CURRICULUM VITAE
AND
LIST OF PUBLICATIONS

CLAUDIA PARIS

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1 PERSONAL DATA

Name:	Claudia Paris
Birth place:	Rieti, Italy
Birth date:	June 19th, 1989
Nationality:	Italian
Work address:	Department of Information Engineering and Computer Science, University of Trento Via Sommarive, 5 I-38123 Povo, Trento Italy
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Home address:	Via Gino Buccella, 9 I-38122 Trento Italy

2 EDUCATION

- April 2016 - Ph.D. in Information and Communication Technology (ICT) International Doctorate School, University of Trento, Trento, Italy. Ph.D. Thesis: "*Novel Methods based on the Fusion of Multisensor Remote Sensing Data for Accurate Forest Parameter Estimation*". Mark: Excellent.
- October 2012 - Master degree in Telecommunications Engineering, University of Trento, Trento, Italy. Master thesis: "*Novel data fusion techniques for Tree Stem Volume Estimation by Multisource Remote Sensing Data"*. Mark: 110/110 cum laude.
- November 2010 - Bachelor degree in. Bachelor thesis: "*Metodi di Domain Adaptation con Active Learning basato su SVM per la classificazione di immagini telerilevate*" (Domain Adaptation methods with Active Learning technique based on SVM for the classification of remote sensing images). Mark: 108/110.
- July 2007 - School leaving certificate received from Liceo Scientifico "G. Galilei", Trento, Italy. Mark: 100/100.
- June 2006 - Certificate in Advanced English (CAE) – Cambridge ESOL Level C1.

3 ACCREDITATIONS

- 2013 – Italian Accreditation to practice as an engineer.

4 WORK EXPERIENCES

- Since October 2018: Temporary Assistant Professor (*ricercatore a tempo determinato Rtda*) at the University of Trento - Department of Information Engineering and Computer Science.
- May 2016 - October 2018: Research fellow (*assegnista di ricerca*) at the University of Trento - Department of Information Engineering and Computer Science.

- September 2016 - December 2016: Post-doc visiting at the Image Processing Group, Instituto de Telecomunicações, Instituto Superior Técnico, Lisbon, Portugal.
- September 2014 - December 2014: PhD visiting at the Center for Imaging Science, Rochester Institute of Technology (RIT), Rochester, New York State, USA.
- January 2011 - December 2011: Fellowship at the University of Trento - Department of Information Engineering and Computer Science, on "Sperimentazione sull'uso di dati LIDAR per l'estrazione di parametri delle foreste del Trentino (FORLIDAR)" (Experimental Analysis on the use of LiDAR data for the extraction of individual tree parameters in Trentino forests).
- October 2011 - December 2011: Tutoring in Scientific Disciplines (Mathematical Analysis) at the Department of Information Engineering and Computer Science. The activity aims to provide support to first year students in their academic progress (e.g., correct student assignments or exercises, explain the solution of exercises assigned during the course).
- April 2009 – May 2012: Assistant at the Orientation office for all activities aimed at promoting the University of Trento (e.g,, information and orientation services, presentation of the University's courses and degrees in high schools, both locally and in neighbouring regions, participation in orientation fairs and open days in Italy).

5 OVERVIEW AND RESEARCH INTERESTS

5.1 OVERVIEW

Claudia Paris received the "Laurea" (B.S.), the "Laurea Specialistica" (M.S.) (*summa cum laude*) degrees in Telecommunication Engineering and the Ph.D. in Information and Communication Technology from the University of Trento, Italy, in 2010, 2012, 2016, respectively. She accomplished the Honors Master Program in Research within the Master Degree in Telecommunication Engineering in 2012. Since 2014 she is a teaching assistant at the Department of Information Engineering and Computer Science of the University of Trento, Italy. In 2014 she was a visiting PhD student at the Rochester Institute of Technology (RIT), Rochester, New York State, USA, working on the fusion of airborne and terrestrial LiDAR data. In 2016 she was a visiting Post-Doc at the Instituto Superior Técnico, Lisbon, Portugal, working on the superresolution of multiresolution multispectral remote sensing images. She is currently Assistant Professor at the Department of Information Engineering and Computer Science of the University of Trento, Italy.

Her main research includes image processing and machine learning with applications to remote sensing image analysis. She conducts research on remote sensing single date and time series image classification, land cover map update and fusion of multisource remote sensing data for the estimation of biophysical parameters. She conducts research on these topics within the frameworks of national and international projects. Dr. Paris is a Scientific Committee Member of the 2020 and 2021 IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2020) and a Member of the Programme Committee of the SPIE International Symposium on Remote Sensing for the 2019 and 2020. She is a reviewer for many international journals, among them the IEEE Transactions on Geoscience and Remote Sensing, IEEE Journal of selected Topics in Applied Earth Observations, IEEE Geoscience and Remote Sensing Magazine and Remote Sensing and IEEE Geoscience and Remote Sensing Letters. Dr. Paris won the very prestigious Symposium Prize Paper Award

(SPPA) at the *2016 International Symposium on Geoscience and Remote Sensing* (Beijing, China, 2016) and at the *2017 International Symposium on Geoscience and Remote Sensing* (Fort Worth, Texas, USA, 2017).

