

## **Dr Alessio Balleri**

### **EDUCATION**

**(Jan 07 - Dec 2010) PhD in Electronic and Electrical Engineering, UCL**

Understanding how echolocating mammals, such as bats, classify targets and how this information can be usefully applied to radar and sonar systems to improve classification performance was at the centre of this research. A setup, carrying an acoustic radar capable of transmitting bat-like waveforms, was developed to collect 3D data of flowers of bat-pollinated plants to exploit and identify flower features that may aid the bat in the selection process. This project was sponsored by the UK MoD and the result of collaboration with the School of Biological Sciences at University of Bristol.

**(Summer Term 08) Elective in Understanding Entrepreneurial Opportunities, London Business School**

**(Sept 99 - March 04) Laurea in Ingegneria delle Telecomunicazioni (VO, 5 years), University of Pisa, Italy**

Final mark was 110/110 with distinction (summa cum laude) with a thesis titled "Statistical Analysis of polarimetric marine clutter data at different range resolutions". 1 conference and 1 journal paper have resulted from my research project.

### **RELEVANT WORK EXPERIENCE**

**(Oct 19 - Current) Reader in Radar Systems, Cranfield University**

I currently also hold the following school internal positions: Head of the RF Group, Assistant Director of Research - Technology

**(Oct 16 - Sept 19) Senior Lecturer, Cranfield University**

**(March 12 - Sept 16) Radar Lecturer, Cranfield University**

**(Feb 10 - March 12) Research Associate in Radar Systems, UCL**

Projects: 1) Wind farm clutter suppression: measurements and simulations of the Radar signature of a new wind turbine design (Funded by Japanese MoEnv.), 2) Automatic target classification by ultrasound micro-Doppler signatures (Funded by UDRC) 3) Classification of scaled radar target data collected at ultrasound frequencies, 4) Biologically inspired radar and sonar target classification (Funded by UK MoD) and 5) bistatic sea clutter (Funded by ONRG, Thales UK, Thales Netherlands).

**Mar 05 - Dec 05 Simulation and Analysis Engineer, IDS S.p.A., Pisa, Italy**

My role included to verify and validate GPS models in critical scenarios such as dense clutter environments, multipath effects and possible satellite failures. I was responsible for: data acquisition, development of the software for the analysis, analysis of the data. I extensively used the Spirent GPS simulator and the Novotel and Septentrio GPS receivers.

**Dec 04 - Mar 05 Research Assistant, University of Pisa, Italy**

Successfully worked on a joint project between University of Pisa and GEM Elettronica, Italy. I carried out a statistical analysis of sea clutter data collected in the Adriatic Sea and an analysis of the relative CFAR detection performance. A report was successfully delivered.

**Jun 04 - Dec 04 Visiting Research Scholar, University of Illinois at Chicago, USA**

I worked on the statistical analysis of radar sea clutter and developed a new Gaussian compound model characterised by an inverse Gamma distributed texture. One IEEE AEES transactions paper has been published.

### **LANGUAGES**

Italian (Mother Tongue), English (Fluent), French (Basic)

### **IT SKILLS**

MatLab, C++, LaTeX, LabView and all Office applications. Basic user of Fortran, Assembler, Unix, Linux.

### **POSTGRADUATE MODULE LEADERSHIP**

Module leader for Radar Principles on the Military Electronic Systems Engineering MSc

Module leader for Military Avionics on the Military Avionics and Airworthiness MSc

## **POSTGRADUATE TEACHING**

Cranfield University is a Postgraduate only University. My teaching activities support the following modules: Statistics and Signal Processing, Radar Principles, Advanced Radar, Guided Weapons, Military Avionics, Battlefield Technology Course (BTC) Introduction Module, BTC Precision Attack, Uninhabited Aircraft Systems (UAS) Technology, Uninhabited Military Vehicles Systems

I have consistently received positive feedback from students

## **MSC STUDENT SUPERVISION**

Successfully supervised 20 MSc students on their final projects

4 best student project awards

2 Military Electronic System Society Prizes

## **RESEARCH GRANTS (Sample)**

**PI** of "Novel deep learning techniques for non-cooperative geolocation in urban environments", funded by DSTL

**PI** of "Multistatic Radar Network with moving dual-channel receivers", funded by DSTL

**PI** of "RF Scalable Seeker Laboratory Demonstrator", funded by Leonardo

**PI** of "Detection and Classification of UAVs by Radar Micro-Doppler -Phase 2", funded by Plextek

**PI** of "Advanced Processing Algorithms for AESA Seekers (Simulations of MIMO techniques for RF Missile Seekers)", funded by QinetiQ

