenna systems. Initially, MIMO antennas operating at 6 GHz and 26 GHz (mmWave) are investigated to evaluate their channel characteristics. Subsequently, a two-element adjacent MIMO antenna operating at 2.85 GHz is developed, and an omega-shaped resonator metasurface is placed above the antenna elements to mitigate mutual coupling and improve isolation.

The proposed approach is then extended to a four-element MIMO antenna configuration, where the same frequency and metasurface unit-cell concept is employed to achieve further isolation enhancement. Finally, a dielectric resonator antenna (DRA)-based MIMO system is designed to generate circular polarization while simultaneously increasing the impedance bandwidth and further suppressing mutual coupling at the frequency 2.85 GHz.

**Keywords:** MIMO antenna, Metasurface, DRA, Mutual Coupling, mmwave