Overview
1. Use existing silicon photonic switch fabrics by Complementary Metal Oxide Semiconductor (CMOS) processes.
2. Develop a reliable and configurable electronic feedback control circuit to stabilize it.

Our project aims
Our project aims to develop an electronic feedback control circuit with tolerance to noise, and reliable and reconfigurable capability, to actively stabilize N-by-N microring-based silicon photonic fabrics by the slope detection method.

The motivation
The advantages of microring-based optical switching are
1. High channel capability with light carrier,
2. Low energy consumption, and
3. Compact footprint.

Major challenges
1. Utilizing silicon photonics to provide high-speed optical data switching
2. Performance degradation of microring-based optical switching because of temperature variation and fabrication imperfection
3. The control signal metal contacts are close to each other, and solved by RF probes with micro-positioners and wire bonding.

In this project, I work with an exchange student, who called Mariyam Sama ZAHRIR, on the same topic. I have prepared
1. Hardware which consists of silicon photonics switching fabric,
2. Printed circuit board, and
3. Aluminium wires bonding to access multiple ring control signals with documentation.

While Sama was in charge of the control logics.

Key component – Micro-resonator
It is the key elements for optical switching. It integrated with two surface-state-absorption (SSA) based PIN photo-diode, and Thermo-optics (TO) tuner. For the two PIN diodes with 2 different purposes:
- Forward bias: Electro-Optic (EO) tuner
- Reverse bias: Photo-monitor (PM), current induced when input laser is on resonance.

Result on single ring device
- Quality factor $Q = \frac{\lambda}{\Delta \lambda}$
- Source power spectrum vs of $P_{source}$
- Source power spectrum vs of $P_{sun}$

Result
- Source power spectrum vs of $P_{source}$
- Source power spectrum vs of $P_{sun}$
- Source wavelength at 2.4V TO voltage
- Source wavelength at 0V TO voltage
- Source wavelength at 1.2V TO voltage

Investigate on the temperature variation and output power
The micro-ring under testing is resonated at 1542.91nm, and Output drop power is -21.9dBm.
- 17°C: 5dBm drops
- 30°C: 12dBm drops

Temperature variation
The output power degradation
Control algorithm with EO, TO, PM are essential.

Process Logic: Select-1 (Mbed LPC 1768)
- USB bootloader: high speed reconfiguration
- Analog inputs with on-chip ADC
  (Analog-to-digital conversion)
- Analog output and digital output

Function of the interfacing circuit
- Finish the interfacing code to get the current value
- Print out ASCII code to computer via USB (serialPC)