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PHOTONICS - EUROPHOTONICS MASTER COURSE

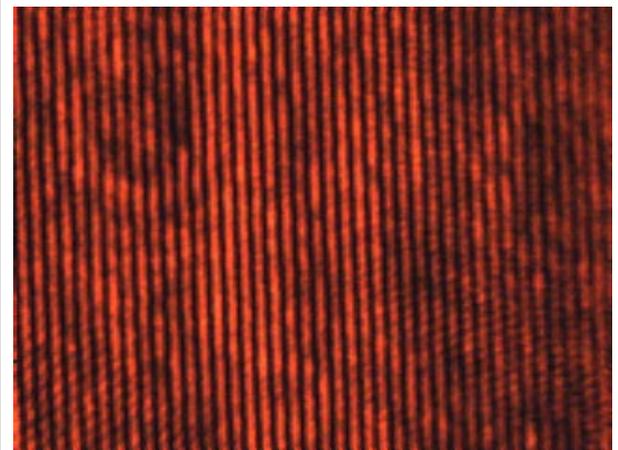
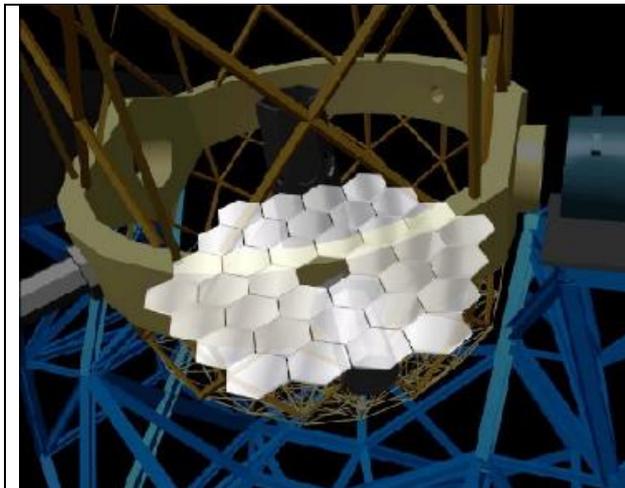
PROPOSAL FOR A MASTER THESIS

Dates: February 1st, 2022 – September 10th, 2022

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

Title of the master thesis:

OPTICAL QUALITY ANALYSIS AND SIMULATION OF NEW
INTERFEROMETRIC TECHNIQUE FOR PISTON MEASUREMENT OF
SEGMENTED MIRRORS



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Summary of the subject (maximum 1 page):

Which is the problem?

At CD6 we are developing the phasing system of the Extremely Large Telescope, to be installed in Atacama, Chile. Our Tasks involve the development of an interferometric system enabling to measure the relative position of the segment of the primary mirror of the telescope, which need frequent maintenance. A large dynamic range, medium resolution interferometer is being built with this purpose.

The ELT M1 Local Coherencer is a non-contact metrology system aimed to simultaneously measure the relative pistons on the six sides of a target M1 segment with respect to neighboring ones with an accuracy below 300nm in a range of $\pm 250\mu\text{m}$. This measurement shall be performed while the Local Coherencer is supported by the M1 Segment Manipulator hanging from the M1 Segment Crane, consisting on:

- Six lightweight and compact Sensing Modules whose main system is a modified Mach-Zehnder interferometer for the piston measurements that hugely simplifies image processing and avoids any ambiguity in the measurements.
- Comprehensive and robust alignment detection and alignment compensation systems that ensure proper positioning and prevent apparent (bias) piston measurement errors.
- A lean embodiment in which all the subsystems, including control and safety elements, are mounted on a single support structure and enclosed in the specified design volume, with no need to use the space reserved in the M1 Segment Manipulator
- A solution largely based on small COTS and simple electronics, which account for ease of use, high reliability, easy replaceability and high durability of the system.

What will you do?

You will join our research group, where you'll have support on the use of computers for optical quality analysis and simulation, and on optical design software ZEMAX and MATLAB. This project aims to explore the new interferometric technique for piston measurement of segmented mirrors. The interested student will work in a combination of design and simulation tasks with the goals of:

- 1) Achieving the optical quality analysis and simulation of the desired magnitudes (piston, tip, tilt, OPD, aberrations...), selecting the better processing procedures (including ghost removal, calibration, and computation of values).
- 2) Implementing the optical quality analysis procedure, initially performed in Matlab, based on Zemax model of interferometer system.
- 3) Finally, to optimize the performance of the optical quality of interferometric system in order to be as fast as possible without affecting the accuracy of the units.

This is a analysis and simulation Thesis. Programming skills on Matlab and ZEMAX are recommended and will be used as criteria for the selection of the candidate.

Keywords: Optical design, Optical quality analysis, optical models, optical simulation, interferometry, metrology

Additional information :

* Amount of the monthly allowance (if it is the case):
To be discussed depending on the value of candidate.

* Required skills:

Interest in application-driven experimental work for solving real-world problems.

Basic concepts in optical metrology and optical engineering

Zemax Software skills

Programming (proficiency in Matlab minimum) and use of scientific software packages
(Labview...)

Search of resources, both scientific and technical

Self-motivated, objective-driven, capable of autonomous working within a multidisciplinary team.

* Miscellaneous:

This thesis contents will be considered confidential due to its closeness to market.

International team with several years of experience in the topic proposed.

Multidisciplinary environment with electronics and mechanics workshops, and specialists and technicians in optical design, metrology, mechatronics, and electronics.

Possibility of joining the Centre for a PhD/Project Manager career in case of common interest.

Early incorporation welcome.

