Dr. Joan Duran

Curriculum Vitae

Academic position and affiliation

Tenure-track Associate Professor of Applied Mathematics
Department of Mathematics and Computer Science
Institute of Applied Computing and Community Code (IAC3)
University of the Balearic Islands (UIB)

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Research profiles

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Résumé

I am a tenure-track associate professor of Applied Mathematics in the Department of Mathematics and Computer Science at the University of the Balearic Islands (UIB). Previously, I was a Ph.D. fellow (2011-2015) from the Conselleria d'Educació Cultura i Universitats of the Govern de les Illes Balears. I am a member of the Mathematical Image Processing (TAMI) research group led by Prof. Bartomeu Coll and of the Institute of Applied Computing and Community Code (IAC3). From July 2021, I am deputy director of the Higher Polytechnic School and head of studies of the Degree in Mathematics.

In February 2016, I obtained my Ph.D. in Mathematics with a thesis on variational models for ill-posed inverse problems in digital imaging. Before that, I received a M.Sc. in Advanced Mathematics and Mathematical Engineering by the Polytechnic University of Catalonia and a B.Sc. in Mathematics (five-years degree) by the UIB. I have been a visiting researcher in the groups led by Prof. Daniel Cremers at the Technical University of Munich, Prof. Jean-Michel Morel at the Centre de Mathématiques et Leurs Applications at ENS Paris-Saclay, and Prof. Joan Bruna at the Courant Institute of Mathematical Sciences and the Center for Data Science at New York University.

My main research interests include functional analysis, variational methods, convex optimization and deep learning with applications in image processing, remote sensing and computer vision. I am also interested in exploring the frontiers between mathematical modelling and deep networks for solving inverse problems.

I have had a long-term collaboration with the french space agency CNES by contributing to the image restoration chain of the Earth observation satellite Pleiades. In collaboration with the Φ-Lab at the European Space Agency (ESA) and the Oceanographic Centre of the Balearic Islands, I am currently working on deep unfolding architectures for the fusion of remote sensing data and the automatic detection of floating objects in the Mediterranean Sea.

Education

02/2016	**Ph.D. in Mathematics (summa cum laude)** Thesis: *Contributions to regularized ill-posed inverse problems in digital imaging* Advisors: Prof. Antoni Buades, Prof. Bartomeu Coll, Dr. Catalina Sbert Institution: University of the Balearic Islands European Ph.D. Mention (Doctor Europaeus certificate)
07/2011	**M.Sc. in Advanced Mathematics and Mathematical Engineering** Thesis: *The total variation in image restoration* Advisor: Prof. Xavier Cabré Institution: Polytechnic University of Catalonia European M.Sc. Supplement
07/2010	**B.Sc. in Mathematics (five-years degree)** Dissertation: *Partial differential equations in image processing* Advisor: Dr. Catalina Sbert Institution: University of the Balearic Islands

Academic career

09/2018 - present	Tenure-track associate professor in the Department of Mathematics and Computer Science at the University of the Balearic Islands
09/2017 - 08/2018	Assistant professor in the Department of Mathematics and Computer Science at the University of the Balearic Islands
09/2015 - 08/2017	Teaching assistant in the Department of Mathematics and Computer Science at the University of the Balearic Islands
11/2011 - 09/2015	Ph.D. fellow from the Conselleria d'Educació Cultura i Universitats of the Govern de les Illes Balears, selected under an operational program co-financed by the European Social Fund

Research interests

My primary research interests are functional analysis, variational methods, convex optimization, deep learning and deep unfolding networks with applications to image processing, remote sensing and computer vision. More specifically, my research topics include:

- Theoretical analysis of TV-based and nonlocal regularization methods
- Convex optimization algorithms
- Image and video super-resolution
- Satellite data fusion
- Optical flow and depth estimation
- Automatic detection of floating objects in open waters.

Recently, I have become interested in nonlocal partial differential equations.

