

# Curriculum Vitae

Daniele Borio

October 2016

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## 1 Personal Details

**Full Name (first, last):** Daniele Borio  
**Private Address:** Via Carlo Beasana, 101,  
Ispra, Varese, Italy, 21027

**E-mail:** [daniele.borio@ieee.org](mailto:daniele.borio@ieee.org)

**Date of birth:** October 31, 1980  
**Citizenship:** Italian  
**Language Skills:** Italian (Native), English (level C1), French (level C1), German (basic user, level A1)

## 2 Professional Experience

### **November 2013 to present:**

**Scientific and Technical Officer** at the Joint Research Center (JRC) of the European Commission, Ispra, Italy. Directorate for Space, Security and Migration

### **October 2010 to October 2013:**

**Post-Doctoral Fellow** at the Joint Research Center (JRC) of the European Commission, Ispra, Italy. Grantholder cat. 30 at the Institute for the Protection and Security of the Citizen (IPSC)

### **January 2008 to September 2010:**

**Senior Research Associate/Post-Doctoral Fellow** at the PLAN group of the University of Calgary

### **July to December 2007:**

**Internship** at the PLAN group of the University of Calgary, under the supervision of Professor Gérard Lachapelle ([lachapel@ucalgary.ca](mailto:lachapel@ucalgary.ca))

### **July to December 2006:**

**Internship** at the Aerospace department of the Colorado University in Boulder, Colorado, under the supervision of Professor Dennis Akos ([dma@colorado.edu](mailto:dma@colorado.edu))

### **2005-2007:**

**Research Associate** at the Research Institute "Istituto Superiore Mario Boella", Torino, ITALY.

Research activities within the projects:

1. GILT, "Galileo Initiative for Local Technologies" coordinated by Thales (<http://www.thalesgroup.com/>) and funded by GJU (Galileo Joint Undertaking)
2. GIRASOLE, "Galileo Integrated Receiver Architecture for Safety of Life Equipment", funded by GJU (Galileo Joint Undertaking)
3. ARTUS, "Advanced Receiver Terminal of User Services", funded by GJU (Galileo Joint Undertaking)

**September 2004 to January 2005:**

**R&D Junior Engineer** in the SAS Group at the Politecnico di Torino, Italy. Conducted R&D on the development of Software-Radio Transceiver based on the IEEE 802.11b, 802.11g and 802.16a standards.

**March to September 2004:**

**Internship** in the Company Euroconcepts S.r.l ([www.euroconcepts.it](http://www.euroconcepts.it)). Development of a prototype transceiver operating according to the IEEE 802.16a standard and equipped with beamforming algorithms.

### 3 Education

**Ph.D. in Electrical Engineering**

Politecnico di Torino<sup>1</sup>, ITALY, April 2008

Thesis: "A Statistical Theory for GNSS Signal Acquisition" (available on-line at

[http://plan.geomatics.ucalgary.ca/papers/phdthesis\\_danieleborio\\_02apr08.pdf](http://plan.geomatics.ucalgary.ca/papers/phdthesis_danieleborio_02apr08.pdf))

Advisors: Prof. Letizia Lo Presti ([letizia.lopresti@polito.it](mailto:letizia.lopresti@polito.it)) and Prof. Gérard Lachapelle ([lachapel@ucalgary.ca](mailto:lachapel@ucalgary.ca))

Major area: satellite navigation, wireless communications, software radio, digital signal processing

**Professional Exam in Electrical Engineering, 2005**

**M.Sc. (Double Diplôme) in Electrical Engineering**

Politecnico di Torino, ITALY, September 2004

Ecole Nationale Supérieure d'Electronique et Radioélectricité de Grenoble (ENSERG), FRANCE, September 2004

Thesis: "DSP implementation of an OFDM Tx-Rx chain with receiver beamforming algorithms"

Advisor: Prof. Letizia Lo Presti ([letizia.lopresti@polito.it](mailto:letizia.lopresti@polito.it))

**Gradué en Ingénierie (Electronic Engineering)**

Ecole Nationale Supérieure d'Electronique et Radioélectricité de Grenoble (ENSERG), FRANCE, June 2003

### 4 Scientific Activity

The applicant's research interests have been developed mainly along the fields of Signal Processing and Wireless Communications with specific focus on Satellite Navigation and Software Defined Radio.

They include digital and satellite communications, signal detection and tracking, Radio Frequency (RF) interference mitigation and digital receiver design. The main research activity of the applicant has been in the field of Global Navigation Satellite Systems (GNSS) with specific focus in the design of navigation receivers. This has led to the development of innovative algorithms for the processing of new GNSS modulations and for specific applications such as indoor navigation and weak signal processing.

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<sup>1</sup> Politecnico di Torino was established in 1859, and is a leader technical university in Italy in the fields of Engineering; it is ranked 51-75th in the 2008 world university ranking in engineering, and 7th in Europe (<http://www.arwu.org/ARWU-FIELD2008/ENG2008.htm>).

From May 2008 to September 2010, the applicant has been involved in the design and development of the GSNRx™ software, a software-based GNSS receiver able to process several modulation schemes including legacy and modernized GPS signals. This has led to a fully operational navigation receiver with a flexible and modular architecture simplifying the design and testing of new receiver and navigation algorithms. The software can be directly interfaced with several front-ends and produce location and navigation information combining measurements from several live signal sources. Specific focus has also been devoted to real-time applications.

Since October 2010, the applicant has been working in the field of RF compatibility with specific focus on the coexistence between GNSS and other communications services. In this respect, he has conducted several studies where potential threats to satellite-based navigation have been identified and analyzed. The topics considered include GNSS interference, jamming and spoofing. Within such fields various topics have been developed. Those where the more original contributions have been produced, are listed in the following along with references<sup>2</sup> to the published works summarized in Section 9.