**PI** of "Radar Cross Section (RCS) of novel Radio Frequency (RF) countermeasure solutions" funded by Meon Technology

**PI** of 3D Phased Array Antennas funded by University of Brest

**PI and Project Manager** of "Adaptive Waveform Accuracy Algorithms For 3D Antennas (DRAGON)", funded by the MCM-ITP scheme, Task 11 (jointly with the French LAB-STICC).

**PI** of "Review of Technical Standards", funded by the EU

**PI** of "Target Detection and Classification of drones with the Aveillant Holographic Radar", funded by Thales Aveillant Ltd

**PI** of Radar Short Course for TUBITAK in Ankara, Turkey

**PI** for Cranfield University of "Coordination of waveform and angular diversity for interception and rendezvous problems" funded by the French DGA under the French/UK PhD scheme (jointly with the French LAB-STICC).

**PI** of "Detection of Classification of Air Targets with the Aveillant Radar", funded by Aveillant Ltd

**PI** of "Monopulse Techniques for Missile Seekers and Conformal Antennas", funded by Thales France

**PI** of "Measurements of the Radar Cross Section of metallic and fiberglass filaments with the Anritsu VNA" funded by Meon Technology Limited

**PI** for Cranfield University of "Multi-Function RF Seekers Based on 3D Phased Arrays" funded by MCM-ITP scheme Task 9 (jointly with the French LAB-STICC).

**PI** of "Study of the LPI properties of multifunction seeker waveforms based on 3D antennas and robustness against jamming" funded by the EPSRC Industrial Case 2015 and DSTL, 2015-2018.

**PI** for Cranfield University of "3D Conformal Antennas for radar applications" funded by the French DGA under the French/UK PhD scheme (jointly with the French LAB-STICC).

**Co-PI** of "DETERMINE- New Configurations of Low Cost, Fast and Efficient Ultra-wideband Ground Penetrating Radar for Humanitarian Demining", funded by Find a Better Way - FABW

**Co-PI** Radar Course for QinetiQ

## **RESEARCH STUDENT SUPERVISION**

**EM**, (MSc Res), "RF Scalable Seeker Laboratory Demonstrator", 2021 - exp 2023

**SHD** (MSc Res), "Radar Deception and Jamming by Phase Lock Disrupters (PLD)", 2020 - exp 2023

**BG** (PhD), “Optimal Radar Network Configurations for Detection, Estimation and Classification of drones” (PhD, 2018 - exp 2022)

**SBZ** (PhD), “Development of mm-wave FMCW Radar for nano-drone detection and classification”, Oct 2016 - Aug 2021

**ET** (MSc Res), “Waveform Design as Electronic Protection Measures for Radar”, 2018 – 2021

**GF** (PhD), “Deception Jamming Against Anti-Ship Missiles Which Use Doppler Beam Sharpening Modes”, Feb 2016 - July 2020

**LK** (PhD), “Multibeam Radar System based on Waveform Diversity for RF Seeker Applications”, Feb 2016 - Feb 2020

**NG** (PhD), “Passive Bistatic Radar Based on Staring Radar Illuminators of Opportunity”, Feb 2015 - Feb 2019

**LF** (PhD), “3D Conformal Antenna Arrays for Radar Applications”, Oct 2014 - Jan 2018.

**KG** (PhD), “Biologically Inspired Radar and Sonar Signal Processing”, Feb 2014 - Aug 2017.

### **POST-DOCTORAL RESEARCHERS**

**MC** (Oct 2018 - Oct 2019)

**DP** (Apr 2020 – Apr 2021)

### **AWARDS**

Cranfield Student Association (CSA) Sensational PhD Supervisor (2018)

Cranfield Student Association (CSA) Sensational PhD Supervisor (2019)

### **OTHER EVIDENCE OF ESTEEM IN RESEARCH**

IET Radar, Sonar and Navigation Special Issue Editor, March 2022-current

Technical co-chair of the 2020 IEEE International Radar Conference 2020, 27 April - 1 May 2020, Washington DC, USA