Publications

Journal articles

[1] J. Mifdal, B. Coll, J. Froment and J. Duran, *Variational fusion of hyperspectral data by non-local filtering*, Mathematics, vol. 9(11), pp. 1265, 2021

[2] J. Duran, J. Navarro and A. Buades, *Variational densification and refinement of registration maps*, SIAM Journal on Imaging Sciences, vol. 14(3), pp. 879-912, 2021

[3] A. Buades and J. Duran, *CFA video denoising and demosaicking chain via spatio-temporal patch-based filtering*, IEEE Transactions on Circuits and Systems for Video Technology, vol. 30(11), pp. 4143-4157, 2019

[4] A. Buades, J. Duran and J. Navarro, *Motion-compensated spatio-temporal filtering for multi-image and multimodal super-resolution*, International Journal of Computer Vision, vol. 127(10), pp. 1474-1500, 2019

[5] J. Duran and A. Buades, *Restoration of pansharpened images by conditional filtering in the PCA domain*, IEEE Geoscience and Remote Sensing Letters, vol. 16(3), pp. 442-446, 2019

[6] J. Duran, A. Buades, B. Coll, C. Sbert and G. Blanchet, *A survey of pansharpening methods with a new band-decoupled variational model*, ISPRS Journal of Photogrammetry and Remote Sensing, vol. 125, pp. 78-105, 2017

[7] J. Duran, M. Moeller, C. Sbert and D. Cremers, *On the implementation of collaborative TV regularization: Application to cartoon+texture decomposition*, Image Processing On Line, vol. 6, pp. 27-74, 2016

[8] J. Duran, M. Moeller, C. Sbert and D. Cremers, *Collaborative total variation: A general framework for vectorial TV models*, SIAM Journal on Imaging Sciences, vol. 9(1), pp. 116–151, 2016

[9] J. Duran and A. Buades, *A demosaicking algorithm with adaptive inter-channel correlation*, Image Processing On Line, vol. 5, pp. 311–327, 2015

[10] B. Coll, J. Duran and C. Sbert, *Half-linear regularization for nonconvex image restoration models*, Inverse Problems and Imaging, vol. 9(2), pp. 337–370, 2015

[11] J. Duran and A. Buades, *Self-similarity and spectral correlation adaptive algorithm for color demosaicking*, IEEE Transactions on Image Processing, vol. 23(9), pp. 4031–4040, 2014

[12] J. Duran, A. Buades, B. Coll and C. Sbert, *A nonlocal variational model for pansharpening image fusion*, SIAM Journal on Imaging Sciences, vol. 7(2), pp. 761–796, 2014

[13] J. Duran, A. Buades, B. Coll and C. Sbert, *Implementation of nonlocal pansharpening image fusion*, Image Processing On Line, vol. 4, pp. 1–15, 2014

[14] J. Duran, B. Coll and C. Sbert, *Chambolle's projection algorithm for total variation denoising*, Image Processing On Line, vol. 3, pp. 301–321, 2013

Peer reviewed conferences

[15] I. Pereira-Sánchez, J Navarro and J. Duran, *What if image self-similarity can be better exploited in data fidelity terms?*, in Proc. IEEE International Conference on Image Processing (ICIP), Bordeaux, 2022

[16] A. Buades and J. Duran, *Joint denoising and demosaicking of raw video sequences*, in Proc. IEEE International Conference on Image Processing (ICIP), pp. 2172-2176, Athens, 2018

[17] J. Navarro, J. Duran and A. Buades, *Filtering and interpolation of inaccurate and incomplete depth maps*, in Proc. IEEE International Conference on Image Processing (ICIP), pp. 1533-1537, Athens, 2018

[18] J. Mifdal, B. Coll and J. Duran, *A variational formulation for hyperspectral and multispectral image fusion*, in Proc. IEEE International Conference on Image Processing (ICIP), pp. 3328-3332, Athens, 2018

[19] A. Buades and J. Duran, *Flow-based video super-resolution with spatio-temporal patch similarity*, in Proc. British Machine Vision Conference (BMVC), pp. 656.1-656.12, London, 2017