1. Signal detection and design of acquisition algorithms for GNSS modulations (P2, P7, P8, P10, P17, P18, C2, C4, C8, C13 and C14)
2. Digital tracking loop design for new GNSS modulations and weak signal applications (P5, P9, P11, P13, P15, C3, C15, C21, C23 and C24)
3. Design and development of Radio Frequency (RF) interference detection and mitigation algorithms in GNSS receivers (P3, P18, C5, C6, C9, C10, C11 and C12 and C47)
4. Coexistence between GNSS services and other technologies such as Digital Video Broadcastig-Terrestrial (DVB-T) and pseudolites (T1, T2, C39, C42, C42, C43)
5. Analysis, design and implementation of GNSS navigation receiver based on Software Defined Radio (SDR) technology (P12, C19 and O1)
6. Multi-rate techniques for signal recovery, analysis and modelling of front-end implementation losses in Direct Sequence Spread Spectrum (DSSS) receivers (P16, C20 and C22)
7. Time-frequency analysis for signal detection and filtering (P4, P6, C5 and C12)

Further contributions have been given to the following fields:

1. Analysis and design of OFDM transceivers (P1, C1 and C7)
2. Beamforming and multi-antenna algorithms (P1, C1, C7, C38 and O5)

The resulting publications are listed in Section 9.

## 5 Teaching and Student Supervision/Advising Activities

The applicant's teaching activity has focused in the fields of Analog and Digital Signal Analysis, Wireless Communications, and Digital Receiver design. Moreover, the candidate has produced teaching material for the classes he taught. Visual material, such as Power Point presentations, has been integrated with software code developed in Matlab in order provide a more complete perspective of the provided notions. When possible, theoretical concepts have been complemented with laboratory experience.

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<sup>2</sup> Acronyms are as follows. P# is short for published Journal Paper, C# stands for published Conference paper, T# is short for Technical and scientific reports and O# indicates "other publications" ..

The details of his teaching activities are summarized in Section 5.1.

The applicant has been involved in student supervision both at the Politecnico di Torino and at the University Of Calgary where he advised several MS.c and Ph.D students. As a result, several works have been published in both International Journals and Conferences.

From January 2008 to October 2010, the applicant has officially supervised/co-supervised several MSc students at the University Of Calgary, AB, Canada. Theses produced under the supervision of Daniele Borio are the following:

1. N. Linty, "Codeless Tracking Algorithms for GNSS Software Receivers", Master Thesis (visiting student from Politecnico di Torino , Facoltà di Ingegneria dell'informazione), September 2010. Available on-line at [http://plan.geomatics.ucalgary.ca/papers/mstthesis\\_codeless\\_nicolalinty24sep10.pdf](http://plan.geomatics.ucalgary.ca/papers/mstthesis_codeless_nicolalinty24sep10.pdf)
2. L. Montloin, "Impact of Interference Mitigation Techniques on a GNSS Receiver", Memoire de fin d'Etudes (visiting student from Ecole Nationale de l'Aviation Civile, Toulouse), September 2010. Available on-line at [http://plan.geomatics.ucalgary.ca/papers/pfe\\_memoire\\_lesliemontloin\\_23aug10.pdf](http://plan.geomatics.ucalgary.ca/papers/pfe_memoire_lesliemontloin_23aug10.pdf)
3. N. Sokolova, "Doppler Measurements and Velocity Estimation: Comparison of Standard and High Sensitivity Receivers", MSc Thesis, published as Report No. 20299, Department of Geomatics Engineering, The University of Calgary, Canada, December 2009. Available on-line at <http://plan.geomatics.ucalgary.ca/papers/09.20299.sokolova.pdf>
4. S. Fazio, "Multi-rate Signal Processing for Wide-band GNSS Signals", Master Thesis (visiting student from Politecnico di Torino, Facoltà di Ingegneria dell'informazione), July 2009. Available on-line at [http://plan.geomatics.ucalgary.ca/papers/thesis\\_salvatoref\\_10jul\\_09.pdf](http://plan.geomatics.ucalgary.ca/papers/thesis_salvatoref_10jul_09.pdf)
5. G. Giordanengo, "Impact of Notch Filtering on Tracking Loops for GNSS Applications", Master Thesis (visiting student from Politecnico di Torino, Facoltà di Ingegneria dell'informazione), January 2009. Available on-line at [http://plan.geomatics.ucalgary.ca/papers/gg\\_thesis\\_30jan09.pdf](http://plan.geomatics.ucalgary.ca/papers/gg_thesis_30jan09.pdf)
6. A. Martinetti, "Comparison of Standard and Generalized Post-Correlation Differential Coherent Detection Strategies for Weak GNSS Signal Acquisition", Master Thesis (visiting student from Politecnico di Torino, Facoltà di Ingegneria dell'informazione), January 2009. Available on-line at [http://plan.geomatics.ucalgary.ca/papers/thesis\\_amartinetti\\_25feb09\\_1.pdf](http://plan.geomatics.ucalgary.ca/papers/thesis_amartinetti_25feb09_1.pdf)
7. J. Courtois, "Enhancement of Acquisition and Detection performance through the combination of GIOVE-A L1 channels", Memoire de fin d'Etudes (visiting student from Ecole Nationale de l'Aviation Civile (ENAC), Toulouse, France), July 2008. Available on-line at [http://plan.geomatics.ucalgary.ca/papers/internship%20report\\_enhancement%20of%20acquisition\\_julie\\_nc\\_01aug08.pdf](http://plan.geomatics.ucalgary.ca/papers/internship%20report_enhancement%20of%20acquisition_julie_nc_01aug08.pdf)

He is also advised/co-supervised the following PhD students in the PLAN Group (University of Calgary) and at the Joint Research Centre (JRC) of the European Commission:

- Ciro Gioia, from January 2013 to April 2014, in the area of satellite navigation in difficult environments
- Pratibha B. Anantharamu, from January 2009 to September 2011, in the area of new GNSS signal processing
- Shashank Satyanarayana, from January 2009 to September 2011, in the field of indoor fading characterization
- Kannan Muthuraman, from January 2009 to January 2010, in the area of combined signal processing for new GNSS signals

The theses produced by the students advised/co-supervised by the applicant are listed in the following:

8. C. Gioia, "GNSS Navigation in difficult environments: Hybridization and Reliability". PhD Thesis, Parthenope University, Naples, Italy, April 2014.  
Available on-line at  
[http://pang.uniparthenope.it/sites/default/files/PhD\\_thesis\\_CG.pdf](http://pang.uniparthenope.it/sites/default/files/PhD_thesis_CG.pdf)
9. P. Anantharamu, "Space-Time Equalization Techniques for New GNSS Signals". PhD Thesis, Report No. 20335, Department of Geomatics Engineering, The University of Calgary, Canada, September 2011.  
Available on-line at  
[http://plan.geomatics.ucalgary.ca/papers/engo%2020335\\_panantharamu\\_phdthesis\\_sep11.pdf](http://plan.geomatics.ucalgary.ca/papers/engo%2020335_panantharamu_phdthesis_sep11.pdf)
10. S. Satyanarayana, "GNSS Channel Characterization and Enhanced Weak Signal Processing". PhD Thesis, Report No. 20336, Department of Geomatics Engineering, The University of Calgary, Canada, September 2011. Available on-line at  
[http://plan.geomatics.ucalgary.ca/papers/engo20336\\_phdthesis\\_ssatyanarayana\\_sep11.pdf](http://plan.geomatics.ucalgary.ca/papers/engo20336_phdthesis_ssatyanarayana_sep11.pdf)
11. K. Muthuraman, "Tracking Techniques for GNSS Data/Pilot Signals". PhD Thesis, published as Report No. 20303, Department of Geomatics Engineering, The University of Calgary, Canada, January 2010.  
Available on-line at [http://plan.geomatics.ucalgary.ca/papers/engo20303.muthuraman\\_jan10.pdf](http://plan.geomatics.ucalgary.ca/papers/engo20303.muthuraman_jan10.pdf)

## 5.1 Detailed List of the Courses Taught

### List of courses taught as instructor

#### 2016:

1. ESA/JRC International Summerschool on GNSS 2016 – He was responsible for the local organization of the event. He also provided a lecture on "GNSS Threats and Countermeasures" and organized the "Lab on GNSS Signal Processing" and the "Workshop: Practical Work with GNSS Receivers".

#### 2015:

2. ESA/JRC International Summerschool on GNSS 2015 – He provided a lecture on "GNSS Threats and Countermeasures" and organized the "Lab on GNSS Signal Processing".

#### 2014:

3. ESA/JRC International Summerschool on GNSS 2015 – He provided a lecture on “GNSS Threats and Countermeasures” and organized the “Lab on GNSS Signal Processing”.

**2013:**

4. ESA International Summerschool on GNSS 2013 – He provided a lecture on “Interference Mitigation and Detection” and organized the “Lab on GNSS Signal Processing”.

**2012:**

1. ENGO638 – GNSS Receiver Design (Master Degree in Geomatics Engineering, University of Calgary). The course has been re-designed and updated with respect to the previous editions. The lecture notes consists of 242 pages
2. JRC Summer School on GNSS Core Technologies – The applicant was one of the organizers/coordinators of the event. His responsibilities included the definition of the program, the coordination of the speakers and the editing of the lecture notes. The applicant provided three lectures on different GNSS related topics.

**2010:**

1. ENGO638 – GNSS Receiver Design (Master Degree in Geomatics Engineering, University of Calgary)

**2009:**

1. ENGO638 – GNSS Receiver Design (Master Degree in Geomatics Engineering, University of Calgary) (co-taught with Dr. C. O’Driscoll) . Development of lecture notes consisting of 221 detailed slides

**List of courses taught as teaching assistant**

**2007:**

1. Signal Analysis (Bachelor in Biomedical Engineering, Politecnico di Torino).

**2005:**

1. Analog and Digital Signal Processing (Bachelor in Telecommunications Engineering, Politecnico di Torino).

**2004-05:**

1. Electrical Communications (Joint Bachelor Degree Program, Politecnico di Torino / Institut National Polytechnique de Grenoble).

**2004:**

1. Analog and Digital Signal Processing (Bachelor in Telecommunications Engineering, Politecnico di Torino).

## **6 Research Projects**

**June 2012 till May 2014:**

Conducted research in the framework of the European Programme for Critical Infrastructure Protection (EPCIP) with specific emphasis on the protection of communication and navigation infrastructures.

**October 2010 to June 2012:**



Conducted research on the compatibility analysis between GNSS and other communications services including pseudolites. These research activities are part of the support provided by the JRC/IPSC to the European Commission (DG ENTR) and the European Conference of Postal and Telecommunications Administrations (CEPT), working group SE40.

Reference: Dr. Joaquim Fortuny Guasch ([joaquim.fortuny@jrc.ec.europa.eu](mailto:joaquim.fortuny@jrc.ec.europa.eu))

#### **January 2008 to September 2010:**

Conducted research for several projects within the activities of the PLAN group at the University of Calgary. These projects involve public and industrial partners including:

1. Research In Motion (RIM), (<http://www.rim.com>)
2. Defence Research and Development Canada (DRDC), (<http://www.drdc-rddc.gc.ca>)
3. General Motors (GM), (<http://www.gm.com>)

These research activities have led to the following conference and journal publications

1. C25, C26 and R1
2. C21, P11 and P13
3. C16, C17, C23, P9 and P10

listed in Section 9, plus several others in preparation

Reference: Prof. Gérard Lachapelle ([lachapel@ucalgary.ca](mailto:lachapel@ucalgary.ca))

#### **2005-2006**

Conducted research within the ARTUS project, “Advanced Receiver Terminal For User Services” (<http://www.artus-gju.org/index.html>), funded by Galileo Joint Undertaking (GJU) within the second call . The applicant was work package (WP) responsible for the task “Core Technology Investigation – Interference Mitigation”, Area 1B.

The research activities within this project led to several publications (P3, P4, C5, C6, C10, C11, C12) listed in Section 9.

Reference: Prof. Letizia Lo Presti ([letizia.lopresti@polito.it](mailto:letizia.lopresti@polito.it))

#### **2005-2006**

Conducted research within the GIRASOLE project, “Galileo Integrated Receiver for Advanced Safety Of Life Equipment” coordinated by Alcatel Alenia Space Italia and funded by Galileo Joint Undertaking (GJU) within the second call. The main research activity was the development and design of detection and mitigation algorithms for Radio Frequency (RF) interference in GNSS receivers for Safety of Life (SoL) applications.

Reference: Prof. Letizia Lo Presti ([letizia.lopresti@polito.it](mailto:letizia.lopresti@polito.it))

#### **2005-2006**

Conducted research within the GILT project, “Galileo Initiative for Local Technologies” funded by Galileo Joint Undertaking (GJU) and coordinated by Thales (<http://www.thalesgroup.com/>).