Demo Sessions co-chair of the IEEE Radar Conference 2020, 21-25 September 2020, Florence, Italy

Technical co-chair of the IET International Radar Conference, Belfast, UK, October, 2017

Guest co-editor of a special Issue in “Emerging Radar Techniques” for EURASIP Journal on Advances in Signal Processing (published 2013)

Guest co-editor IET Sonar, Radar & Navigation systems special issue in “Biologically Inspired Radar and Sonar Systems” (published 2012)

Honorary Research Associate, School of Biological Sciences, University of Bristol (2008-2010)

Honorary Research Associate, Dept. of Electronic & Electrical Engineering, University College London (2012-2017)

### **LIST OF PUBLICATIONS**

#### **Journals**

1. Rosamilia M, Balleri A, De Maio A, Aubry A and Carotenuto V, “Radar Detection Performance Prediction using Measured UAVs RCS Data”, accepted with major revisions in *IEEE Transactions on Aerospace and Electronic Systems*.
2. Markow J, Balleri A, Catherall A, “Statistical analysis of in-flight drone signatures” in *IET Radar Sonar & Navigation*, vol. 16, no. 11, pp. 1737–1751, 2022.
3. Belloni C, Balleri A, Aouf N, Le Caillec JM and Merlet T, “Explainability of Deep SAR ATR Through Feature Analysis” in *IEEE Transactions on Aerospace and Electronic Systems*, vol. 57, no. 1, pp. 659-673, 2021.
4. Bennett A, Yu N, Castelli M. *et al.* “Characterisation of a microwave induced plasma torch for glass surface modification”, *Front. Mech. Eng.*, vol 16, pp.122–132, 2021.
5. Belloni C, Aouf N, Balleri A, Le Caillec JM and Merlet T, “Pose-informed Deep Learning Method for SAR ATR”, in *IET Radar Sonar & Navigation*, March 2020.
6. Lombardi F, Griffiths HD, Lualdi M and Balleri A, “Characterization of the Internal Structure of Landmines Using Ground-Penetrating Radar”, *IEEE Geoscience and Remote Sensing Letters*, (Early Access), 2020.