[20] J. Duran and A. Buades, *Nonlocal regularizing constraints in variational optical flow*, in Proc. Int. Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP), vol. 6, pp. 151–161, Porto, 2017

[21] J. Duran, A. Buades, B. Coll, C. Sbert and G. Blanchet, *Pansharpening by a nonlocal channel-decoupled variational method*, in Proc. IEEE International Conference on Image Processing (ICIP), pp. 4339–4343, Phoenix, 2016

[22] J. Duran, M. Moeller, C. Sbert and D. Cremers, *A novel framework for nonlocal vectorial total variation based on $\ell^{p,q,r}-$norms*, in Proc. International Conference on Energy Minimization Methods in Computer Vision and Pattern Recognition (EMMCVPR), Lecture Notes in Computer Science, vol. 8932, pp. 141–154, Hong Kong, 2015

[23] B. Coll, J. Duran and C. Sbert, *An algorithm for nonconvex functional minimization and applications to image restoration*, in Proc. IEEE International Conference on Image Processing (ICIP), pp. 4547–4551, Paris, 2014

Funded projects

2022 - 2025	*Bringing together modelization and machine learning techniques for mathematical multi-image processing and analysis* Reference: PID2021-125711OB-I00 Funding institution: Ministerio de Ciencia e Innovación, Spain Principal investigators: Antoni Buades and José Luis Lisani Funded amount: 145.000 €
2022 - 2023	*Xarxa interdisciplinària per a la detecció de residus a la Mediterrània mitjançant imatges satèl·lit* Reference: AP-2021-023 Funding institution: Conselleria de Fons Europeus, Universitat i Cultura, Illes Balears Principal investigator: Joan Duran Funded amount: 23.980 €
2020 - 2023	*Cámaras submarinas como sensores biológicos: Deep learning en ecología marina* Reference: PRD2018/26 Funding institution: Conselleria d'Innovació, Recera i Turisme, Illes Balears Principal investigators: Ignasi Catalán and José Luis Lisani

	Funded amount: 95.214 €
2018 - 2020	*Cadena completa de procesamiento multi-imagen y video* Reference: TIN2017-85572-P Funding institution: Ministerio de Economía, Industria y Competitividad, Spain Principal investigator: Antoni Buades Funded amount: 55.176 €
2015 - 2017	*Procesamiento de imágenes digitales y aplicaciones* Reference: TIN2014-53772-R Funding institution: Ministerio de Economía y Competitividad, Spain Principal investigators: Bartomeu Coll and Antoni Buades Funded amount: 52.151 €
2012 - 2015	*Restauración y análisis matemático de imágenes* Reference: TIN2011-27539 Funding institution: Ministerio de Ciencia e Innovación, Spain Principal investigator: Bartomeu Coll Funded amount: 41.745 €

Industry contracts

2016 - 2018	*Méthodes locale et globale rapides pour la stéréorestitution* Reference: R-S16/OT-0004-084 Funding institution: Centre National d'Études Spatiales (CNES), France Principal investigator: Antoni Buades Funded amount: 60.000 €
2016	*Feasability of oil production monitoring through infra-red satellite imaging* Funding institution: Eurobios - Kayrros, France Principal investigator: Jean-Michel Morel
2013 - 2015	*Optimization bord/sol débruitage et démosaïquage* Reference: R-S13/OT-0001-098 Funding institution: Centre National d'Études Spatiales (CNES), France Principal investigator: Bartomeu Coll Funded amount: 60.000 €
2013 - 2015	*Extraction 3D multi-vues en THR optique* Reference: R-S13/OT-0004-068 Funding institution: Centre National d'Études Spatiales (CNES), France Principal investigator: Bartomeu Coll Funded amount: 80.000 €
2011 - 2013	*RAFA2: Methode automatique de calcul du relief par adaptation geometriques des fenetres aux occlusions et deformations du relief* Reference: DCT/SI/AP-2011.0011638 Funding institution: Centre National d'Études Spatiales (CNES), France

