IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project title: Bound Solitons and Advanced Photonics Techniques for Characterization of Ultra-short pulses

Project number: IMURA0157

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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 and ultra-short pulse sequence to increase the transmission capacity over the low loss silica-based single mode fiber.

Besides advanced modulation schemes involving the amplitude, phase and frequency of the lightwave carrier, time domain division multiplexing would offer some significant advantages. In order to generate such ultra-short pulse sequences for transmission applications, the two research groups at IITB and Monash ECSE have made advances on generation of mode-locked pulses, soliton pulses and multi-bound soliton pulse sequences. However, the pulses of these sequences must be shortened further to an order of a few picosecond or even in the femtosecond ranges. A number of possibilities would be studied and investigated including the use of parametric amplification to widen the gain and phase matching spectrum of the generated pulse sequence, the uses of high nonlinear guided wave devices etc…

Monitoring techniques of the generated pulses and their transmission over single mode fibers would be very important and are essential for their applications in ultra-high speed optical networks. The project will address these issues and devise novel photonic devices for characterization of these ultra-short pulses.

Project aims

This program aims to:

- Experimentally generate ultra-short solitons and multi-bound solitons using fiber mode locked ring resonance phenomena.

- Develop the techniques to explore complex optical signals of the generated pulses, especially the amplitude and phases which have not been reported before in published literature.
- Design methods for assessing complex signals for monitoring the evolution of signals in temporal and spatial domains.

Expected outcomes

- Simulation software for assessing the quality of monitored signals in both optical and electronic domain.
- Experimental soliton and bound soliton sources for long haul ultra-high speed optical communications.
- Novel optical spectrum assessor of lightwave signals.
- Optical 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