5.2 RESEARCH INTERESTS

Claudia Paris' research interests are in the area of Telecommunications (ING-INF/03) and in particular are related to remote sensing and radar. Her research is focused on passive and active remote sensing with special regards to design novel and automatic methods for data analysis. The main research interests include remote sensing image processing, signal processing and pattern recognition with specific reference to classification and fusion of multisource remote sensing data (LiDAR data, hyperspectral, multispectral and high resolution optical images), multi-temporal image analysis, domain adaptation methods and biophysical parameter estimation. Satellite and airborne data are considered. Recently, some attention is devoted to radar and remote sensing for planetary exploration.

The main research areas are briefly summarized as follows:

- **Pattern Recognition and Image Processing:**
  - *Development of advanced and efficient methods for the analysis and the classification of Earth Observation data for different applications (e.g., forestry, agriculture, urban areas).*
  - *Design of data fusion techniques to exploit information coming from multiple Earth Observation and in situ data sources for environmental monitoring, land cover classification and biophysical parameter estimation.*
  - *Single date and time series of optical image classification based on Domain adaptation and Active Learning methods.*
  - *Design of effective and efficient data-driven methods to the accurate estimation of biophysical parameters for environmental monitoring.*
  - *Definition of sharpening approaches to the superresolution of multispectral multiresolution optical images.*

- **Analysis of Image Time Series:**
  - *Definition of novel automatic processing chains to land cover map update using satellite optical images via Supervised, Unsupervised and Semi-supervised learning methods.*
  - *Development of advanced and efficient methods for the multi-temporal analysis of long image time series of remote sensing data on large spatial scale.*
- **LiDAR and Radar:**
  - *Fusion of Airborne Laser Scanning (ALS) systems or Terrestrial Laser Scanning (TLS) LiDAR data to the accurate reconstruction of the 3D structure of the forest.*
  - *3D Change detection analysis of LiDAR point clouds characterized by different acquisition conditions (e.g., laser point density) for forest monitoring.*
  - *LiDAR signal processing and information extraction for several applications (e.g., forest parameter estimation, land-cover classification, biophysical parameter characterization).*

6 AWARDS

- Winner of the **Symposium Prize Paper Award** (**SPPA**) at the International Symposium on Geoscience and Remote Sensing (IGARSS) hold in July 2017 in Fort Worth, Texas, USA. The Geoscience and Remote Sensing Society (GRSS) established this award "to recognize the author(s) who presented at the IEEE International Geoscience and Remote Sensing Symposium (IGARSS) an exceptional paper in terms of content and impact on the GRSS". In selecting the paper, other factors considered are originality, clarity and timeliness of the paper. The paper [CI8] resulted the winner out of 1057 papers presented in the oral sessions at the symposium.
- Winner of the **Symposium Prize Paper Award** (**SPPA**) at the International Symposium on Geoscience and Remote Sensing (IGARSS) hold in July 2016 in Beijing, China. The paper [CI6] resulted the winner out of 1083 papers presented in the oral sessions at the symposium.
- Winner of the prestigious **Honors Master Program** in Research within the Master Degree in Telecommunication Engineering in 2012. (The program consists in a path reserved to the academically talented students interested to start a PhD at the end of the master. During the Honor program, students enrolled are required to: (i) satisfy a set of additional requirements on the number and grades of exams, (ii) take five additional PhD courses, and (iii) produce a thesis with a set of unique characteristics - written in English, must contain a detailed description of the state of the art and possible directions for future research work as part of a PhD thesis work.).
- Winner of the **Merit Award** for the Master Degree in Telecommunication Engineering, (acknowledgement reserved to students who have delivered excellent results in the field of their studies during the undergraduate path. Compulsory requirement to receive the award are: student has completed university exams within set time, the grade point has to be high-ranking, higher of the average of his year.)
- **Co-supervisor** of the Master Thesis "*A novel approach to 3D change Detection in multitemporal lidar data for forest monitoring*" by Daniele Marinelli, who won the IEEE-Geoscience and Remote Sensing Society (GRSS) South Italy Chapter Prize for the **best Italian Master Thesis on Remote Sensing** in 2015.

