

Roberto Mecca

Curriculum Vitae

Interests

Main activities in computer vision and graphics:

- modeling computational techniques for inverse problems in computer vision and computer graphics
- management of interdisciplinary projects for development of prototypes and demos
- development of deep learning based techniques for 3D shape reconstruction
- reinforcement learning for autonomous visual navigation
- hands-on 3D shape reconstruction beyond camera sensors

Employment

January 2019 – present
Senior Research Scientist

Supervisor Professor Roberto Cipolla

Institution Toshiba Europe Ltd

Description Development of 3D scanning methods along with hardware engineering of working prototypes. Visual target driven autonomous navigation.

June 2018 – December 2018
Postdoctoral Research Fellow

Supervisor Professors Lorenzo Rosasco, Giorgio Metta, Lorenzo Natale

Institution Laboratory for Computational and Statistical Learning, IIT Italy

Description Development of machine learning algorithm for applications in robotics and vision, theory and implementation. Incremental learning and kernel based approaches.

December 2017 – May 2018
Research Associate

Supervisor Professor Roberto Cipolla

Institution Department of Engineering, University of Cambridge, United Kingdom

Description Photometric Stereo problem using highly non-linear irradiance equations.

December 2015 – November 2017
Marie Curie Research Fellow of the INdAM, Italy
INdAM COFUND 2012 - Grant Agreement Number 600198

Supervisor Professor Roberto Cipolla and Professor Fiorella Sgallari

Institution Department of Engineering, University of Cambridge, United Kingdom and Department of Mathematics, University of Bologna

Toshiba Europe Ltd – Cambridge Research Laboratory, United Kingdom

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- Description Combining Diffuse and Specular reflection into a single framework based on hyperbolic PDEs related to the 3D shape reconstruction with the Photometric Stereo technique. New differential approaches for the Shape from Polarization and Defocusing problems.
- February - Postdoctoral Research Fellow
November 2015
- Supervisor Professor Fiorella Sgallari
Institution Department of Mathematics, University of Bologna, Italy
Description Numerical analysis of new approach to the (Uncalibrated) Photometric Stereo problem. Fractional derivative operators. Novel numerical approach to high order generalized Grünwald-Letnikov type of formula for fractional derivative.
- 2013 - 2015 Postdoctoral Research Fellow
Supervisor Professor Vittorio Murino and Alessio Del Bue
Institution Department of Pattern Analysis and Computer Vision, IIT Italy
Description Shape from Photometric Stereo with bias of ambient light. Shape from Uncalibrated Photometric Stereo and Shape from Polarization.
- 2012 - 2013 Postdoctoral Research Fellow
Supervisor Professors Alfred Marcel Bruckstein and Ron Kimmel
Institution Department of Computer Science, Technion - Israel Institute of Technology, Israel
Description New models for the Perspective Shape from Shading problem solved using Photometric Stereo technique and related Numerical Methods for Non-Linear Partial Differential Equations.
- 2011 - 2012 Postdoctoral Research Fellow
Supervisor Professor Maurizio Falcone
Institution Department of Mathematics, Sapienza - University of Rome, Italy
Description Numerical Methods for Non-Linear Partial Differential Equations. Numerical analysis for hyperbolic partial differential equations applied to Shape from Shading problem and granular flow.

Education

- 2007 - 2011 PhD Student
Advisor Professor Maurizio Falcone
Institution Department of Mathematics, Sapienza - University of Rome, Italy
Description 3D shape recovery from digital images using Photometric Stereo, system of non-linear PDE of the Hamilton-Jacobi type.
- 2005 - 2007 Undergraduate Student
Advisor Professor Maurizio Falcone
Institution Department of Mathematics, Sapienza - University of Rome, Italy

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Description A Variational Approach to the Image Warping and Applications. Interpolation with radial basis functions used for the deformation of digital images.

Industrial Experiences

2007 **Digital Video** - cartoon animation, Rome, Italy

Activity Research and implementation of image warping algorithm for a special effect option for the development of the software "Toonz 5.1".

