

# Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars 2011)

**Proposition de stage pour l'année 2010-2011 (ne pas dépasser 1 page)**

Date de la proposition : 7/12/2010

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Lieu du stage / internship place: Palaiseau	

**Titre du stage / internship title: Polarimetric properties of speckle in optics : modeling, processing, and experimental validation.**

Taking into account the polarization state of light considerably enhances the information content of optical measurements. It can provide useful information about the observed scene (contrast, orientation, surface state) or increase the performance of imaging through turbid media.

In systems measuring the polarization, illumination and/or detection are often performed coherently. Measurements are thus affected by the **speckle phenomenon**. The intensity fluctuations of a speckle pattern have been studied in detail, both on a theoretical and applicative point of view. It is not the case of its **polarization properties**. However, experimental measurements have demonstrated their applicative interest and the relations between polarization and coherence are the object of intense studies in the scientific community. Moreover, the equipment for measuring and analyzing polarization has considerably progressed in the past years. It is thus now possible to perform an in depth study of the polarization properties of speckle both theoretically and experimentally.

### **Brief description of the scientific work**

**The objective of this internship project is to improve our knowledge about the polarimetric properties of speckle and draw from this study some tools that will be useful to solve practical applications.** Indeed, depending on the application, the speckle phenomenon can be seen whether as a noise (for example in imaging), or as a source of useful information. In both cases, it is necessary to have a precise knowledge of the statistical properties of its polarization state in order to compensate for it or to exploit in an optimal way the information it contains.

The project will consist in developing methods for characterizing and estimating the polarimetric properties of speckle. This work will involve, in a closely interleaved manner, the three following topics :

- **Definition of signal and image processing algorithms** for statistical characterization and estimation of the polarization state of the speckle.
- **Validation of these algorithms with numerical simulations.** Simulations will make it possible to evaluate the impact of the diffusion properties of materials on the polarization properties of speckle.
- **Experimental validation.** It will be performed on a simple but optimized setup.

The obtained results will make it possible to solve such applications as characterization of the surface state and structural anisotropy of materials or imaging through turbid media.

### **Skills acquired during the internship**

This project is clearly multidisciplinary. Its originality lies in the coupling of physical modeling, signal and image processing for information extraction and optical experiments.

**Ce stage pourra-t-il se prolonger en thèse ? Possibility of a PhD ? : yes**

**Si oui, financement de thèse envisagé/ financial support for the PhD: ED scholarship**

Lasers et matière		Lumière, Matière : Mesures Extrêmes	
Optique de la science à la technologie	x	Physique des plasmas	