7 SCIENTIFIC ACTIVITY

7.1 SCIENTIFIC REVIEWER

- *IEEE Transaction on Geoscience and Remote Sensing;*
- *IEEE Geoscience and Remote Sensing Letters;*
- *IEEE Geoscience and Remote Sensing Magazine;*
- *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing;*
- *International Journal of Digital Earth;*
- *Remote Sensing;*
- *Remote Sensing of Environment;*

7.2 EDITORIAL BOARD AS TOPIC EDITOR

- *Remote Sensing;*

7.3 ROLES IN ORGANIZATION OF CONFERENCES AND WORKSHOPS (COMMITTEE MEMBERSHIP)

- Member of the Scientific Program Committee of the IEEE *International Geoscience and Remote Sensing Symposium* (IGARSS 2021), Brussels, Belgium, July 2021.
- Invited Session organizer in the Technical Program Committee (TPC) of the *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS 2020*)*, Brussels, Belgium, July 2021.
- Member of the Programme Committee of the SPIE *International Symposium on Remote Sensing*, Edinburgh, Scotland, September 2021.
- Member of the Scientific Program Committee of the IEEE *International Geoscience and Remote Sensing Symposium* (IGARSS 2020), Waikoloa, Hawaii, USA, July 2020.
- Invited Session organizer in the Technical Program Committee (TPC) of the *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS 2020*)*, Waikoloa, Hawaii, USA, July 2020.
- Member of the Programme Committee of the SPIE *International Symposium on Remote Sensing*, Edinburgh, Scotland, September 2020.
- Member of the Programme Committee of the SPIE *International Symposium on Remote Sensing*, Strasbourg, France, September 2019.
- Session Chair at the 2019 Int*ernational Geoscience and Remote Sensing Symposium* (IGARSS 2019), Yokohama, Japan, July 28 - August 2, 2019.
- Member of the Technical Committee of the IEEE 2018 *DeepGlobe Satellite Image Understanding Challenge*, in the IEEE Computer Vision and Pattern Recognition (CVPR 2018), June 18, 2018, Salt Lake City, UT.
- Member of the co-organizing team di 2018 *European Geosciences Union* (EGU 2018) for the session "Sentinels for Science: Advances in Land dynamics and processes understanding." April 13-18, 2018, Vienna, Austria.
- Member of the Technical Committee of the IEEE 2017 *Earthvision International Workshop on Large Scale Computer Vision for Remote Sensing Imagery* in conjunction with the *Computer Vision and Pattern Recognition* (CVPR 2017), July 21-26, 2017, *Honolulu, Hawaii.*
- Session Chair at the *2017 International Geoscience and Remote Sensing Symposium* (IGARSS 2017), Fort Worth, Texas, USA, 23-28 July 2017.

7.4 RESEARCH EXPERIENCE ABROAD

- **Post-doc visiting** at the *Image Processing Group*, Instituto de Telecomunicações, **Instituto Superior Técnico**, Lisbon, Portugal. (September 2016 - December 2016).
- **PhD visiting** at the *Center for Imaging Science*, **Rochester Institute of Technology (RIT)**, Rochester, New York State, USA. (September 2014 - December 2014).

7.5 PROFESSIONAL SOCIETIES

- *IEEE* (*Institute of Electrical and Electronics Engineers*):
  - member since 2016.

8 TEACHING AND ACADEMIC EXPERIENCES

8.1 MASTER AND BACHELOR LEVEL

- Teaching assistant for Comunicazioni Elettriche (Communication Systems) course, Bachelor in Telecommunication Engineering:
  - a.y. 2013/14, 45 hours;
  - a.y. 2014/15, 32 hours;
  - a.y. 2015/16, 28 hours;
  - a.y. 2016/17, 28 hours;
  - a.y. 2017/18, 32 hours;
  - a.y. 2018/19, 12 hours;
  - a.y. 2019/20, 14 hours;
  - a.y. 2020/21, 14 hours.
  -
- Teaching assistant for Advanced Remote Sensing (ARSS) course, Master course in Telecommunication Engineering:
  - a.y. 2019/18, 12 hours;
  - a.y. 2019/20, 10 hours;
  - a.y. 2020/21, 10 hours.

- Seminar on LiDAR data in the **Radar and Radiolocalization** course – Master in Telecommunication Engineering – University of Trento (December 2017).
- Seminar on LiDAR data in the **Radar and Radiolocalization** course – Master in Telecommunication Engineering – University of Trento (December 2014).
- Co-supervisor of several Bachelor and Master theses (more than 20) in Telecommunication Engineering – University of Trento (since 2013).
- Co-supervisor of Ph.D. students when at the University of Trento:
  - Iwona Podsiadło (cycle 33rd, 2017-2021);

9 ACTIVITY ON RESEARCH PROJECTS

9.1 COORDINATION ROLES

- The H2020 ExtremeEarth – From Copernicus Big Data to Extreme Earth Analytics (ExtremeEarth), European Commission (H2020-ICT-2018-2020, RIA) [2019-2021]. (**WP Leader**). Role in the project: develop a deep learning architecture tailored to the specific spatial, temporal and spectral nature of dense time series of Sentinel 2 images for crop mapping.
- The Land Cover Component of the ESA Climate Change (CCI+) – High Resolution Land Cover ECV (European Space Agency) [2018-present] (**WP Leader**). Role in the project: examine the effect of the spatial resolution of land cover maps used to support climate research.
- Scientific Exploitation of Operational Missions (SEOM) – S2-4Sci Land and Water – Multi-temporal Analysis (European Space Agency) [2016-2020] (**WP Leader**). Role in the

project: define and develop an automatic processing chain to perform unsupervised land-cover map update using time series of S2 images.

