IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project title: Advanced Monitoring Techniques for Long Haul Optical Transmission Systems

Project number: IMURA0156

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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

Modern optical communication 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, 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. Monitoring the quality of these signals over ultra-high speed optical networks is critical for network management.

Thus monitoring techniques and technology are essential for these ultra-high speed optical networks. Recently our laboratory at Monash University has discovered novel techniques to evaluate signals in the spectral domain which has never been reported in published literature for optical transmission systems. The techniques are applicable to chaotic, phase-dependent signals which are complex. These novel techniques will be employed in this work.

Project aims

This program aims to:

- Develop the techniques to explore complex signals in electronic and optical systems at different phases in complex systems and networks.
- Design methods for assessing complex signals for monitoring the evolution of signals in temporal and spatial domains.
- Apply to several complex systems such as optical solitons and bound solitons, phase modulated optical systems such as DQPSK, MSK etc… Chaotic signals in optoelectronic nonlinear systems, ECG medical signal monitoring systems….

Expected outcomes

- Simulation software for assessing the quality of monitored signals in both optical and electronic domain.
- Novel optical spectrum assessor of lightwave signals.
- Optical and electronic amplitude-phase spectrum analyzer.

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 21st century. It also fits into computational engineering and simulation as efficient algorithms are needed for the digital signal amplitude-phase analyser 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