

Visiting research fellow in Applied Solid State Physics group at Hokkaido University, Sapporo, Japan

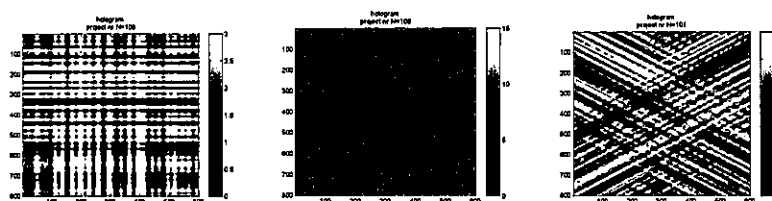
5 January 2015 – 5 February 2015

Research activities

Most of the research exchange was achieved via daily interactions with Prof. Osamu Matsuda, Prof. Oliver Wright and their PhD and Master students. Most of the joint research was performed in the framework of the extension of a picosecond laser ultrasonic (probe laser) scanning system with a new system of computer generated hologram (CGH) images of pulsed excitation (pump) laser light. During the research stay,

- An algorithm to solve the inverse problem of holography, i.e. the calculation of the phase image wavefront modification needed to achieve a certain projection on the sample surface, was improved and adapted to the hardware of the setup.
- The development of a new method was initiated to develop alternative algorithms that allow to solve the inverse problem of calculating phase patterns faster and more accurate. One approach is to fit a truncated Fourier expansion of the phase image rather than the phase image itself.
- holograms were calculated to photoacoustically generate surface acoustic wave (SAW) fronts in different geometries:
 - Circle pattern, with the goal of focusing SAW down to a single point, with very large amplitude magnification
 - Anisotropic ring pattern, with the goal of focusing SAW down to a single point in anisotropic materials, taking into account the SAW velocity anisotropy in the shape of the ring
 - Stretched line and stretched ring pattern, with the goal of adding a frequency dependent delay to the SAW, which compensates frequency dependent delay effects caused by dispersion due to the non-uniformity of coating-substrate samples.
 - Arbitrary geometries, imported from a standard picture file, in order to allow for flexible generation and verification of new patterns.

As in illustration, the figures below show calculated phase patterns needed to make holograms for a plus, ring and cross shape:



- a joint article on a new photorefractive interferometry technique to locally detect and image the displacement field of propagating SAWs was finalized and submitted to *IEEE UFFC*: "Imaging of Transient Surface acoustic Waves by Full-Field Photorefractive Interferometry", by Jichuan Xiong, Xiaodong Xu, Christ Glorieux, Osamu Matsuda, and Liping Cheng
- a second joint article on heterodyne diffraction by impulsive stimulated scattering was finalized and submitted to *Photoacoustics*: "Determination of thermoelastic material properties by differential heterodyne detection of impulsive stimulated scattering", Bert Verstraeten, Jan Sermeus, Robbe Salenbien, Jan Fizez, Gennady Shkerdin, Osamu Matsuda and Christ Glorieux

Personal evaluation

In consider the research stay in Applied Solid State Physics group at Hokkaido University, which I could do in the framework of a sabbatical leave from the Physics and Astronomy department at KU Leuven, Belgium, as highly fruitful and enriching. Not only did it give me the opportunity for joint research on generating surface acoustic wave pattern for different scientific goals, but it has also allowed me to get acquainted with the picosecond ultrasonic setups, which have experimental possibilities that are complementary to the ones of the heterodyne diffraction and beam deflection setups in my home research team. Many of the sophisticated optics in the Sapporo lab can be implemented in Leuven. The daily conversations with researchers has also given me the opportunity to learn from the different physics problems they are working on.

I was also impressed by the highly efficient organized functioning of the daily life in Japan, and by the very kind, helpful and respectful attitude of Japanese people among each other and towards people from abroad. The Hokkaido island also has a very rich pallet of delightful gastronomic, cultural and touristic opportunities, which I could deeply enjoy thanks to the leisure time and company given by the people from the lab, in particular Prof. Osamu Matsuda and Prof. Oliver Wright.

Seminar

- "Applications of photothermal and photoacoustic methods using different spatiotemporal excitation patterns", Applied Solid State Physics laboratory, Hokkaido University, Sapporo, 4 February 2015

Heverlee, 6 February 2015

Christ Glorieux
Laboratory of Acoustics - Soft Matter and Biophysics
Department of Physics and Astronomy