- Processing of LiDAR data and Hyperspectral Images to the estimation of the forest parameters based on the methodology developed during the FORLIDAR project (NEWFOR) ([2013-2014] (**WP Leader**). Role in the project: define advanced fusion methods to the automatic estimation of biophysical forest parameters at individual tree level and at plot level (e.g., forest height, species, biomass).

9.2 OTHER ROLES IN PROJECTS

Involved in the following national and international research projects:

- RIME - Design, development, and scientific exploitation of the Radar for Icy Moon Exploration (RIME) instrument for the JUpiter ICy moons Explorer (JUICE) mission, European Space Agency - Italian Space Agency – NASA [2013-present] (**Participant to Scientific Activity**). Role in the project: support in designing automatic techniques for the analysis of data acquired by planetary radar sounder systems.
- PRIN2012-VINDAS – "Very High spatial and spectral resolution remote sensing: a novel integrated data analysis system" (Italian Ministry of Education, University and Research), [2012-2017] (**Participant to Scientific Activity**). Role in the project: support in defining advanced methods to the automatic analysis of very high spatial and spectral resolution remote sensing optical images.
- Forest Parameter Estimation in the Trentino Region (FORLIDAR) [2011-2012] (**Participant to Scientific Activity**). Role in the project: support in investigating the potentiality of passive and remote sensing data to the forest parameter estimation in Trentino Region.

10 LANGUAGE KNOWLEDGE

- English: excellent knowledge of spoken and written English language – Level (C1).
- Italian: Native proficiency.

11 TECHNICAL SKILLS

- Remote sensing software: ENVI, QGIS, eCognition.
- Programming languages: C/C++, Matlab.
- Operating systems: Windows, Linux.
- Engineering Software: Matlab, AutoCAD.
- Microsoft Office suite: Word, Power Point, Excel, Access.

12 LIST OF PUBLICATIONS

The detailed list of papers is reported below. The list is organized in paper in Referred International Journals [Jx], Referred International Conferences [Cx], Workshops [Wx], and Theses [Tx].

12.1 INTERNATIONAL JOURNALS

[J1] **C. Paris**, L. Bruzzone, "A Three-Dimensional Model-Based Approach to the Estimation of the Tree Top Height by fusing Low-Density LiDAR data and Very High Resolution Optical Images", *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 53, no.1, pp. 467-480, 2015.

[J2] **C. Paris**, D. Valduga, L. Bruzzone, "A Hierarchical Approach to Three-Dimensional Segmentation of LiDAR Data at Single-Tree Level in MultiLayered Forest," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 54, no. 7, pp. 4190-4203, 2016.

[J3] **C. Paris**, D. Kelbe, J. v. Aardt, L. Bruzzone, "A Novel Automatic Method for the Fusion of ALS and TLS LiDAR data for Robust Assessment of Tree Crown Structure," *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 55, no. 7 pp. 3679-3693, 2017.

[J4] **C. Paris**, L. Bruzzone, "A Sensor-Driven Hierarchical Method for Domain Adaptation in Classification of Remote Sensing Images," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 56, no. 3, pp. 1308-1324, 2018.

[J5] D. Marinelli, **C. Paris**, L. Bruzzone, "A Novel Approach to 3-D Change Detection in Multitemporal LiDAR Data Acquired in Forest Areas," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 56, no. 6, pp. 3030-3046, 2018.

[J6] **C**. **Paris**, L. Bruzzone, "A Growth-Model Driven Technique for Tree Stem Attribute Estimation by using Airborne LiDAR Data," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 57, no. 1, pp. 76-92, Jan. 2019.

[J7] **C. Paris**, J. Bioucas-Dias, L. Bruzzone "A Novel Sharpening Approach for Superresolving Multiresolution Optical Images." *IEEE Transactions on Geoscience and Remote Sensing*, vol. 57, no. 3, pp. 1545-1560, March 2019.

[J8] **C. Paris**, L. Bruzzone, D. Fernández-Prieto, "Novel Approach to the Unsupervised Update of Land-Cover Maps by Classification of Time Series of Multispectral Images." in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 57, no. 7, pp. 4259-4277, July 2019.

[J9] D. Marinelli, **C. Paris**, L. Bruzzone, "An Approach to Tree Detection based on the Fusion of Multitemporal LiDAR Data", *IEEE Geoscience and Remote Sensing Letters*, vol. 16, no. 11, pp. 1771-1775, Nov. 2019.