Reference: Prof. Letizia Lo Presti ([letizia.lopresti@polito.it](mailto:letizia.lopresti@polito.it))

#### **2004-2006**

Conducted research within the CAPANINA project, “Communications from Aerial Platform Networks delivering broadband communications for All” (contract number FP6-IST-2003-506745), which received a total funding of \$4.2 million distributed over 13 European partners from both Universities and private companies.

The research in this project led to a number of scientific results presented in the papers P1, C1 and C9 listed in Section 9.

Reference: Prof. Marina Mondin ([marina.mondin@polito.it](mailto:marina.mondin@polito.it))

#### **2004-2005**

Conducted research with in the PRIMO project (Piattaforme Riconfigurabili per Interoperabilità in Mobilità – Reconfigurable platforms for mobile interoperability). The project led to the development of a prototype OFDM transceiver equipped with beamforming algorithms at the receiver side.

Reference: Prof. Marina Mondin ([marina.mondin@polito.it](mailto:marina.mondin@polito.it))

## **7 Professional Activities**

**Member of the Editorial Advisory Board** of GPS Solutions, the Journal of Global Navigation Satellite Systems, Springer (<http://www.springer.com/earth+sciences+and+geography/geophysics/journal/10291>) (Since April 2010).

**Member of the Technical Program Committee** of the International Conference on Localization and GNSS (ICL) (Since 2014)

**Session chair** of the Institute of Navigation GNSS Conference, Portland, OR, September 2010.

#### **2005 to present:**

**Regular reviewer** for many International Journals and Conferences.

Among them:

Springer GPS Solutions

IEEE Transactions on Signal Processing

IEEE Transactions on Aerospace and Electronic Systems

IET Radar Sonar and Navigation

IET Signal Processing

## **8 Honors, Awards, Patents, Software, and Professional Society Membership**

- ✓ **Member of IEEE (since 2005).**
- ✓ **Member of the American Institute of Navigation (ION) (since 2008).**

#### **September 2015**

**Best presentation awards** at the ION GNSS+ conference. He obtained two awards for the presentations relative to the papers titled “GGTO: Stability and Impact on Multi-constellation Positioning” and “A Dual-antenna Spoofing Detection System Using GNSS Commercial Receivers”

### **January 2013**

**Dr. Samuel M. Burka Award 2012** from the Institute of Navigation, for the paper “A Composite Model for Indoor GNSS Signals: Characterization, Experimental Validation and Simulation” published in the Summer issue of NAVIGATION, Journal of The Institute of Navigation, Vol. 59, No. 2, pp. 77-92.

The purpose of the award is to recognize outstanding achievement in the preparation of papers contributing to the advancement of navigation and space guidance. Shared with Dr. S. Satyanarayana and Prof. G. Lachapelle

### **September 2008**

**Student sponsorship award** from the Institute of Navigation, GNSS'08 conference for the paper “Ultra-stable Oscillators: Limits of GNSS Coherent Integration”. Shared with P. Gaggero

### **January 2007**

Co-author of a patent with Dr Letizia Lo Presti, Laura Camoriano, Elisabetta Grignani and Emanuele Del Pero, entitled “Method and apparatus for frequency estimation”, Patent No. EP1847838 of the European Patent Office.

The main functionalities of the proposed algorithm have been published in the papers P5 and C3.

### **October 2006**

Co-author of a patent with Laura Camoriano and Dr Paolo Mulassano entitled “A method and an apparatus for reducing interference frequencies by using a notch filter”, Patent No. EP1916767 of the European Patent Office.

The main functionalities of the proposed algorithm have been published in the papers P3, C9 and C11.

### **May 2006**

**Best student paper award** at the European Navigation Conference (ENC) for the paper “Acquisition analysis for Galileo BOC modulated Signals: theory and simulation”.

### **April 2006**

Co-author of a patent with Laura Camoriano and Dr Paolo Mulassano entitled, “Time-frequency interfering detector”, Patent No. EP1862816 of the European Patent Office.

The main functionalities of the proposed algorithm have been published in the papers P6, C5 and C12.

### **2005**

The applicant was awarded the *Premio Optime* by Unione Industriale of Turin, ITALY, for his university career in Electrical and Electronics Engineering.

### **Software development**

#### **October 2010 to Present**

Development of several software tools for the analysis and characterization of radio frequency threats to GNSS signals. These tools include JIM (JRC Interference Monitor) and PLight, a real-time pseudolite able to operate in the GPS L1 bands. The software is developed in C++ and is designed to operate along with an USRP (Universal Software Radio Platform).

#### **May 2008 to September 2010**

Co-authorship of GSNRx™ (GNSS Software Navigation Receiver), a C++ class-based GNSS software receiver (Petovello, O'Driscoll, Lachapelle, Borio).

## 9 List of Publications in International Journals and Conferences

### 9.1 International Journals

P.46. **D. Borio** "Coherent Side-Band BOC Processing" *IET Radar Sonar and Navigation*, E-first, September 2016, pp. 1-27

P.45. F. Dimc, **D. Borio**, C. Gioia, G. Baldini, M. Bazec and M. Basso, "An Experimental Evaluation of Low-cost GNSS Jamming Sensors" *NAVIGATION, the Journal of the Institute of Navigation*, Accepted for publications, pp. 1-14, September 2016

P.44. **D. Borio** "Loop Analysis of Adaptive Notch Filters", *IET Signal Processing*, Vol. 10, Issue 6, August 2016, pp. 659-669

P.43. **D. Borio**, F. Dovis, H. Kuusniemi and L. Lo Presti, "Impact and Detection of GNSS Jammers on Consumer Grade Satellite Navigation Receivers" *Proceedings of the IEEE*, Vol. 104, Issue: 6, June 2016, 1233 - 1245

P.42. C. Gioia and **D. Borio** "A Statistical Characterization of the Galileo-to-GPS Inter-system Bias", *Journal of Geodesy*, First Online, June 2016, pp. 1-13

P.41. **D. Borio**, C. Gioia, G. Baldini, "Asynchronous Pseudolite Navigation Using C/N0 Measurements", *Journal of Navigation*, Vol. 69, Issue 3, May 2016, pp. 639-658

