Master internship
Light control in a looping multimode fiber

The study of light propagation in disordered materials - such as biological tissues, layers of paint, fog or multimode fibers – has strongly attracted the attention of the optics community during the past decades. When light propagates in such complex systems, light is scattered by the heterogeneities of the medium and all the information carried by light seems to be lost. For example, it is impossible to see through a dense fog because light is multiply scattered by the water droplets. When a coherent light beam propagates through such a medium, it yields a complex, seemingly random interference pattern, a so-called speckle pattern.
However, it has been recently demonstrated that the distortions induced by scattering can be pre-compensated by shaping the optical wavefront before propagation in the complex medium. For example, light can be focused through an opaque layer of paint and objects hidden behind scattering media can be imaged.
Recently, these novel techniques have been used to control light propagation through multimode fibers. Similarly to the case of a scattering medium, light propagates in a multimode fiber following different optical paths. The propagation modes of the fiber then accumulate different phase retardations, and recombine in an uncontrolled way, yielding a speckle pattern at the output of the fiber. By pre-compensating this mixing process with light shaping techniques, such systems are expected to play an important role for imaging or communication purposes.
The internship project we propose aims at studying and controlling light propagation in multimode fibers in a specific configuration, called the 'fiber loop' configuration. In this configuration, light propagates through a bended multimode fiber where a part of the output light is directly re-injected in its input. Light collected at the output is then composed of photons that has performed different numbers of fiber loops.
The main objectives on the internship is to develop the experimental setup and use light shaping techniques to control light propagation in the system.
The student will be working on experimental optical setups. Programming skills and a strong background in experimental optics are required. This project has been carefully designed to enable the student to progress step-by-step with some intermediate goals to reach.

Requirements

Candidates with a strong background in physics, optics, electrical engineering, or any related field are encouraged to apply. Programming skills would be beneficial (Matlab or Python), as well as a certain taste for tinkering. As they will be evolving in an international environment, the candidates must be fluent in English, and exhibit excellent communications capabilities (written and spoken).

Host lab

The project will be carried out at the Fresnel Institute in Marseille, within the MOSAIC group. Gathering more than 40 people from around the world, this interdisciplinary group is working at the crossroad of physics and biology.

Application procedure

Please send a detailed CV, a cover letter, as well as names, affiliations, and email addresses of two references to thomas.chaigne@fresnel.fr. Make sure to mention "[Application]" in the email object.