[J10] **C. Paris**, L. Bruzzone, "A Novel Approach to the Unsupervised Extraction of Reliable Training Samples from Thematic Product.", submitted to IEEE Transactions on Geoscience and Remote Sensing", in *IEEE Transactions on Geoscience and Remote Sensing*, doi: 10.1109/TGRS.2020.3001004.

[J11] A. Harikumar, **C. Paris**, F. Bovolo, L. Bruzzone, "A Crown Quantization-Based Approach to Tree-Species Classification Using High-Density Airborne Laser Scanning Data," in *IEEE Transactions on Geoscience and Remote Sensing*.

[J12] I. Podsiadło, **C. Paris**, M. Callegari, C. Marin, D. Günther, U. Strasser, C. Notarnicola, L. Bruzzone, "Integrating models and remote sensing data for distributed glacier mass balance estimation," IEEE *Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 13, pp. 6177-6194, 2020

12.2 INTERNATIONAL CONFERENCES

[CI1] **C. Paris**, L. Bruzzone, "A novel technique for tree stem height estimation by fusing low density LiDAR data and optical images," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '13), Melbourne, Australia, 21-26, July 2013, pp. 3022-3025.

[CI2] **C. Paris**, L. Bruzzone, "A sensor-driven domain adaptation method for the classification of remote sensing images," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '14), Quebec City, Quebec, 13-18 July 2014, pp. 185-188.

[CI3] **C. Paris**, D. Valduga, L. Bruzzone, "A hierarchical approach to the segmentation of single dominant and dominated trees in forest areas by using high-density LiDAR data," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '15), Milan, Italy, 27-31 July 2015, pp. 65-68.

[CI4] **C. Paris**, D. Kelbe, J. v. Aardt, L. Bruzzone, "A precise estimation of the 3D structure of the forest based on the fusion of airborne and terrestrial LiDAR data," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '15), Milan, Italy, 27-31 July 2015, pp. 49-52.

[CI5] D. Marinelli, **C. Paris**, L. Bruzzone, "Fusion of high and very high density lidar data for 3D forest change detection," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '16), Beijing, China, 10-15 July 2016, pp. 3595-3598.

[CI6] C. **Paris**, L. Bruzzone, "A data-driven identification of growth-model classes for the adaptive estimation of single-tree stem diameter in LiDAR data," IEEE International Geoscience and Remote Sensing Symposium (IGARSS '16), Beijing, China, 10-15 July 2016, pp. 6918-6921. – (Received the **Symposium Prize Paper Award**)

[CI7] L. Bruzzone, F. Bovolo, **C. Paris**, Y. T. Solano-Correa, M. Zanetti, D. Fernández - Prieto, "Analysis of Multitemporal Sentinel-2 Images in the Framework of the ESA Scientific Exploitation of Operational Missions" in 2017 *10th International Workshop on the Analysis of Multitemporal Remote Sensing Images* (MultiTemp), Bruges, Belgium, 27-29 June 2017, pp.1-4.

[CI8] **C. Paris**, L. Bruzzone, D. Fernández-Prieto "A novel automatic approach to the update of land-cover maps by unsupervised classification of remote sensing images," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '17), Fort Worth, Texas, USA, 23-28 July 2017, pp. 2207-2210. – (Received the **Symposium Prize Paper Award**)

[CI9] **C. Paris**, J. Bioucas-Dias, L. Bruzzone, "A hierarchical approach to superresolution of multispectral images with different spatial resolutions," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '17), Fort Worth, Texas, USA, 23-28 July 2017, pp. 2589-2592.

[CI10] D. Marinelli, **C. Paris**, L. Bruzzone, "Fusion of multitemporal lidar data for individual tree crown parameter estimation on low density point clouds," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '18), Valencia, Spain, 23-28 July 2018, pp. 3999-4002 .

[CI11] **C. Paris**, L. Bruzzone, D. Fernández-Prieto, "A novel method based on source domain understanding and modeling to transfer labels from land-cover vector maps to classifiers for multispectral images," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '18), Valencia, Spain, 23-28 July 2018, pp. 3619-3622.

[CI12] A. Harikumar, **C. Paris**, F. Bovolo, L. Bruzzone, "A novel data-driven approach to tree species classification using high density multi-return airborne LiDAR data," *SPIE Remote Sensing Conference*, Berlin, Germany, 10-13 September 2018, Vol. 10789, p. 107890E.

[CI13] **C. Paris**, L. Bruzzone, "Automatic extraction of weak labeled samples from existing thematic products for training convolutional neural networks," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '19), Yokohama, Japan, July 28 - August 2, 2019, pp. 5722-5725.

[CI14] D. Marinelli, **C. Paris**, L. Bruzzone, "An automatic technique for deciduous trees detection in high density lidar data based on Delaunay triangulation," *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS '19), Yokohama, Japan, July 28 - August 2, 2019, pp. 94-97.