P.40. **D. Borio** and C. Gioia "A Sum-of-Squares Approach to GNSS Spoofing Detection", *IEEE Trans. on Aerospace and Electronic Systems*, Accepted for publications, pp. 1-12, January 2016

P.39. **D. Borio**, E. Angiuli, R. Giuliani and G. Baldini "Robust Spectrum Sensing Demonstration Using a Low-Cost Front-End Receiver" *International Journal of Antennas and Propagation*, Hindawi, Vol. 2015, July 2015, pp. 1-11

P.38. **D. Borio**, C. Gioia and Neil Mitchison "Identifying a low-frequency oscillation in Galileo IOV pseudorange rates", *GPS Solutions*, Springer, February 2015, pp. 1-10,

P37. C. Gioia and **D. Borio** "Stand-alone and Hybrid Positioning using Asynchronous Pseudolites", *Sensors*, MDPI, Vol. 2015, No. 1, January 2015, pp. 166-192

P36. **D. Borio** "Double Phase Estimator: a New Unambiguous BOC Tracking Algorithm", *IET Radar Sonar and Navigation*, Volume 8, Issue 7, August 2014, pp. 729-741

P35. C. Gioia, **D. Borio**, A. Angrisano, S. Gaglione and J. Fortuny-Guasch, "A Galileo IOV Assessment: Measurement and Position Domain", *GPS Solutions*, Springer, Accepted for publication, April 2014

P34. **D. Borio** "The Non-coherent Squaring Detector and its Application to Bi-phased Signals", *IET Radar Sonar and Navigation*, Volume 8, Issue 4, April 2014, pp. 327 - 335

- P33. M. Rao, C. O'Driscoll, **D. Borio** and J. Fortuny, "LightSquared Effects on Estimated C/N0, Pseudoranges and Positions", *GPS Solutions*, Springer, Volume 18, Issue 1, January 2014, pp 1-13
- P32. **D. Borio** and E. Cano "Optimal Global Navigation Satellite System Pulse Blanking in the Presence of Signal Quantisation", *IET Signal Processing*, Volume 7, Issue 5, July 2013, pp. 400-410
- P31. **D. Borio** and C. O'Driscoll, "Design of a General Pseudolite Pulsing Scheme", *IEEE Trans. on Aerospace and Electronic Systems*, Accepted for publication, May 2013
- P30. **D. Borio**, "Square Wave Decomposition for Fast Correlation in DSSS Receivers", *IEEE Trans. On Aerospace and Electronic Systems*, Volume 49, Issue 2, April 2013, pp. 969-981
- P29. **D. Borio**, M. Rao and C. O'Driscoll, "Codeless Processing of BOC Modulated Signals", *IET Radar Sonar and Navigation*, Volume 7, Issue 2, February 2013, pp. 143 –152
- P28. **D. Borio** "PANOVA Tests and their Application to GNSS Spoofing Detection", *IEEE Trans. On Aerospace and Electronic Systems*, Volume 49, Issue 1, January 2013, pp. 381 – 394
- P27. P. B. Anantharamu, **D. Borio** and G. Lachapelle, "Self-Contained Antenna Array Calibration using GNSS Signals", *NAVIGATION, the Journal of the Institute of Navigation*, Volume 59, No. 3, Fall 2012, pp. 209-220
- P26. S. Satyanarayana, **D. Borio** and G. Lachapelle, "A Composite Model for Indoor GNSS Signals: Characterization, Experimental Validation and Simulation", *NAVIGATION: the Journal of the Institute of Navigation*, Vol. 59, No. 2, Summer 2012, pp. 77-92
- P25. S. Satyanarayana, **D. Borio** and G. Lachapelle, "C/N0 Estimation: Design Criteria and Reliability Analysis under GNSS Weak Signal Scenarios", *IET Radar Sonar and Navigation*, Volume 6, Issue 2, February 2012, pp. 81-89
- P24. **D. Borio**, "Squaring and Cross-Correlation Codeless Tracking: Analysis and Generalization", *IET Radar Sonar and Navigation*, Volume 5, Issue 9, December 2011, pp. 958-969
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P9. **D. Borio**, C. Mongrédien and G. Lachapelle "Collaborative Code Tracking of Composite GNSS Signals" *IEEE Journal of Selected Topics in Signal Processing*, Volume 3, Issue 4, April 2009, pp. 613-626

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P7. **D. Borio**, L. Camoriano and L. Lo Presti, "The Impact of GPS Acquisition Strategy on Decision Probabilities" *IEEE Transactions on Aerospace and Electronic Systems*, Volume 44, Issue 3, July 2008, pp. 996-1001

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P2. **D. Borio** and L. Lo Presti, "Data and Pilot Combining for Composite GNSS Signal Acquisition" *International Journal of Navigation and Observation*, Article ID 738183, March 2008, 12 pages

P1. **D. Borio**, L. Camoriano, L. Lo Presti and M. Mondin, "Beamforming and Synchronization algorithms integration for OFDM communications", *International Journal on Wireless Information Networks*, Special Issue on Communications via High Altitude Platforms: Technologies and Trials. Volume 13, Number 1, January 2006

## 9.2 International Conferences

C65. **D. Borio**, C. Gioia, A. Stern, F. Dimc and G. Baldini "Jammer Localization: from Crowdsourcing to Synthetic Detection" 29th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS+), Portland, Oregon, 14-16 September 2016

C64. **D. Borio**, C. Gioia, G. Baldini and Joaquim Fortuny "GNSS Receiver Fingerprinting for Security-Enhanced Applications" 29th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS+), Portland, Oregon, 14-16 September 2016

C63. **D. Borio**, E. Cano and C. Gioia "From Agnostic to Model-Based GNSS Jamming Detection" 29th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS+), Portland, Oregon, 14-16 September 2016

C62. **D. Borio** "Swept GNSS Jamming Mitigation through Pulse Blanking" European Navigation Conference (ENC), Helsinki, Finland, 30 May - 2 June 2016

C61. **D. Borio**, C. Gioia, G. Baldini and R. Giuliani "A Real-time SDR Sanitizer for GNSS Interference Mitigation in Road Transportation" 24th International Electrotechnical and Computer Science Conference, IEEE ERK, Portorož, Slovenia, 21-23 September 2015

