Faculty of Engineering  
Summer Research Program 2021-2022

Project Title: DESIGN AND ANALYSIS OF A RECONFIGURABLE INTELLIGENT SURFACE

Supervisor(s): Associate Professor Nemai Karmakar  
Department: Electrical and Computer System Engineering  
Email: nemai.karmakar@monash.edu.au  
Website profile of project supervisor:  
https://www.monash.edu/engineering/nemaikarmakar

Objective

The main project objective is to design and develop the experimental prototype for Reconfigurable Intelligent Surface (RIS) on computer simulation technology (CST Microwave Studio).

RIS is a massive low-cost passive element mounted on a planar surface. In general, it is composed of many controllable RIS elements made of multiple metal patches distributed uniformly. A passive system module can control the wireless propagation environment by re-engineering an electromagnetic wave [1]. These passive elements do not need a dedicated energy source for radio frequency (RF) processing and are different from current MIMO and backscatter communication. Thus, the RIS-assisted wireless communication system, also known as software-defined surface (SDS), provides a cost-effective and energy-efficient solution for next-generation wireless technology [2].

Project Details

The project is divided into three phases:
1. Feasibility Study: This will be the preliminary research where students come up with knowledge of RIS and its implementation.
2. System Design and Implementation: After feasibility, the student will focus on system design and implementation. Figure 1 provides the design layout of the RIS element, its experiment analysis using universal software radio peripheral (USRP) devices and its practical application area for IoT applications.
3. Summary, Limitation and Future Implementation: In this phase, students mainly focus on the testing of the system, evaluation, and analysis for future implementation.
Figure 1. (a) Design Layout of RIS element [2] (b) Experimental prototype using RIS based system [2]. (b) Application area based on the use of RIS system [3].

**TIMELINE**

<table>
<thead>
<tr>
<th>Task</th>
<th>22 November 2021 - 25 February 2022</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nov</td>
</tr>
<tr>
<td>Task 1 Feasibility Study</td>
<td></td>
</tr>
<tr>
<td>Task 2 System Design and Implementation</td>
<td></td>
</tr>
<tr>
<td>Task 3 Summary, Limitation and Future Implementation</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisites**

*Student must complete ECE4122 (Advanced Electromagnetic)*

**Additional Information**

*Students need to attend an interview.*
References