[CI15] M. Bertoluzza, **C. Paris**, L. Bruzzone, "A fast method for cloud removal and image restoration on Time Series of Multispectral Images" in 2019 *10th International Workshop on the Analysis of Multitemporal Remote Sensing Images* (MultiTemp), Shanghai, China, August 5-7, 2019, pp. 1-4.

[CI16] I. Podsiadło, **C. Paris**, F. Bovolo, M. Callegari, L. De Gregorio, D. Günther, C. Marin, T. Marke, M. Niroumand-Jadidi, C. Notarnicola, U. Strasser, M. Zebisch, L. Bruzzone, "Integration of Hydro-Climatological Model and Remote Sensing for Glacier Mass Balance Estimation," *SPIE Remote Sensing Conference*, Strasbourg, France, 9 - 12 September 2019, Vol. 11155, p. 1115513.

[CI17] M. Koubarakis, K. Bereta, D. Bilidas, K. Giannousis, T. Ioannidis, D.A. Pantazi, G. Stamoulis, J. Dowling, S. Haridi, V. Vlassov, L. Bruzzone, **C. Paris**, T. Eltoft, T. Krämer, A. Charalabidis, V. Karkaletsis, S. Konstantopoulos, T. Kakantousis, M. Datcu, C. O. Dumitru, F. Appel, H. Bach, S. Migdall, N. Hughes, D. Arthurs, A.

Fleming, “From Copernicus Big Data to Extreme Earth Analytics”, EDBT/ICDT 2019 Joint Conference, Lisbon, Portugal, March 26-29, 2019, Open Proceedings, 690-693.

[CI18] I. Podsiadło, **C. Paris**, L. Bruzzone, “A Study on the Robustness of the Long Short Term Memory classifier to Cloudy Time Series of Multispectral Images.”, submitted to SPIE Remote Sensing Conference, Edinburgh, United Kingdom, 21 - 24 September 2020.

[CI19] **C. Paris**, L. Bruzzone, “Monitoring of Agricultural Areas by using Sentinel 2 Image Time Series and Deep Learning Techniques”, submitted to SPIE Remote Sensing Conference, Edinburgh, United Kingdom, 21 - 24 September 2020.

12.3 NATIONAL WORKSHOP

[W1] **C. Paris**, L. Bruzzone, “Tecniche automatiche di ultima generazione per l’analisi di immagini iperspettrali satellitari,” Abstract in *Data Exploitation of PRISMA Mission Precursor of National Hyperspectral Space Mission*, Roma, Italy, February 2017.

[W2] F. Bovolo, L. Bruzzone, D. Fernandez-Prieto, **C. Paris**, Y.T. Solano-Correa, M. Zanetti, “Advanced Methods for the Analysis of Multitemporal Sentinel 2 Images,” Abstract in *2nd GTTI Radar and Remote Sensing Workshop* 2018, Pavia, Italy, 28,29 May 2018.

12.4 THESES

[T1] **C. Paris**, “*Metodi di Domain Adaptation con Active Learning basato su SVM per la classificazione di immagini telerilevate*” (Domain adaptation methods with Active Learning technique based on SVM for the classification of remote sensing images), Bachelor degree, advisor Prof. L. Bruzzone, November 2010.

[T2] **C. Paris**, “*Novel data fusion techniques for Tree Stem Volume Estimation by Multisource Remote Sensing Data*”, Master degree, advisor Prof. L. Bruzzone, October 2012.

[T3] **C. Paris**, “*Novel Methods based on the Fusion of Multisensor Remote Sensing Data for Accurate Forest Parameter Estimation*”, Ph.D. dissertation, advisor Prof. L. Bruzzone, April 2016.

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To Whom It May Concern

I am very pleased to write this letter to strongly endorse the application of Dr. Claudia Paris for research positions in the area of processing and analysis of remotely sensed data. I know Dr. Claudia Paris since September 2016, when she did a research visit to our research group at Instituto de Telecomunicações, Instituto Superior Técnico, Universidade de Lisboa, and I had the opportunity to collaborate with her and on the topic of "image super-resolution of multiresolution, multispectral images". This is a challenging problem, calling for strong background in inverse problems, including regularization, and optimization.

Prior to further appraise Dr. Claudia Paris's background, scientific skills, and contributions, I'll write a few words about myself. I'm a Full Professor with *Habilitation* at IST. I'm also a Senior Researcher with the Pattern Image Analysis Group of the Instituto de Telecomunicações, Lisboa, Portugal. My research interests include image inverse problems, signal and image processing, pattern recognition, optimization, and remote sensing. I have introduced scientific contributions in convex optimization, phase estimation, phase unwrapping, Bayesian inference, and in imaging inverse problems, namely for remote sensing applications with a focus on multiband imaging. I was included in Thomson Reuters' Highly Cited Researchers 2015 list, I'm an IEEE Fellow, and I've received the "IEEE-GRSS David Landgrebe Award" for 2017.