C60. **D. Borio**, C. Gioia, F. Dimc, M. Bažec, J. Fortuny, M. Basso and G. Baldini "An Experimental Evaluation of the GNSS Jamming Threat" 24th International Electrotechnical and Computer Science Conference, IEEE ERK, Portorož, Slovenia, 21-23 September 2015

C59. **D. Borio** and C. Gioia "A Dual-antenna Spoofing Detection System Using GNSS Commercial Receivers" 28th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS+), Tampa, Florida, 14-18 September 2015

- C58. C. Gioia and **D. Borio** "GGTO: Stability and Impact on Multi-constellation Positioning", 28th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS+), Tampa, Florida, 14-18 September 2015
- C57. **D. Borio** and C. Gioia "Real-Time Jamming Detection using the Sum-of-Squares Paradigm", 5th International Conference on Localization and GNSS (ICL-GNSS), Gothenburg, Sweden, 22-24 June 2015
- C56. C. Gioia, S. Gaglione and **D. Borio** "Inter-system Bias: Stability and Impact on Multi-constellation Positioning" IEEE Metrology for Aerospace (MetroAeroSpace), pp. 103-108, Benevento, Italy, 4-5 June 2015
- C55. **D. Borio** "Double Phase Estimator: New Results", 7th ESA Workshop on Satellite Navigation Technologies (NAVITEC), ESTEC, Noordwijk, the Netherlands, 3-5 December 2014
- C54. **D. Borio** and C. Gioia "Improved Pseudolite Navigation using C/N0 Measurements", 22nd European Signal Processing Conference (EUSIPCO 2014), Lisbon, Portugal, 1-5 September, 2014.
- C53. **D. Borio** "A Multi-State Notch Filter for GNSS Jamming Mitigation", 4th International Conference on Localization and GNSS (ICL-GNSS), Helsinki, Finland, 24-26 June, 2014
- C52. C. Gioia and **D. Borio** "Asynchronous Pseudolites and GNSS Hybrid Positioning", 4rd International Conference on Localization and GNSS (ICL-GNSS), Helsinki, Finland, 24-26 June, 2014
- C51. **D. Borio** and C. Gioia "Indoor Navigation Using Asynchronous Pseudolites", 6th European Workshop on GNSS Signals and Signal Processing, Munich, Germany, 5 – 6 December, 2013
- C50. **D. Borio**, C. O'Driscoll and J. Fortuny "Jammer Impact on Galileo and GPS Receivers", 3rd International Conference on Localization and GNSS (ICL-GNSS), Torino, Italy, 25-27 June 2013
- C49. A. Angrisano, S. Gaglione, C. Gioia, **D. Borio**, and J. Fortuny "Testing the Test Satellites: the Galileo IOV Measurement Accuracy", 3rd International Conference on Localization and GNSS (ICL-GNSS), Torino, Italy, 25-27 June 2013
- C48. **D. Borio**, J. Fortuny and C. O'Driscoll "Spectral and Spatial Characterization of GNSS Jammers", 7th GNSS Vulnerabilities and Solutions Conference, Baska, Croatia, 18-20 April 2013
- C47. **D. Borio**, C. O'Driscoll and J. Fortuny "GNSS Jammers: Effects and Countermeasures", 6th ESA Workshop on Satellite Navigation Technologies (NAVITEC), ESTEC, Noordwijk, the Netherlands, 5-7 December 2012
- C46. **D. Borio**, E. Cano and G. Baldini "Synchronization of Pulsed Pseudolite Signals: Analysis and Comparison" ION/GNSS'12, Nashville, Tennessee, 17-21 September 2012
- C45. **D. Borio**, E. Cano "Evaluation of Pulsed Interference Mitigation Techniques Accounting for Signal Conditioning" European Navigation Conference, Gdansk, Poland, 25-27 April 2012



- C.44 **D. Borio**, M. Rao and C. O'Driscoll "Quality Monitoring of BOC Signals Through Codeless Techniques" European Navigation Conference, Gdansk, Poland, 25-27 April 2012
- C.43 C. O'Driscoll, M. Rao, **D. Borio**, E. Cano, J. Fortuny, F. Bastide and D. Hayes "Compatibility Analysis Between LightSquared and L1/E1 GNSS Signals", IEEE/ION Position Location and Navigation Symposium (PLANS), Myrtle Beach, SC, 24-26 April 2012
- C42. **D. Borio**, C. O'Driscoll and J. Fortuny-Gausch "Impact of Pseudolite Signals on Non-participating GNSS Receivers" European Navigation Conference, London, 29 November- 2 December 2011.
- C41. **D. Borio**, C. O'Driscoll and J. Fortuny-Guasch "Pulsed Pseudolite Signal Effects on Non-Participating GNSS Receivers", International Conference on Indoor Positioning and Indoor Navigation (IPIN), Guimarães, Portugal, 21-23 September 2011.
- C40. N. Sokolova, **D. Borio** and B. Forsell "Loop Filters with Controllable Doppler Jitter for Standard and High Sensitivity (HS) GNSS Receivers", International Conference on Indoor Positioning and Indoor Navigation (IPIN), Guimarães, Portugal, 21-23 September 2011.
- C39. S. Satyanarayana, **D. Borio** and G. Lachapelle "A Non-Coherent Block Processing Architecture for Standalone GNSS Weak Signal Tracking", *ION/GNSS'11*, Portland, Oregon, 19-23 September 2011.
- C38. C. O'Driscoll, **D. Borio** and J. Fortuny-Guasch "Investigation of Pulsing Schemes for Pseudolite Applications", *ION/GNSS'11*, Portland, Oregon, 19-23 September 2011.
- C37. P.B. Anantharamu, **D. Borio**, G. Lachapelle "Space-Time Equalization Techniques for New GNSS Signals", *ION/GNSS'11*, Portland, Oregon, 19-23 September 2011.
- C36. J. Fortuny-Guasch, M. Wildemeersch and **D. Borio** "Assessment of DVB-T Impact on GNSS Acquisition and Tracking Performance", *ION/ITM'11*, San Diego, California, 24-26 January 2011.
- C35. M. Susi, **D. Borio** and G. Lachapelle "Accelerometer Signal Features and Classification Algorithms for Positioning Applications, *ION/ITM'11*, San Diego, California, 24-26 January 2011.
- C34. A. Kamel, **D. Borio**, J. Nielsen and G. Lachapelle "Interference Mitigation for Highly Dynamic GPS Receivers Using Intelligent Tracking Loops", *ION/ITM'11*, San Diego, California, 24-26 January 2011.
- C33 S. Satyanarayana, **D. Borio** and G. Lachapelle "Small and Large Scale Spatial Characterization of GPS Indoor Signals", *ION/ITM'11*, San Diego, California, 24-26 January 2011.
- C32. P.B. Anantharamu, **D. Borio** and G. Lachapelle "Self-Contained GNSS-Based Antenna Array Calibration", *ION/ITM'11*, San Diego, California, 24-26 January 2011.
- C31. S. Satyanarayana, **D. Borio** and G. Lachapelle "Power Levels and Second Order Statistics for Indoor Fading Using a Calibrated A-GPS Software Receiver", *ION/GNSS'10*, Portland, Oregon, 21-24 September 2010

