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PHOTONICS - EUROPHOTONICS MASTER COURSE

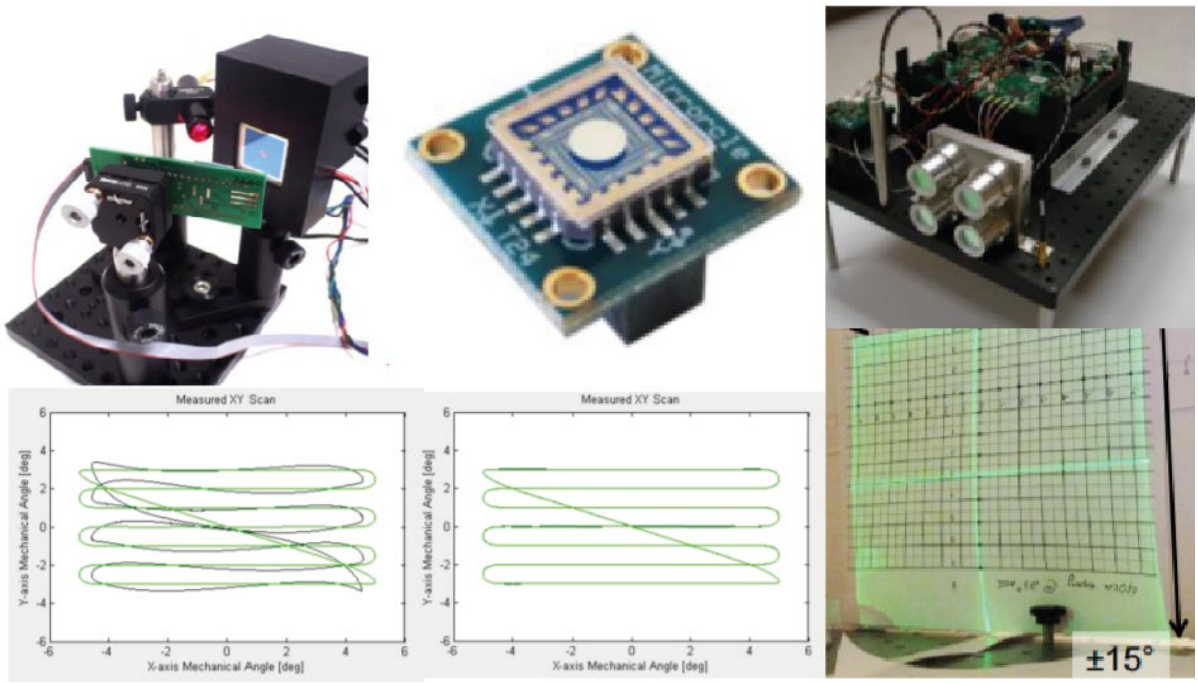
PROPOSAL FOR A MASTER THESIS

Dates: February 1st, 2020 – September 31st, 2020

Laboratory: Centre for Sensors, Instrumentation and systems Development (UPC-CD6)
City, Country: Terrassa, Spain

Title of the master thesis:

Smart iterative learning control of resonant electrostatic-based MEMS mirror



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Keywords: MEMS micromirrors, optical engineering, active optics, LiDAR, 3D imaging, OCT, optical metrology, optomechanics, optoelectronics

Summary of the subject:

Which is the problem?

Micro-electro-mechanical systems (MEMS) ara a technology which uses electrical signals to generate movements in a microscopic scale. It is a broad field which includes different applications like precise accelerometers and gyroscopes, microfluidics, key components in electron microscopes or new strategies to make novel optical devices. In this last framework, MEMS mirrors have an important role as oscillating mirrors for scanning, and, in some cases, they are opening new opportunities overcoming traditional technological trade-offs, due to their size, speed and reliability.

One of these key applications is its use as substitutes to bulky mechanical arrangements in laser scanning systems. In order to acquire maximum velocities of scan, some micromirrors work like resonators, reaching frequencies of some kilohertz. When the mirrors work in this regime, its movement stops behaving like a harmonic oscillator, generating chaotic displacements when they approximate the resonance frequency. This problem is a main issue when you want to use MEMS mirrors in scanning systems where you don't have a feedback of the movement, as the shape of the scanning affects the quality of the images. This TFM proposal is about the development of an optical approach we have started to implement in CD6 together with a MEMS mirror manufacturer and an industrial partner, in order to improve performance of lidar systems.

What will you do?

This is a real-world optical engineering project. In your first weeks, you will learn and discuss the optical solution proposed with the team related to the project, which will support you throughout your project trying to make some improvements and designing the setup. Progressively, you will win independence to make decisions on different aspects of your work, like which type of detectors you will use, how will be your optical arrangements, what kind of data you will get from your experiments, how you will coordinate the different instrumentation, and other little technical choices that any optical engineer must deal with every day. Once the experiment is mounted, different problems will raise, and you will have to deal with them together with your teammates. You will practice your patience and you will see how enriching it is to work in a framework with very diverse technical knowledge.

The technique that we want to implement involves building a setup but also a feedback system using an algorithm in MATLAB which sends signals to the mirror, so you will win also knowledge about control systems. You will also have to deal with some data analysis.

Is this TFM for you?

This is an applied thesis work with unsolved challenges and with controlled risk. It involves a variety of technical disciplines and components, involving photonics, electronics, data analysis and control.

This Thesis is for you if you like technical challenges where you can learn from different disciplines, and/or to work in a real world problem of the latest technology.

Additional information

* A monthly allowance is possible depending on value of candidate. In any case allowance requires full-time dedication and early incorporation, even part-time in the first months. Contact for details.

* Recommended skills:
Interest in application-driven experimental work for solving real-world problems.
Search of resources, both scientific and technical.
Self-motivated, objective-driven, capable of autonomous working within a multidisciplinary team.
Basic concepts in optical metrology and optical engineering.
Programming (C++, MatLab) and use of scientific software packages (Labview) recommended.

* Miscellaneous :
This thesis contents will be considered confidential due to its closeness to market.
Consolidated research team with several years of experience in the topic.
Multidisciplinary environment with electronics and mechanics workshops, and specialists and technicians in metrology, optics, mechatronics, and electronics.
Possibility of joining the Centre for a PhD/Project Manager career in case of common interest.
Early incorporation welcome.