

OUTCOME



Universidad
Carlos III de Madrid



PhD position in Marie Skłodowska-Curie ITN-ETN

The outstanding challenge in Solid Mechanics: engineering structures subjected to extreme loading conditions

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In this project we aim to train early-stage researchers in what is referred to as an outstanding challenge in solid mechanics: developing novel solutions for the analysis and design of aerospace and defense structures subjected to extreme loading conditions. Structural elements used in aerospace and defense industries are frequently subjected to a large variety of unusually severe thermo-mechanical solicitations. One easily realizes that this type of structures (e.g. components for satellites) has to be designed to sustain extreme temperatures, which may vary hundred degrees in short periods of time, and extreme mechanical loadings like hypervelocity impacts. New specific structural solutions are constantly developed to fulfill such requirements, which place these industrial sectors in the forefront of the technological innovation. We have formed a consortium composed of 3 academic and 4 industrial partners which aims at developing specific training for early-stage researchers within the field of aerospace and defense structures subjected to severe thermo-mechanical loads. The leitmotif of this ITN is to train creative and innovative researchers ready to face structural-engineering challenges which arise in the vanguard of technological innovation. OUTCOME is a unique opportunity for 8 motivated early-stage researchers that are willing to set the basis of their scientific career within the field of Solid Mechanics.

PhD Research

Computational optical metrology development for defects, damages and deviations detection in aerospace structures subjected to ground and flight conditions

Host

AEROSERTEC



Supervisors

Professor Jose Luis Vega Miguel (Aerosertec CEO)

Juan Sanz Peciña (Aerosertec R&T Manager)

Professor José A. Rodríguez-Martínez (University Carlos III of Madrid)

Synopsis

AEROSERTEC develops and manufactures visual systems to identify and measure surface imperfections and damage in aerospace and defense structures. For this purpose, AEROSERTEC accumulated over the years great expertise on the use of different technologies, especially in mechanical testing and assembly applications for aerospace (though they are used in fields as diverse as medical imaging and industrial quality controls) due to its relative ease of implementation and use. Within this context, in this research

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we aim at developing a measurement methodology, based on the Plennoptic technology, to detect mechanical damage before, during and after flight-tests of aircraft components. From the theoretical point of view, the challenge is to derive a mathematical model suitable to re-create from the captive image a complete high precision and measurable 3D scene. From the experimental point of view, the challenge is to validate and make operational this measurement methodology. For that goal, flight-tests on aircraft-wing structures will be performed. These are experiments to establish how aircraft-wing structures behave with normal and exceptional loads. The results shall provide precise information about the loading conditions and the level of strains that lead to surface damage in aerospace structural elements.

Research outputs

Development of a mathematical model measuring real-time initiation and progression of surface mechanical damage or defects in aircraft structures. It is a challenge hardly approached by the industry. This fact motivates this investigation in which we will develop a measurement method capable of detecting damage and defects and its evolutions in aircraft-wing structures before, during and after flight-tests. This research will strengthen the competitiveness of AEROSERTEC and will enable to the company to reach a leadership position in relation to its competitors.

Multidisciplinary / intersectoral research approach:

The ESR will develop at the **University Carlos III of Madrid** the core of the mathematical model to describe the imaging properties of projector and cameras, and the tests on aircraft-wing structures will be developed at **AEROSERTEC**. Taking advantage of the geographical proximity between AEROSERTEC and the University Carlos III of Madrid, the ESR will conduct periodic visits to the UC3M where she/he will have regular meetings with the academic advisor of her/his thesis. Moreover, the ESR will conduct a dedicated secondment at the University Carlos III of Madrid where she/he will be assisted to implement the mathematical model into a computational code. In addition, the ESR will conduct a secondment at the **TECHNION** where she/he will interpret and analyze the results of the flight-tests to determine the precise loading conditions which lead to surface damage in the aircraft-wing structures.

Training activities

The successful candidate will have access to the PhD program of the **University Carlos III of Madrid** as well as to the training activities organized within OUTCOME. These activities include, among others:

- **Attendance to the Workshop:** Extreme structural mechanics in aerospace applications to be organized by AEROSERTEC in Madrid.
- **Attendance to the Workshop:** Extreme structural mechanics in defense applications to be organized by RAFAEL in HAIFA.
- **Attendance to the course:** Horizon 2020 Proposal Development to be organized by EUROPA Media in Budapest.
- **Attendance of the course:** Damage and failure of solids subjected to extreme loading conditions to be organized by the University of Lorraine.
- **Attendance to the course:** From PhD to Scientific Leadership to be organized by Yellow Research in Madrid.
- **Attendance to prestigious international conferences** on damage and failure of engineering materials.