Awards and Funding

2015–2017 Marie Curie Fellowship of the INdAM (Italian Institute of Advanced Mathematics)

2007–2011 Italian Government scholarship for the Ph.D. course in Applied Mathematics

Publications

Peer Reviewed Journal Papers

- (1) S.D. Morad, **R. Mecca**, R.P.K. Poudel, S. Liwicki, R. Cipolla, Embodied Visual Navigation with Automatic Curriculum Learning in Real Environments, IEEE Robotics and Automation Letters, 2021 / IEEE International Conference on Robotics and Automation (ICRA 2021)
- (2) F. Logothetis, **R. Mecca**, F. Sgallari and R. Cipolla, A Differential Approach to Shape from Polarisation: a Level-Set Characterisation, *International Journal of Computer Vision*, 2019.
- (3) Y. Quèau, **R. Mecca**, J.D. Durou, X. Descombes, Photometric Stereo with Only Two Images: A Theoretical Study and Numerical Resolution, *Image and Vision Computing*, Vol. 57, pp. 175-191, 2017.
- (4) **R. Mecca**, Y. Quèau, F. Logothetis and R. Cipolla, A Single Lobe Photometric Stereo Approach for Heterogeneous Material, *SIAM Journal on Imaging Sciences*, Vol. 9, No. 4, pp. 1858-1888, 2016.
- (5) S. Tozza, **R. Mecca**, M. Duocastella and A. Del Bue, Direct Differential Photometric Stereo Shape Recovery of Diffuse and Specular Surfaces, *Journal of Mathematical Imaging and Vision*, Vol. 56, No. 1, Page 57, 2016.
- (6) **R. Mecca**, E. Rodolà and D. Cremers, Realistic photometric stereo using partial differential irradiance equation ratios, *Computers & Graphics*, Vol. 51, pp. 8-16, 2015.
- (7) **R. Mecca**, A. Wetzler, A. M. Bruckstein and R. Kimmel, Near Field Photometric Stereo with Point Light Sources, *SIAM Journal on Imaging Sciences*, Vol. 7, No. 4, pp. 2732-2770, 2014.
- (8) **R. Mecca**, A. Tankus, A. Wetzler and A. M. Bruckstein, A Direct Differential Approach to Photometric Stereo with Perspective Viewing, *SIAM Journal on Imaging Sciences*, Vol. 7, No. 2, pp. 579-612, 2014.
- (9) **R. Mecca** and M. Falcone, Uniqueness and approximation of a Photometric Shape-from-Shading model, *SIAM Journal on Imaging Sciences*, Vol. 6, No. 1, pp. 616-659, 2013.

Book Chapters

- (1) **R. Mecca** and S. Tozza, Shape Reconstruction of Symmetric Surfaces using Photometric Stereo, In book: *Innovations for Shape Analysis*, Publisher: Springer Berlin Heidelberg, Editors: Breuß, Michael and Bruckstein, Alfred and Maragos, Petros, pp.219-243 (2013).

