

Luca Leggio

PhD in Optoelectronics



Education

University Carlos III of Madrid (Madrid, Spain)

- 2017 PhD in Electrical, Electronic and Automatic Engineering (Cum laude)

Thesis: *Design and development of a multi-wavelength optoacoustic system based on high-power diode laser sources. Optoacoustic signal generation with nanoparticles for biomedical applications.*

University of Roma Tre (Rome, Italy)

- 2012 Master's Degree in Telecommunications Engineering (110/110 cum laude)
- 2009 Bachelor's Degree in Electronic Engineering



Masters, Courses and Seminars

Polytechnic University of Madrid (Madrid, Spain)

- 2018 Master in Development of Applications for Mobile Devices

Asociación Española de Programadores Informáticos (Madrid, Spain)

- 2017 Intensive Course of Java and SQLite
- 2017 Course of C/C++

Seminaries in OILTEBIA European Project

- 2016 Industrial Involvement Workshop in "Micro-electromechanical systems and biosensors" (Phillips, Eindhoven, Netherlands)
- 2016 Summer School in "Optical and Ultrasound Imaging" (University of Lyon, Lyon, France)

- 2016 OILTEBIA Laboratory Training Platform in “Biological and Medical Imaging” (Helmholtz Zentrum München, Munich, Germany)
- 2016 Industrial Workshop in “Laser Sources for Biomedical, Scientific and Industrial Applications” (Sacher LaserTechnik, Marburg, Germany)
- 2015 Industrial Workshop in “MEMS-based Transducers and Biomedical Applications” (VERMON, Tours, France)
- 2015 Summer School in “Biophotonics and Molecular Imaging” (FORTH Institute, Heraklion, Greece)
- 2014 Laboratory Training Platform in “Sensors and Instrumentation in Biomedical Imaging” (Politecnico di Milano, Milan, Italy)
- 2014 Course of “Introduction to Analogue and Mixed Signal IC Design” (Oxford, UK)



Prizes

- 2018 *Winner of Extraordinary Prize for the year 2017*: Doctoral Program in Electric, Electronics and Automatic Engineering (University Carlos III of Madrid, Madrid, Spain)

This award is based on merits in scientific publications during the doctoral studies.



Employment history

From May 2019 University of Minho (Braga, Portugal)

- Participation in the project “*In vivo biometric and optical changes of the crystalline lens with accommodation and its impact in subjective retina image quality-LensUM*”. In this project, my task is to investigate the effects of eye accommodation, consisting in the focusing of objects at different distances, in the retina image quality. The responsible of eye accommodation is the crystalline lens that changes its curvatures depending on the object distance. In the long run, eye accommodation leads to deterioration of sight, resulting in myopia, astigmatism or presbyopia.

In order to measure the eye aberrations of different human subjects we use an aberrometer, composed of different optical elements, among which a light source, several lenses, a deformable mirror, and a Hartmann-Shack sensor that measures the eye aberrations comparing the light wavefront reflected from the eye with an reference ideal wavefront.

In parallel, we use a custom-built optical tomography system to measure the changes of biometric parameters of the lens induced by eye accommodation. In this way, we can analyze in real-time the images of the eye and, after signal processing in Matlab and Wolfram Mathematica, we can detect the curvatures of both cornea

and crystalline lens. In this work, I use my knowledge of optics, light propagation and computer programming.

2018 VOptica, Visual Adaptive Optics (Murcia, Spain)

- Participation in the European project BeVision. In this project I contributed to the development of the medical device VAO, which currently is the only medical device in the world that can measure objectively all eye aberrations of patients. In addition, this device can simulate the different optical solutions to correct the patient's eye imperfections during visual testing. Various institutions and hospitals around the world for research purposes currently use this technology. During this experience, my task has been to propose a more compact and cheaper design of the optical system of the device with the aim to improve the demand in the market.

2014–2017 University Carlos III of Madrid (Madrid, Spain)

- Participation in European project OILTEBIA (Optical Imaging Laser TEchniques for Biomedical Applications)
 - ✓ Objective: to develop a diode laser-based system coupled to optical fibers for optoacoustic endoscopy.
 - ✓ I analyzed the optoacoustic response of different kinds of nanoparticles by using high-power diode lasers (wavelengths: 870 nm, 905 nm, and 980 nm) coupled to optical fibers with 200/400- μ m core diameter.
 - ✓ I achieved the optical coupling of a multi-wavelength system (808 nm, 880 nm, 910 nm, 940 nm, and 980 nm) based on high-power diode laser bars in a 400- μ m optical fiber by using the software Zemax, fulfilling the requirements of size and coupling efficiency for optoacoustic endoscopy. The use of commercial available optical elements such as fast-axis collimation lenses, beam twisters and dichroic mirrors has been determinant to the achievement of efficient fiber coupling.
 - ✓ I improved my skills to present in public in several conferences (Rio de Janeiro and Munich (SPIE, 2015), San Francisco and Bruxelles (SPIE, 2016), Warsaw (CPPTA, 2016), and San Francisco (SPIE, 2017)) and workshops in several institutions participating to OILTEBIA project.