7. Frazer G, Balleri A and Jacob G, "Deception Jamming Against Doppler Beam Sharpening Radars", *IEEE Access*, vol. 8, pp. 32792-32801, 2020.
8. Benavoli A, Balleri A and Farina A, "Joint waveform and guidance control optimisation for target rendezvous", *IEEE Transactions on Signal Processing*, vol. 67, no. 16, pp. 4357-4369, 2019.
9. Georgiev K, Balleri A, Stove A and Holderied MW, "Bio-inspired processing of radar target echoes", *IET Radar, Sonar and Navigation*, vol. 12, no. 12, pp.1402-1409, 2018.
10. Kocjancic L, Balleri A and Merlet T, "Multibeam radar based on linear frequency modulated waveform diversity", *IET Radar, Sonar and Navigation*, vol. 12, no. 11, pp. 1320-1329, 2018.
11. Balleri A, Farina A and Benavoli A, "Coordination of optimal guidance law and adaptive radiated waveform for interception and rendezvous problems", *IET Radar, Sonar and Navigation*, vol. 11, no. 7, pp. 1132-1139, 2017.
12. Fioranelli F, Ritchie M, Balleri A and Griffiths H, "Practical investigation of multiband mono- and bistatic radar signatures of wind turbines", *IET Radar, Sonar and Navigation*, vol. 11, no. 6, pp. 909-921, 2017.
13. Lombardi F, Griffiths HD, Wright L and Balleri A, "Dependence of landmine radar signature on aspect angle", *IET Radar, Sonar and Navigation*, vol. 11, no. 6, pp. 892-902, 2017.
14. Balleri A and Farina A, "Ambiguity function and accuracy of the hyperbolic chirp: comparison with the linear chirp", *IET Radar, Sonar and Navigation*, vol. 11, no. 1, pp. 142-153, 2017.
15. Gurbuz SZ, Clemente C, Balleri A and Soraghan JJ, "Micro-Doppler-based in-home aided and unaided walking recognition with multiple radar and sonar systems", *IET Radar, Sonar and Navigation*, vol. 11, no. 1, pp. 107-115, 2017.
16. Fioranelli F, Ritchie M, Balleri A and Griffiths HD, "Experimental Analysis of Multistatic Multiband Radar Signatures of Wind Turbines", *IET Radar, Sonar and Navigation*, vol. 10, no. 8, pp. 1400-1410, 2016.
17. Fioranelli F, Ritchie M, Balleri A and Griffiths HD, "Experimental Analysis of Multistatic Wind Turbine Radar Clutter Statistics", *Electronic Letters*, vol. 52, no. 3, pp. 226-228, February 2016.
18. Ritchie M, Fioranelli F, Balleri A and Griffiths HD, "Measurement and Analysis of Multiband Bistatic and Monostatic Radar Signatures of Wind Turbines", *Electronic Letters*, vol. 51, no. 14, pp. 1112-1113, July 2015.
19. Ricci R and Balleri A, "Recognition of humans based on radar micro-Doppler Shape Spectrum features", *IET Radar Sonar & Navigation*, June 2015.
20. Baker CJ, Smith GE, Balleri A, Holderied M & Griffiths HD, "Biomimetic Echolocation with Application to Radar and Sonar Sensing", *Proceedings of the IEEE*, vol. 102, no. 4, April 2014.
21. Baker CJ, Smith GE, Balleri A, Holderied M & Griffiths HD, "Sensing, Cognition, and Engineering Application [Further Thoughts]", *Proceedings of the IEEE*, vol. 102, no. 4, April 2014.
22. Balleri A, Al-Armaghany A, Griffiths HD, Tong KF, Matsuura T, Karasudani T and Ohya Y, "Measurements and analysis of the radar signature of a new wind turbine design at X-band", *IET Radar Sonar and Navigation*, vol. 7, no. 2, pp. 170-177, 2013.
23. \*Clemente C, Balleri A, Woodbridge K and Soraghan JJ, "Developments in Target Micro-Doppler Signatures Analysis: Radar Imaging, Ultrasound and Through-the-Wall Radar", *EURASIP Journal on Advances in Signal Processing*, vol. 47, 2013.
24. Leighton TG and Balleri A, "Editorial: Biologically-inspired radar and sonar systems", *IET Radar Sonar and Navigation*, vol. 6, no. 6, pp. 507-509, July 2012.
25. Balleri A, Griffiths HD, Baker CJ, Woodbridge K and Holderied MW, "Analysis of acoustic echoes from a bat-pollinated plant species: insight into strategies for radar and sonar target classification," *IET Radar, Sonar and Navigation*, vol. 6, no. 6, pp. 536-544, July 2012.

26. Balleri A, Chetty K and Woodbridge K, "Classification of personnel targets by acoustic micro-Doppler signatures", *IET Radar, Sonar and Navigation*, vol. 5, no. 9, pp. 943-951, December 2011.
27. Al-Ashwal WA, Baker CJ, Balleri A, Griffiths HD, Harmanny R, Inggs M, Miceli WJ, Ritchie M, Sandenbergh JS, Stove A, Tough RJA, Ward KD, Watts S and Woodbridge K, "Statistical analysis of simultaneous monostatic and bistatic sea clutter at low grazing angles", *Electronics Letters*, vol.47, no.10, pp.621 -622, May 2011.
28. Balleri A, Baker CJ, Woodbridge K and Holderied MW, "Flower classification by bats: radar comparisons", *IEEE Aerospace and Electronic Systems Magazine*, vol. 24, no. 5, pp. 4-7, May 2009.
29. Balleri A, Nehorai A and Wang J, "Maximum likelihood estimation for compound-Gaussian clutter with inverse Gamma texture", *IEEE Transactions on Aerospace and Electronic Systems*, vol. 43, no. 2, pp. 775-779, April 2007.