Peer Reviewed Conference Publications

- (1) **R. Mecca**, F. Logothetis, I. Budvytis, R. Cipolla, LUCES: A Dataset for Near-Field Point Light Source Photometric Stereo, *British Machine Vision Conference (BMVC)*, 2021
- (2) F. Logothetis, I. Budvytis, **R. Mecca**, R. Cipolla, PX-NET: Simple, Efficient Pixel-Wise Training of Photometric Stereo Networks, *International Conference on Computer Vision (ICCV)*, 2021
- (3) F. Logothetis, I. Budvytis, **R. Mecca**, R. Cipolla, A CNN Based Approach for the Near-Field Photometric Stereo Problem, *British Machine Vision Conference (BMVC)*, 2020, **Best Industry Paper Award**
- (4) F. Logothetis, **R. Mecca**, R. Cipolla: A Differential Volumetric Approach to Multi-View Photometric Stereo, *International Conference on Computer Vision (ICCV)*, 2019
- (5) **R. Mecca**, F. Logothetis and R. Cipolla, A Differential Approach to Shape from Polarisation, *British Machine Vision Conference (BMVC)*, 2017.
- (6) F. Logothetis, **R. Mecca** and R. Cipolla, Semi-calibrated Near Field Photometric Stereo, *Proceedings of IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2017
- (7) F. Logothetis, **R. Mecca**, Y. Quèau and R. Cipolla, Near-Field Photometric Stereo in Ambient Light, *British Machine Vision Conference (BMVC)*, 2016.
- (8) Y. Quèau, **R. Mecca** and J.D. Durou, Unbiased Photometric Stereo for Colored Surfaces: A Variational Approach, *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2016
- (9) **R. Mecca** and Y. Quèau, Unifying Diffuse and Specular Reflections for the Photometric Stereo Problem, *IEEE Winter Conference on Applications of Computer Vision (WACV)*, 2016
- (10) **R. Mecca**, E. Rodolà and D. Cremers, Analysis of surface parametrizations for modern photometric stereo modeling, *Proceedings of the Twelfth International Conference on Quality Control by Artificial Vision (QCAV)*, 2015
- (11) A. Wetzler, **R. Mecca**, A. M. Bruckstein and R. Kimmel, Close-range Photometric Stereo with Point Light Sources, *3D Vision Conference (3DV)*, 2014
- (12) **R. Mecca**, A. Wetzler, R. Kimmel, and A. M. Bruckstein, Direct Shape Recovery from Photometric Stereo with Shadows, *Proceedings of 3D Vision Conference (3DV)*, 2013
- (13) **R. Mecca**, G. Rosman, R. Kimmel, and A. M. Bruckstein, Perspective Photometric Stereo with Shadows, *International Conference on Scale Space and Variational Methods in Computer Vision (SSVM)*, 2013
- (14) **R. Mecca**, A. Tankus and A. M. Bruckstein, Two-Image Perspective Photometric Stereo using Shape-from-Shading, *Asian Conference on Computer Vision (ACCV)*, 2012
- (15) S. Larnier and **R. Mecca**, Fractional-Order Diffusion for Image Reconstruction, *IEEE International Conference on Acoustic Speech and Signal (ICASSP)*, 2012
- (16) **R. Mecca**, Uniqueness for Shape from Shading via Photometric Stereo Technique, *IEEE International Conference on Image Processing (ICIP)*, 2011
- (17) **R. Mecca** and J.D. Durou, Unambiguous Photometric Stereo Using Two Images, *International Conference on Image Analysis and Processing (ICIAP)*, 2011

Patents

Title 3D shape recovery from photometric stereo with shadows - Technion, Israel Institute of Technology

Patent application no. WO2015036994A1

Title Task performing agent system methods, Toshiba Europe Ltd

Toshiba Europe Ltd – Cambridge Research Laboratory, United Kingdom

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Patent application no. 2014285.7
Title A computer vision method and system, Toshiba Europe Ltd
Patent application no. 2012490.5
Title System and method for performing 3D imaging of an object, Toshiba Europe Ltd
Patent application no. 1911354.7

Reviewing Activity for Scientific Journals

American Mathematical Society
Nature Scientific Reports
International Journal of Computer Vision
Journal of Mathematical Imaging and Vision
IEEE Transactions on Image Processing

Computer skills

Computer Programming C, MatLab, PYTHON
Computer Graphics Blender
Operative System Mac OS X, Linux, Microsoft Windows
Text Editing L^AT_EX, OpenOffice, Microsoft Office, Pages, Keynote, Numbers
Image/Video Editing Final Cut Pro, Adobe Illustrator, After Effects, Photoshop, Muse

Soft Skills

- Team building and leadership skills, mentorship/coaching strategies proven throughout the supervision of students
- Excellent communication techniques
- Ability to prioritize and meet deadlines as needed, as well as coordinate the group activities juggling multiple tasks effectively

Languages

Italian Native speaker
English Fluent in writing and speaking
French Basic knowledge

Interests

- Trumpet
- Classic Music
- First Person View (FPV) Quadcopters
- Football
- Cinema
- Cycling