

Training 2010

Lab : Institut Fresnel – MOSAIC group

Address : Bât Fresnel - Domaine Univ St Jérôme – 13397 Marseille Cedex 20 – France

Contact : Hervé Rigneault

Web : www.fresnel.fr/mosaic

Phone : +33 4 91 28 80 49

Email : herve.rigneault@fresnel.fr



Optimization of light supercontinuum generation by temporal pulse shaping

Scientific Context:

Photonics Crystal Fibres (PCF) are novel fibre optics that exhibit nanoscale structuration (Fig 1) [1]. When illuminated with ultra-short laser pulses, PCF can generate a broadband radiation extended from the blue to the infra-red part of the spectrum; such a radiation is called a supercontinuum (SC) [2]. Fig 2 shows a PCF injected with a 200fs IR laser pulse that generates a broad SC that covers the entire visible spectrum. Up to now only short pulses have been used to generate SC but recent work [3] have shown that SC spectrum is very dependent of the temporal shape of the incoming pulse.

Recent advances in laser technology permit nowadays to control the temporal shape of an ultrashort laser pulse (Fig 3 top) thanks to a spatial light modulator (SLM). With this SLM it is possible to generate a laser pulse with an arbitrary temporal shape [4]. This shaped pulse can be further injected into a PCF to generate a SC.

In this project we aim at optimizing the temporal shape of a laser pulse to generate a controlled SC.

Detailed project

A close collaboration with Pr. Dudley (Univ Franch Comte, Besançon, France) has permitted the implementation of numerical simulations (mathlab) that fully predict the SC generation into a PCF.

The proposed work of this PhD is:

- (1) To include the SC generation code into an optimization algorithm that modifies the temporal shape of the incoming pulse to optimize the spectrum of the generated SC (Fig 3). This optimization algorithm will use the mathLab Toolbox or genetic algorithm.
- (2) To implement the optimization algorithm directly on the experiment developed at the Fresnel Institute (Fig3) and to test its validity.

The following skills will be developed in the project :

Optimization using mathLab

Electromagnetic simulation

Laboratory optical bench optics, electronics, optoelectronics, and lasers.

Weblinks

MOSAIC team webpage : www.fresnel.fr/mosaic

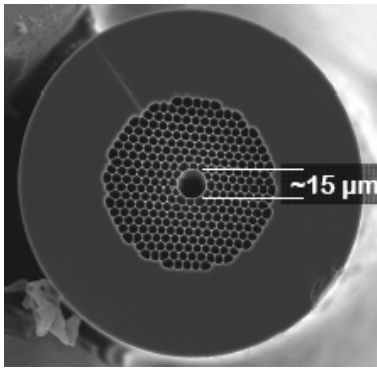


Fig 1: Photonics Crystal Fiber (PCF)

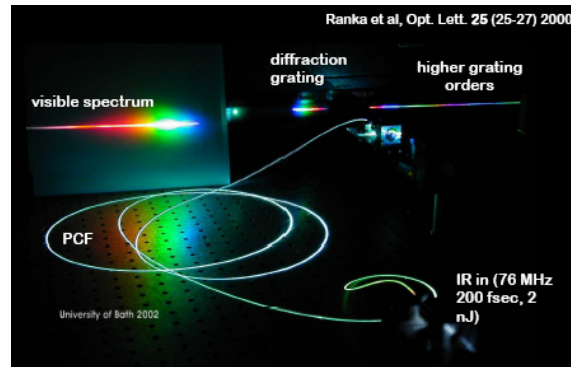


Fig 2: Supercontinuum (SC) generation in a PCF

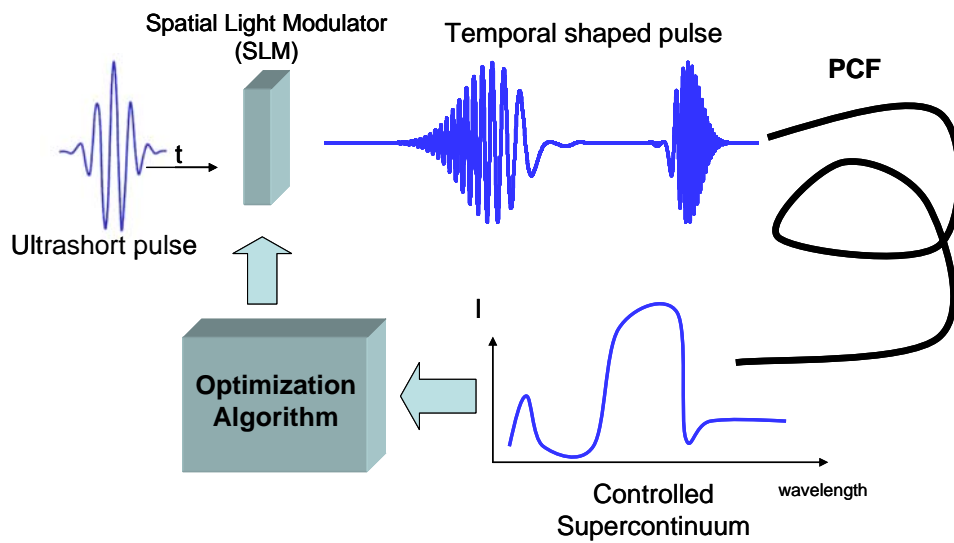


Fig 3: Principle an optimize SC generation using a PCF

Selected references :

1. Russel, Science 302, 1489 (2003)
2. J. Dudley et al., Rev. Mod. Phys. 78, 1135 (2006)
3. S. Michel, H. Rigneault – Private Communication (2009)
4. P. Tournois, Opt. Comm. 140, 245 (1997)