C.30. C. O'Driscoll, M. Tamazin, **D. Borio** and G. Lachapelle "Investigation of the Benefits of Combined GPS/GLONASS for High Sensitivity Receiver", *ION/GNSS'10*, Portland, Oregon, 21-24 September 2010

C29. B. Aminian, V. Renaudin, **D. Borio** and G. Lachapelle "Indoor Doppler Measurements and Velocity Characterization Using a Reference-Rover Software Receiver", *ION/GNSS'10*, Portland, Oregon, 21-24 September 2010

C28. N. Sokolova, **D. Borio**, B. Forssell, and G. Lachapelle "Doppler Rate Measurements in Standard and High Sensitivity GPS Receivers: Theoretical Analysis and Comparison", *International Conference on Indoor Positioning and Indoor Navigation (IPIN)*, Zurich, 15-17 September 2010

C27. **D. Borio**, P. Anantharamu and G. Lachapelle "Semi-Analytic Simulations: An Extension to Unambiguous BOC Tracking" *International Technical Meeting, Institute of Navigation*, San Diego, California, January 25-27, 2010

C26. K. Muthuraman, **D. Borio**, R. Klukas and G. Lachapelle "Adaptive Data/Pilot Carrier Phase Tracking for Modernized GNSS Signals" *International Technical Meeting, Institute of Navigation*, San Diego, California, January 25-27, 2010

C25. S. Satyanarayana, **D. Borio** and G. Lachapelle "GPS L1 Indoor Fading Characterization Using Block Processing Techniques" *ION/GNSS'09*, Savannah, Georgia, September 22-25, 2009

C24. **D. Borio**, N. Sokolova and G. Lachapelle "Doppler Measurements and Velocity Estimation: a Theoretical Framework with Software Receiver Implementation" *ION/GNSS'09*, Savannah, Georgia, September 22-25, 2009

C23. P.B. Anantharamu, **D. Borio** and G. Lachapelle "Pre-Filtering, Side-Peak Rejection and Mapping: Several Solutions for Unambiguous BOC Tracking" *ION/GNSS'09*, Savannah, Georgia, September 22-25, 2009

C22. J. Curran, **D. Borio** and C. C. Murphy "Front-End Filtering and Quantisation Effects on GNSS Signal Processing" *Wireless Communication Society, Vehicular Technology, Information Theory and Aerospace & Electronics Systems Technology (Wireless VITAE)*, Aalborg, Denmark, May 17-20, 2009

C21. **D. Borio**, N. Sokolova and G. Lachapelle "Memory Discriminators for Non-Coherent Integration in GNSS Tracking Loops" *European Navigation Conference (ENC'09)*, Naples, Italy, May 3-6, 2009

C20. **D. Borio**, S. Fazio and G. Lachapelle "Multirate Signal Processing: a Solution for Wideband GNSS Signal Recovery" *European Navigation Conference (ENC'09)*, Naples, Italy, May 3-6, 2009

C19. M. G. Petovello, C. O'Driscoll, G. Lachapelle, **D. Borio** and H. Murtaza "Architecture and Benefits of an Advanced GNSS Software Receiver" *International Symposium on GPS/GNSS*, Tokyo, Japan, November 11-14, 2008

C18. P. Gaggero and **D. Borio** "Ultra-stable Oscillators: Limits of GNSS Coherent Integration", *ION GNSS 2008*, Savannah, Georgia, US, September, 16-19, 2008

- C17. **D. Borio** "FFT Sign Search with Secondary Code Constraints for GNSS Signal Acquisition", *IEEE Vehicular Technology Conference (VTC)*, Calgary, Alberta, Canada, September 21-24, 2008
- C16. **D. Borio**, C. Mongrédien and G. Lachapelle "New L5/E5a Acquisition Algorithms: Analysis and Comparison", *10th International Symposium on Spread Spectrum Techniques and Applications (ISSSTA)*, Bologna, Italy, August 25-28, 2008
- C15. **D. Borio**, L. Lo Presti, M. Fantino and M. Pini "Robust DLL Discrimination Functions Normalization in GNSS Receivers", *IEEE/ION Position Location and Navigation Symposium (PLANS)*, Monterey, California May 6-8, 2008
- C14. **D. Borio**, C. Gernot, F. Macchi and G. Lachapelle "The Output SNR and its Role in Quantifying GNSS Signal Acquisition Performance", *European Navigation Conference (ENC-GNSS)*, Toulouse, France, April 23-25, 2008
- C13. F. Macchi, **D. Borio**, M. Petovello and G. Lachapelle "New Galileo L1 Acquisition Algorithms: Real Data Analysis and Statistical Characterization", *European Navigation Conference (ENC-GNSS)*, Toulouse, France, April 23- 25, 2008
- C12. **D. Borio**, L. Camoriano, S. Savasta and L. Lo Presti "A Time-Frequency Excisor for GNSS Interference", *7th International Conference on ITS Telecommunications*, Sophia Antipolis, France, June 6-8, 2007
- C11. **D. Borio**, L. Camoriano and L. Lo Presti "Two-pole and Multi-pole Notch Filters: a Computationally Effective Solution for Interference Detection and Mitigation", *7th International Conference on ITS Telecommunications*, Sophia Antipolis, France, June 6-8, 2007
- C10. **D. Borio**, L. Lo Presti and P. Mulassano "Digital Spectral Separation Coefficient (SSC) for GNSS Signal to Noise Measurements and Interference Detection", *ION GNSS 2006*, Fort Worth, Texas, September 26-29, 2006
- C9. **D. Borio**, L. Camoriano, L. Lo Presti and P. Mulassano "Analysis of the One-Pole Notch Filter for Interference Mitigation: Wiener Solution and Loss Estimations", *ION GNSS 2006*, Fort Worth, Texas September 26-29, 2006
- C8. **D. Borio**, M. Fantino and L. Lo Presti "The Impact of the Galileo Signal in Space in the Acquisition System" *Tyrrhenian International Workshop on Digital Communications (TIWDC'06)*, Island of Ponza, Italy September 6-8, 2006
- C7. **D. Borio**, L. Camoriano and L. Lo Presti, "Wiener solution for OFDM pre and post-FFT beamforming" *14th European Signal Processing Conference (EUSIPCO)*, Florence, Italy, September 4-8, 2006
- C6. **D. Borio**, L. Camoriano and L. Lo Presti, "Spectral Separation Coefficient for Digital GNSS receivers" *14th European Signal Processing Conference (EUSIPCO)*, Florence, Italy, September 4-8, 2006
- C5. **D. Borio**, L. Lo Presti and P. Mulassano "Time-Frequency interfering detector for GNSS receivers", *Fifth International Workshop on Information Optics*, June 5-7, 2006, Toledo, Spain