Principal researcher: Bartomeu Coll
Funded amount: 70.000 €

Internships

2018	Visiting postdoctoral researcher at the Courant Institute of Mathematical Sciences and the Center for Data Science at New York University, supervised by Prof. Joan Bruna. Research: Deep learning for non-euclidean domains, such as graphs and manifolds, with applications to particle physics
2016	Visiting postdoctoral researcher at the Centre de Mathématiques et Leurs Applications (CMLA) at ENS Paris-Saclay, supervised by Prof. Jean-Michel Morel. Research: Analysis and restoration of high-dynamic range video flow and automatic change detection algorithms on remote-sensing images
2014	Visiting Ph.D. student in the Computer Vision group at the Technical University of Munich, supervised by Prof. Daniel Cremers and Dr. Michael Moeller. Research: Variational models and convex optimization techniques for color image restoration

Grants

05/2016 – 07/2016	Fellowship *Ajudes de mobilitat per a joves investigadors* from the Obra Social La Caixa for the realization of a postdoctoral internship in the Centre de Mathématiques et Leurs Applications at ENS Paris-Saclay, France, selected under a competitive program
11/2011 – 09/2015	Four-years fellowship from the Conselleria d'Educació Cultura i Universitats of the Govern de les Illes Balears for the realization of the Ph.D. thesis, selected under an operational program co-financed by the European Social Fund

Invited talks

08/06/2018	*Collaborative regularization models for color imaging problems* SIAM Conference on Imaging Sciences, Bologna
01/02/2018	*Collaborative regularization approaches in multi-channel variational imaging: Theory, applications and perspectives* School of Mathematics, The University of Manchester, Manchester
25/01/2018	*Deep learning: Last trends and applications* Ciclo de Conferencias Datos Masivos e Inteligencia Artificial, Cátedra Hotelbeds Group & Universitat de les Illes Balears, Palma
09/05/2017	*Color aliasing removal for pansharpened images* Mathématiques de l'Imagerie Stéréoscopique Spatiale (MISS) Workshop, Paris
19/11/2015	*Pansharpening avec des images Pléiades* Mathématiques de l'Imagerie Stéréoscopique Spatiale (MISS) Workshop, Paris
14/08/2015	*A new mathematical model for pansharpening satellite images* International Conference on Industrial and Applied Mathematics (ICIAM), Beijing

24/06/2015	*Channel-decoupled variational model for satellite pansharpening* Mathématiques de l'Imagerie Stéréoscopique Spatiale (MISS) Workshop, Toulouse
25/11/2014	*Pansharpening by variational method* Mathématiques de l'Imagerie Stéréoscopique Spatiale (MISS) Workshop, Paris
16/05/2014	*Epsilon contributions to the mathematical image processing field* Computer Vision Group Seminar, Technical University of Munich, Munich
04/12/2013	*A nonlocal variational model for pansharpening* Mathématiques de l'Imagerie Stéréoscopique Spatiale (MISS) Workshop, Paris
11/09/2012	*A projection algorithm for a nonconvex restoration image model* Algoritmy Conference on Scientific Computing, Podbanské

Mentoring

PhD students

2021 – present	Iván Pereira-Sánchez *Deep variational learning for multi-image super-resolution* University of the Balearic Islands Co-advised with Dr. Julia Navarro

Visiting students

06/2020 - 08/2020	Bernat Ramis *Variational video deblurring* Visiting B.Sc. student from the Polytechnic University of Catalonia
05/2019 - 07/2019	Antoine Reynaert *Processing time optimization of variational optical flow* Visiting M.Sc. student from the Grenoble Institute of Technology

Undergraduate students

09/2022 - 07/2023	Marc Tomás *Deep unfolding networks for satellite image fusion* Student of the double B.Sc. in Mathematics and Telematics Engineering, University of the Balearic Islands
09/2021 - 07/2022	M. Francesc Alcover *Nonlocal vector calculus with applications to image processing* Student of the B.Sc. in Mathematics, University of the Balearic Islands
09/2020 - 07/2021	Maria Mulet and Guillem Serra *Introduction to graph neural networks* Students of the B.Sc. in Mathematics, University of the Balearic Islands