During Dr. Claudia Paris's stay in Lisbon, I had the opportunity and the privilege to collaborate with her on the super-resolution of multispectral images with different spatial resolutions. This topic is in the research boundary of multiband image super-resolution, calling for sophisticated frameworks, tools, and concepts. I would like to single-out two ideas that Dr. Claudia Paris introduced and that underlay the state-of-the-art performance obtained by the proposed super-resolution algorithms: a) to capitalize on the plug-and-play optimization framework to design scene-adapted regularizers; b) to decompose the super-resolution algorithms into a two-step process tackled in a hierarchical fashion.

Since I first met Dr. Claudia Paris, I have witnessed her intellectual brightness and ability in understanding complex concepts, determination, commitment, and eagerness to learn. In our interactions and discussions, namely on image processing and inverse problems topics oriented to hyperspectral image processing, she has always revealed curiosity and a research oriented attitude, crucial in any research activity. I also stress her outstanding communication skills, both in writing and in speaking, of which the various awards she has received are a corollary. As a person, Dr. Claudia Paris is polite and friendly, making any interaction with her simple and pleasant.

Dr. Claudia Paris has published 7 papers since 2015 in top ranked journals and 12 papers in top ranked conferences. This is a remarkable publication record for a young researcher (Dr. Claudia Paris has finished her PhD in 2016). These contributions have

opened new views and perspectives in the field and are an unequivocal testimony of Dr. Claudia Paris's exceptional qualities as a researcher, namely in the area of Pattern Recognition and Image processing applied to remotely sensed data.

I conclude, therefore, that Dr. Claudia Paris has the determination, the commitment, the curiosity, and the intellectual ability to develop outstanding research on statistical image processing and pattern recognition oriented to remote sensing applications. I am therefore most pleased to support Dr. Claudia Paris's application for any research position in the aforementioned areas.

José M. Bioucas Dias, Full Professor
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24/6/2018

Hyperspectral Computing Laboratory (HyperComp)
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Avda. de la Universidad s/n, 10071 Cáceres, SPAIN

Cáceres, Spain, June 22th, 2018

Dear Madam/Sir:

I have been asked to provide my professional and expert opinion of Dr. Claudia Paris' research and its impact on the field of remote sensing image processing. Based on my knowledge of her work, I am of the opinion that Dr. Paris has made a significant international impact with her research and therefore regarded as a superior expert within her field.

Dr. Paris has published groundbreaking findings pursuant to her research in remote sensing image processing. Her main contributions have been in the areas of image processing and machine learning, with applications to remote sensing image analysis. Specifically, she has contributed outstanding works on remote sensing single date and time series image classification, land cover map update and fusion of multisource remote sensing data for the estimation of biophysical parameters. She has been actively involved in very important international initiatives, including the analysis of multitemporal images acquired by the ESA Sentinel 2 satellite constellation for the automatic update of land cover maps in the context of the Scientific Exploitation of Operational Missions (SEOM) Sentinel-2 for Science ESA program. She has also served as an expert reviewer for many international journals, including the *IEEE Transactions on Geoscience and Remote Sensing* (for which she assisted me with a number of high-quality reviews during my term as Editor-in-Chief), the *IEEE Journal of selected Topics in Applied Earth Observations*, the *IEEE Geoscience and Remote Sensing Magazine*, *Remote Sensing* and *IEEE Geoscience and Remote Sensing Letters*.

At her young age, she has already received important recognitions at the international level, such as the received the very prestigious Symposium Prize Paper Award (SPPA) at the *IEEE International Geoscience and Remote Sensing Symposium* (IGARSS 2016) hold in July 2016 in Beijing, China. She has also received other important recognitions, including the prestigious Honors Master Program in Research within the Master Degree in Telecommunication Engineering in 2012, or the Merit Award for the Master Degree in Telecommunication Engineering. She has also actively contributed to the organization of important international conferences and workshops within her field. In addition, she possesses outstanding teaching experience after serving as Teaching Assistant for several courses in Telecommunication Engineering, and also after serving as instructor in different seminars (at the international level) on topics related to remote sensing image processing. I would like to take this opportunity to enthusiastically stress Dr. Paris' outstanding pedagogical skills in preparing and brilliantly presenting her research work in several international conferences to which I had the opportunity to attend. Dr. Paris' outstanding capacity to present both basic and advanced concepts to a wide audience (with heterogeneous backgrounds) in a very well-structured and intriguing way, as well as her presentation skills impressed the audience, who followed the presentations with enthusiasm. It is also important to emphasize that Dr. Paris is an extraordinarily prolific scientist. Her work has appeared in the top journals in her field, including the prestigious *IEEE Transactions on Geoscience and Remote Sensing* in which she has published a number of papers. Further, she has presented her work at prestigious conferences such as IGARSS and the *SPIE Remote Sensing conference*. Her extensive publications and awards speak to her extraordinary abilities as a research scientist.