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Benefits

The successful candidate will be employed for 3 years and receive a **financial package plus an additional mobility and family allowance** according to the rules for Early Stage Researchers (ESRs) in an EU Marie Skłodowska-Curie Actions Innovative Training Networks (ITN):

- Living allowance – 3035.36€ (per month)
- Mobility allowance – 600€ (per month)
- Family allowance – 500€ (per month – if applicable)

This amount is a gross contribution to the salary costs. Net salary will result from deducting all compulsory social security/direct taxes from the gross salary according to the law applicable to the agreement concluded with the ESR.

Additional information about the funding provided by the ITN projects can be found in:
http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-msca_en.pdf

Key publications

Adelson, T. A. Single lens stereo with a plenoptic camera. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 1992; 14: 99-106.

Clare, R., Lane, R. Wave-front sensing from subdivision of the focal plane with a lenslet array. *Journal of the Optical Society of America*. 2005; 22: 117-125.

Conforti, G. Zernike aberration coefficients from Seidel and higher-order power-series coefficients. *Optics Letters*. 1983; 8: 407-408.

Marichal-Hernández, J. G., Rodríguez-Ramos, J. M., & Rosa, F. (2007). Modal Fourier wavefront reconstruction using graphics processing units. *Journal of Electronic Imaging*. 2007; 16: 023005.

Rodríguez-Ramos L. F., Viera T., Gigante J. V., Gago F., Herrera G., Alonso A., Descharmes N. et al. FPGA adaptive optics test bench. *Astronomical Adaptive Optics Systems and Applications II*. Edited by Tyson R. K., Lloyd-Hart M. *Proceedings of the SPIE*. 2005; 5903: 120-128.

Goodmann, J. W. Introduction to Fourier Optics. Edited by McGraw-Hill. 1996.

Rodríguez-Ramos, J. M. Detección de frente de onda: Aplicación a técnicas de alta resolución espacial y alineamiento de superficies ópticas segmentadas. Tesis Doctoral. Universidad de La Laguna. 1997.

Rodríguez-Ramos, J. M. *International Patente nº ES200800126 ES200600210*. 2006

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Profile

We are looking for highly motivated early-stage researchers with the following profile:

- Hands-on mentality, good organizational and communication skills.
- Proactive attitude and ability to work both independently/autonomously and within a team.
- Good communication skills in English.

In order to meet the specific requirements of the Marie Skłodowska-Curie funded PhDs, you must not have resided or carried out your main activity (work, studies, etc.) in **Spain** for more than 12 months in the last 3 years. You may be of any Nationality.

Required educational level

Degree	Master degree or equivalent
Degree field	Engineer vision and automatization
Degree	Master degree or equivalent
Degree field	Physics Optics
Degree	Master degree or equivalent
Degree field	Mathematics (computational science)

Career stage

Early stage researcher or 0-4 years (Post graduate)

Professional and/or research experience

We will particularly consider those candidates with proven experience in technological and/or research activities. Publication/s in journals indexed in the Journal of Citation Reports will be especially welcomed

Letter of motivation

The candidates must provide a letter of motivation where they clearly state why, under their point of view, they should be enrolled in OUTCOME.

References

At least, one recommendation letter from the scientist/s who mentored the candidate during her/his master studies is required. The letter must clearly expose the profile of the candidate with emphasis in the qualities which make her/him suitable for being recruited in OUTCOME. Additional recommendation letters from any other professor/professional will be most welcomed.

Specific qualifications

Candidates should have a solid background in Mathematics and Programming.
Desired knowledge: CUDA, GPUs, FPGA knowledge, Fortran, C++, Unix.



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Flexible working conditions

We are committed to provide flexible hours and home working conditions for researchers having family obligations. The following web-site contains relevant information **related to the EU equal opportunities policy** https://ec.europa.eu/research/science-society/women/wir/index_en.html. Moreover, the web-site <http://www.partnerjob.com/> facilitates geographic mobility by providing help to find a job for an accompanying partner.

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The application period closes in June 2016

The PhD starts in September 2016