

An Indian-Australian research partnership

## Project title

# Advanced Optical Communications: Modulation and Electronic Equalization

**Project number:** IMURA0158

**Monash University supervisors:** Dr Le N. Binh and Assoc Prof. Malin Premaratne

**Monash University contact:** Dr. Le Nguyen Binh, Reader; Email: le.nguyen.binh@eng.monash.edu.au

**IITB supervisors:** Professor [R. Vijaya](#)

**IITB contact:** Dr [R. Vijaya](#), Professor; Email: rvijaya@iitb.ac.in

---

## Research Academy theme/s: 1 and 2

List only the research academy theme/s that is relevant to the project

1. **Advanced computational engineering, simulation and manufacture**
2. **Infrastructure engineering**
3. Clean energy
4. Water
5. Nanotechnology
6. Biotechnology and stem cell research

## The research problem

### Advanced Optical Communications: Modulation and Electronic Equalization

Modern optical communications has advanced tremendously over the last few years with extensive application of modulation techniques to increase the transmission capacity over the low loss window of silica-based single mode fiber. Several modulation schemes involving the amplitude, phase and frequency of the lightwave carrier can be employed. However one must determine which scheme is more appropriate in term of signal bandwidth **and** detection scheme. Although there are several published papers on the topics, **minimum shift keying** (MSK) is the scheme that we have investigated and obtained significant results, especially when the detection scheme is frequency discrimination.

Furthermore equalization **of** the electronic signals at the output of the optoelectronic receiver would further enhance the quality of the received signals. Thus this project would also aim to integrate a number of equalization techniques including Least mean square error (LMSE), Feed forward equalization, Decision feedback equalization, MLSE (maximum likelihood sequence estimation) etc. Each of the equalization would be most suitable for a particular modulation scheme and **one** needs to identify the transmitting and detection techniques.

This project can accept at least two PhD students, one on software and simulation and one on hardware implementation. Candidates will be integrated into a small research team.

## **Project aims**

This project aims to:

- Investigate a number of modulation formats such as minimum shift keying (MSK) and corresponding detection techniques for long haul optically amplified fiber transmission
- Devise new techniques to assess the quality of transmission
- Study and design of advanced equalization techniques for optical signals in the photonic or electronic domain

Theoretical and simulation, and experimental works are involved.

## **Expected outcomes**

- Simulation software for design of ultra-high speed optical transmission systems employing advanced modulation formats.
- Optical quality monitoring software and optical /electronic hardware for transmission monitoring
- Equalization – simulation and ultra-high electronic equalizers using digital signal processors. Digital signal processors dedicated to equalization.

## **Which of the above Theme does this project address?**

Highlight the Theme from the above list that this project will address. Feel free to nominate more than one.

This project would fit into the theme “infrastructure” as it involves telecommunication infrastructures for the emerging India in the 21<sup>st</sup> century. It also fits into computational engineering and simulation as efficient algorithms are needed for the digital signal processors working at ultra-high speed in order to minimize the constraints of minimum memory and execution time and these limits.

## **How will the project address the Goals of the above Themes?**

Describe how the project will address the goals of one or more of the 6 Themes listed above.

See above section