09/2020 - 07/2021	Cristian Comellas *Deep neural networks for image decompression* Student of the B.Sc. in Computer Engineering, University of the Balearic Islands
09/2019 - 07/2020	Ginés Carreto and Martí Gelabert *Deep neural networks for image denoising* Students of the B.Sc. in Computer Engineering, University of the Balearic Islands

M.Sc. thesis

2020	Iván Pereira *Completació de vídeo a partir de la distribució espaciotemporal de patches* M.Sc. in Advanced Physics and Applied Mathematics, University of the Balearic Islands Co-advised with Prof. Bartomeu Coll

B.Sc. thesis

2022	M. Francesc Alcover *Classical functional analysis and a new nonlocal BV space* B.Sc. in Mathematics, University of the Balearic Islands Co-advised with Dr. Catalina Sbert
2022	Daniel Torres *Anàlisi i optimització convexa amb aplicacions al processament d'imatges* B.Sc. in Mathematics, University of the Balearic Islands Co-advised with Prof. Bartomeu Coll
2022	Andreu Reviriego *Introducció a l'aprenentatge automàtic i als seus mètodes d'optimització* B.Sc. in Mathematics, University of the Balearic Islands Co-advised with Prof. Antoni Buades
2021	Catalina V. Molina *Equacions en derivades parcials per al processament digital d'imatges* B.Sc. in Mathematics, University of the Balearic Islands Co-advised with Dr. Catalina Sbert
2021	Joana Cáceres *Análisis multivariante de datos para procesamiento de imágenes* B.Sc. in Mathematics, University of the Balearic Islands Co-advised with Dr. Catalina Vich
2018	Ramon Oliver-Bonafoux *Convex variational methods and optimization techniques for image processing* B.Sc. in Mathematics, University of the Balearic Islands Co-advised with Prof. Bartomeu Coll

Collegial

Editorial board

- Image Processing On Line

Reviewer

- SIAM Journal on Imaging Sciences
- Journal of Mathematical Imaging and Vision
- IEEE Transactions on Image Processing
- IEEE Signal Processing Letters
- IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing
- ISPRS Journal of Photogrammetry and Remote Sensing
- AIMS Inverse Problems and Imaging
- International Journal of Remote Sensing
- Image Processing On Line
- Information Fusion
- IET Image Processing

Teaching experience

2022 - present	Advanced Mathematical Analysis (Functional Analysis) B.Sc. in Mathematics University of the Balearic Islands
2021 - present	Fundamentals of Mathematics B.Sc. in Mathematics University of the Balearic Islands
2019 - present	Partial Differential Equations B.Sc. in Mathematics University of the Balearic Islands
2018 - 2022	Mathematical Analysis II B.Sc. in Mathematics University of the Balearic Islands
2016 - 2022	Introduction to Mathematical Models in Image Restoration M.Sc. in Advanced Physics and Applied Mathematics University of the Balearic Islands
2020 - 2021	Affine and Metric Geometry B.Sc. in Mathematics

	University of the Balearic Islands
2017 - 2021	Mathematics I B.Sc. in Chemistry University of the Balearic Islands
2017 - 2020	Introduction to Subpixel Images M.Sc. in Advanced Physics and Applied Mathematics University of the Balearic Islands
2013 - 2020	Mathematics II – Calculus B.Sc. in Computer Engineering University of the Balearic Islands
2018 - 2019	Advanced Models: Mathematical Information Modelling B.Sc. in Mathematics University of the Balearic Islands
2018 – 2019	Mathematics I B.Sc. in Biochemistry University of the Balearic Islands

Administrative duties

07/2021 - present	Deputy director of the Higher Polytechnic School and head of studies of the Degree in Mathematics at the University of the Balearic Islands

Skills

Programming	C/C++, Python
Tools	Matlab, LaTeX
Languages	Catalan (native), Spanish (native), English (intermediate)