2012-2013 Telecom ParisTech (Paris, France)

- Participation in European project LEXNET (Low electromagnetic fields EXposure NETworks)
 - ✓ Objective: to reestablish the exposure limits in multi-channel environments.
 - ✓ I obtained new values of absorption of electromagnetic fields at LTE frequencies (4G networks) performing simulations on human models by using the software CST Microwave Studio.



Language skills

Italian (Mother tongue)	★ ★ ★ ★ ★
English (B2/C1)	★ ★ ★ ★ ★
Spanish (C2)	★ ★ ★ ★ ★
French (A1)	★ ★ ★ ★ ★



Computer skills

ZEMAX	★ ★ ★ ★ ★
MATLAB	★ ★ ★ ★ ★
Mathematica	★ ★ ★ ★ ★
Java	★ ★ ★ ★ ★
Office	★ ★ ★ ★ ★
Android Studio	★ ★ ★ ★ ★
XCode/Swift	★ ★ ★ ★ ★
CST	★ ★ ★ ★ ★
LT SPICE	★ ★ ★ ★ ★
CAD	★ ★ ★ ★ ★
C/C ++	★ ★ ★ ★ ★



References

- Dr. Horacio Lamela Rivera / horacio@ing.uc3m.es
Professor of University Carlos III of Madrid
- Dr. Guillermo Carpintero del Barrio / guiller@ing.uc3m.es
Professor of University Carlos III of Madrid
- Dr. Julio Enrique Posada Román / jposada@ing.uc3m.es
Researcher of University Carlos III of Madrid



Research achievements

Articles in international peer-reviewed journals

"A Comparison between different schemes of microwave cancer hyperthermia treatment by means of left-handed metamaterial lenses," Progress In Electromagnetics Research, Vol. 150, 73-87, 2015.

"Microwave focusing within arbitrary refractive index media using left-handed metamaterial lenses," Progress In Electromagnetics Research M, Vol. 45, 51-58, 2016.

"Beam profile improvement of a high-power diode laser stack for optoacoustic applications", International Journal of Thermophysics, 38 (48), 2017.

"Optoacoustic response of gold nanorods in soft phantoms using high-power diode laser assemblies at 870 and 905 nm" Biomedical Optics Express 8(3), 1430-1440, 2017. Erratum published on November 1st, 2017.

"Accurate determination of gold nanorods concentrations from optoacoustic signals detected at 870 nm and 905 nm by using high-power diode lasers with fast switching electronics", Progress In Electromagnetic Research B, Vol. 78, 143-154, 2017.

"Invited Article: Experimental evaluation of gold nanoparticles as infrared scatterers for advanced cardiovascular optical imaging", APL Photonics, Volume 3, Issue 8, 080803 (2018).

Conference proceedings

"A compact multi-wavelength optoacoustic system based on high-power diode lasers for characterization of double-walled carbon nanotubes (DWCNTs) for biomedical applications," SPIE Proceedings, Biophotonics South America, Rio de Janeiro, Brazil, Volume 9531, 05/2015.

"Improvement of signal-to-noise ratio of optoacoustic signals from double-walled carbon nanotubes by using an array of dual-wavelength high-power diode lasers," SPIE Proceedings, Opto-Acoustic Methods and Applications in Biophotonics II, Munich, Volume 9539, 06/2015.

"Optoacoustic response from graphene-based solutions embedded in optical phantoms by using 905-nm high-power diode-laser assemblies," Photonics West, Photons Plus Ultrasound: Imaging and Sensing 2016, San Francisco, CA, USA, SPIE Proceedings 9708, 2016.

"System analysis of wavelength beam combining of high-power diode lasers for photoacoustic endoscopy," Photonics Europe, Micro-Optics, Brussels, Belgium, SPIE Proceedings 9888, 2016.

"Combining high power diode lasers using fiber bundles for beam delivery in photoacoustic endoscopy applications," Photonics Europe, Semiconductor Lasers and Laser Dynamics VII, Brussels, Belgium, SPIE Proceedings 9892, 2016.

"Multi-wavelength photoacoustic system based on high-power diode laser bars," SPIE Proceedings 10064, 1006441, 2017.

"Image reconstruction algorithms with wavelet filtering for photoacoustic imaging," SPIE Proceedings, 2016.

"Cost-effective photoacoustic system based on the combination of high-power diode lasers," SPIE Proceedings 10064, 100644F, 2017.

"Photoacoustic system based on 808-nm high energy short pulse diode laser stacks," SPIE Proceedings, 2017.

Braga 22-11-19

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