C4. **D. Borio**, M. Fantino, L. Lo Presti and L. Camoriano "Acquisition analysis for Galileo BOC modulated Signals: theory and simulation", *European Navigation Conference (ENC)*, Manchester, UK, May 7-10 , 2006 (Best student paper award)

C3. **D. Borio**, L. Camoriano, L. Lo Presti and M. Fantino "DTFT-based frequency lock loop for GNSS applications", *European Navigation Conference (ENC)*, Manchester, UK, May, 7-10 , 2006

C2. **D. Borio**, L. Camoriano and L. Lo Presti, "Impact of the acquisition searching strategy on the detection and false alarm probabilities in a CDMA receiver", *IEEE/ION Position Location and Navigation Symposium (PLANS)*, San Diego, California, April, 25-27 , 2006

C1. **D. Borio**, L. Camoriano and L. Lo Presti, "A DSP Emulator for OFDM Communications via HAP with Beamforming Algorithms", *International Workshop on High Altitude Platform Systems (WHAPS)*, Athens, Greece, September 2005

### 9.3 Book Chapters, Scientific and Technical Reports

T4. **D. Borio** and E. Cano "Semi-Analytic Techniques for Fast MATLAB Simulations", in "MATLAB - A Fundamental Tool for Scientific Computing and Engineering Applications" - Volume 2, Prof. Vasilios Katsikis (Ed.), ISBN: 978-953-51-0751-4, InTech, DOI: 10.5772/46470. Available from: <http://www.intechopen.com/books/matlab-a-fundamental-tool-for-scientific-computing-and-engineering-applications-volume-2/semi-analytic-techniques-for-fast-matlab-simulations>

T3. **D. Borio**, C. O'Driscoll and J. Fortuny-Gausch "Impact of Pseudolite Signals on Non-Participating GNSS Receivers: Modelling receiver losses" Publications Office of the European Union, ISBN: 978-92-79-21845-3, ISSN: 1831-9424, DOI: 10.2788/93735, September 2011 (<http://dx.doi.org/10.2788/93735>)

T2. C. O'Driscoll, **D. Borio** and J. Fortuny-Gausch "Scoping Study on Pseudolites", Publications Office of the European Union, JRC Publication N°: JRC64608, ISBN: 978-92-79-19990-5, ISSN: 1018-5593, March 2011

T1. **D. Borio** and J. Fortuny-Gausch "Impact of Pseudolite Signals on Non-Participating GPS Receivers", Publications Office of the European Union, JRC Publication N°: JRC62608, ISBN: 978-92-79-19522-8, ISSN: 1018-5593, November 2010

### 9.4 Other Publications

O8. **D. Borio**, "Double Phase Estimator. Towards a New Perception of the Subcarrier Component" ", *Inside GNSS*, Volume 10, Number 3, pp. 58-64, May/June 2015 (<http://www.insidegnss.com/node/4501>)

O7. **D. Borio**, C. O'Driscoll and J. Fortuny "Fast and Flexible. Tracking and Mitigating a Jamming Signal with an Adaptive Notch Filter", *Inside GNSS*, Volume 9, Number 2, pp. 67-73, March/April 2014 (<http://www.insidegnss.com/node/3928>)

O6. **D. Borio**, J. Fortuny and C. O'Driscoll "Characterization of GNSS Jammers", *Coordinates*, Vol. XI, Issue 5, May 2013, pp. 8-16

O5. P. Anantharamu, **D. Borio** and G. Lachapelle G. "Space-Time Equalization Techniques for New GNSS Signals", *GPS World*, Vol. 22, No. 10, October 2011, pp. 36-41

O4. A. M. Kamel, **D. Borio**, J. Nielsen and G. Lachapelle "Mitigation for Missiles. Fuzzy Logic and Intelligent Tracking Loops Cope with Interference", *GPS World*, Vol. 22, No. 6, June 2011, pp. 50-58

O3. C. O'Driscoll, **D. Borio**, M. Petovello, T. Williams and G. Lachapelle "The Soft Approach: A Recipe for a Multi-System, Multi-Frequency GNSS Receiver", *Inside GNSS*, Volume 4, Number 5, pp. 46-51, 2009. (<http://www.insidegnss.com/node/1635>)

O2. **D. Borio**, L. Lo Presti and D. Odijk "Mathematical Models and GNSS Interference", *GNSS Solutions*, Inside GNSS Magazine, Volume 3, Number 2, pp. 22-27, 2008. (<http://www.insidegnss.com/node/587> )

O1. **D. Borio**, L. Lo Presti and C. O'Driscoll "Galileo Open Service and Weak Signal Acquisition", *GNSS Solutions*, Inside GNSS Magazine, Volume 2, Number 8, pp. 22-29, 2007. (<http://www.insidegnss.com/node/418>)