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In summary, Dr. Paris is an outstanding young researcher who has already received the highest international recognition, with remarkable research, teaching and pedagogical skills. Based on my previous interactions with Dr. Paris, I envisage the qualities of a highly self-motivated young scientist who has already reached a significant stature in several highly relevant and innovative disciplines in the area of remote sensing image processing. I strongly believe that Dr. Paris will gain a great deal from this opportunity and will exceed all your expectations. Therefore, I am most pleased and greatly honored to unreservedly recommend Dr. Paris for a position in your very prestigious establishment.

Sincerely,

Prof. Antonio J. Plaza
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June 22, 2018

To whom it may concern:

RE: Reference letter in support of Dr. Claudia Paris' application to a scientist position

It gives me great pleasure to provide this reference letter for Dr. Claudia Paris in support of her application to a scientist position at your institution. Dr. Paris was affiliated with our research group, the Digital Imaging and Remote Sensing (DIRS) laboratory in the Chester F. Carlson Center for Imaging Science at Rochester Institute of Technology (Rochester, New York, USA), for a brief period from September 13 - December 14, 2014. This was one of her PhD degree requirements, where she was expected to perform independent, but PhD-related research at an external research laboratory. ***In short, Dr. Paris' contributions and research outputs during this relatively short period were truly outstanding***. I will first bore you with why I believe that I am in the position to judge Dr. Paris' research performance.

I obtained MS and PhD Forestry degrees from Virginia Tech (Blacksburg, VA), with the former supported by the Fulbright program. These degrees were followed by a two-year postdoctoral position at the Katholieke Universiteit Leuven (Belgium). I then served as the research group leader for the Earth Observation Group, Natural Resources and the Environment, CSIR (South Africa), from 2006-2008. I joined RIT's Chester F. Carlson Center for Imaging Science in 2008 at the associate professor level, where I still work, now as a full professor. I serve as our department's graduate admissions chair, have served as group director for the Laboratory for Imaging Algorithms and Systems and as acting director for the Digital Imaging and Remote Sensing Group. I currently have >60 in press/published peer-reviewed journal papers and approximately $3m in external research awards at RIT (>$5m in total). I am a co-recipient of the 2014-15 RIT Board of Trustees Scholarship Award and serve on the National Ecological Observatory Network's lidar technical working group.

I never quite know what to expect when an outside researcher joins our research group, let alone a researcher at the PhD level. ***Dr. Paris exceeded all my expectations***. She worked closely with two of my own PhD students, Dr. David Kelbe (now at Oak Ridge National Laboratory) and Dr. Paul Romanczyk (now at Aerospace Corporation). Specifically, she was involved with our primary National Ecological Observatory Network (NEON) light detection and ranging (lidar) project and a related terrestrial lidar effort (forest structural assessment and calibration/validation of airborne remote sensing products). Dr. Paris integrated seamlessly with our research team, and quickly became involved in our research discussion, strategic planning, and execution of actual research outcomes. We identified a stand-alone project where she would lead a study on the fusion of airborne and terrestrial lidar data sets toward tree structural characterization, not a trivial task at all. ***Dr. Paris was, in my opinion, very successful in this effort, as evidenced by not only a conference proceedings paper, but also a peer-reviewed journal article, with her as first author***:

- Paris, C., Kelbe, D., van Aardt, J., and Bruzzone, L., 2015. A precise characterization of the 3D structure of tree crowns based on the fusion of Airborne and Terrestrial LiDAR data. Proceedings of IGARSS; July 26-31, 2015; Milan, Italy.
- Paris C., D. Kelbe, J. van Aardt, and L. Bruzzone, 2017. A novel automatic method for the fusion of ALS and TLS LiDAR data for robust assessment of tree crown structure. *IEEE Transactions on Geoscience and Remote Sensing* 55(7): 3679- 3693.

I generally judge our group's research performance by such dissemination outputs, and to have a young researcher join our group for a three-month period and produce two high-quality papers in renowned outlets, was genuinely astounding. I can say without hesitation that Dr. Paris is i) quantitatively excellent (quantitative remote sensing), ii) a quick study, iii) highly adaptable (she applied her skills across a diverse set of remote sensing projects and modalities), and very importantly, iv) a strong leader with a collegial personality. She quickly integrated with our group and became part of the larger research effort, mainly due to her academic ability, pleasant personality, and constructive approach to science.

I can keep going by regaling you with Dr. Paris's qualities as a top-notch scientist, but to me it ultimately boils down to this: ***I would appoint her as a scientist or in a similar academic/ research position in my own group without reservation… she is exceptional.***

Please do not hesitate to contact me if you have any questions, and I wish you the best with your selection process.

Warm regards,

Jan van Aardt

Professor | Graduate Admissions Chair

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