### **Book Chapters**

1. Balleri A, Georgiev K, Stove A, Griffiths H, Baker C and Holderied M, "Biologically inspired processing of target echoes" (Radar, Sonar and Navigation, 2017), in "Novel Radar Techniques and Applications Volume 2: Waveform Diversity and Cognitive Radar, and Target Tracking and Data Fusion", Chap. 7, pp. 215-232.
2. Balleri A, Griffiths H, Baker C, "Introduction" (Radar, Sonar and Navigation Series, 2017), in "Biologically-Inspired Radar and Sonar: Lessons from nature", Chap. 1, pp. 1-3.
3. Balleri A, Farina A and Benavoli A., "Biologically-inspired coordination of guidance and adaptive radiated waveform for interception and rendezvous problems" (Radar, Sonar and Navigation Series, 2017), in "Biologically-Inspired Radar and Sonar: Lessons from nature", Chap. 7, pp. 137-154.
4. Georgiev K, Balleri A, Stove A and Holderied M.W, "Enhanced range resolution: comparison with the matched filter" (Radar, Sonar and Navigation Series, 2017), in "Biologically-Inspired Radar and Sonar: Lessons from nature", Chap. 3, pp. 37-60.
5. Balleri A, Griffiths H, Baker C and Holderied M, "Analysis of acoustic echoes from bat-pollinated plants" (Radar, Sonar and Navigation, 2017), in "Biologically-Inspired Radar and Sonar: Lessons from nature", Chap. 5, pp. 89-107.
6. Balleri A and Mehmood A, "Sonar Micro-Doppler Signatures: Principles and Applications" in *Radar Micro-Doppler Signatures: Processing and Applications* (edited by V. Chen, D. Tamoush and W. Miceli), IET Radar, Sonar, Navigation and Avionics, Chapter 11, pp. 329-344, 2014.
7. Griffiths H, Balleri A and Baker C, "Biologically inspired and multi-perspective target recognition" in *Radar Automatic Target Recognition (ATR) and Non-Cooperative Target Recognition (NCTR)* (edited by D. Blacknell and H. Griffiths), IET Radar, Sonar, Navigation and Avionics, Chapter 7, pp. 177-211, 2013.
8. C.J. Baker, H.D. Griffiths and A. Balleri, "Biologically inspired waveform diversity", in *Waveform Design and Diversity for Advanced Radar Systems* (edited by F. Gini, A. De Maio and L. Patton), IET Radar, Sonar and Navigation Series 22, pp. 149-172, 2012.

### **Edited Books**

1. Fioranelli F, Ritchie M, Griffiths HD and A Balleri, "Micro-Doppler Radar and its Applications", *IET Radar, Sonar and Navigation Series*, 2020.
2. Balleri A, Griffiths H, Baker C, "Biologically-Inspired Radar and Sonar: Lessons from nature", *IET Radar, Sonar and Navigation Series*, 2017.

### **Sample Conferences (Tot 40+)**

1. Balleri A, Kocjancic L and Merlet T, "Characterisation of Sidelobes for Multibeam Radar Based on Quasi-Orthogonal LFM Waveforms", in *2020 International Radar Conference*, Washington DC, USA, 27-30 April 2020.
2. Zulkifli S and Balleri A, "FMCW Radar Prototype Development for Detection and Classification of Nano-Targets", in *2020 International Radar Conference*, Washington DC, USA, 27-30 April 2020.
3. Kocjancic L, Balleri A and Merlet T, "Micro-Doppler Signature Extraction with Multibeam Radar", in *International Radar Conference 2019*, Toulon, France, 23-27 September, 2019.
4. Abedrabba S, Ahiska K, Allanic R, Balleri A, Chatterjee M, Merlet T and Quendo C, "DRAGON: Adaptive RF Seekers based on 3D Conformal Antennas" in *International Radar Conference 2019*, Toulon, France, 23-27 September, 2019.
5. Ghazalli N, Balleri A, Jahangir M, Colone F, Baker CJ, "Passive Detection Using a Staring Radar Illuminator of Opportunity", in *International Radar Conference 2019*, Toulon, France, 23-27 September, 2019.
6. Kocjancic L, Balleri A and Merlet T, "Numerical Characterisation of Quasi-Orthogonal Piecewise Linear Frequency Modulated Waveforms", in *Sensor Signal Processing for Defence 2019*, Brighton, UK, 9-10 May, 2019.
7. Kocjancic L, Balleri A and Merlet T, "Experiments of Quasi-Orthogonal Linear Frequency Modulated Waveforms for Multibeam Radar", in *IEEE Radar Conference 2019*, Boston, USA, 22-16 April 2019.
8. Frazer G, Balleri A and Jacob GS, "False Target Errors Against Doppler Beam Sharpening Radars", in *IEEE Radar Conference 2019*, Boston, USA, 22-16 April 2019.
9. Gersone F, Balleri A, Jahangir M and Baker CJ, "Simulations of L-band Staring Radar Moving Target Integration Efficiency", *IEEE Conference on Antenna Measurements & Applications 2018 (CAMA)*, Vasteras, Sweden, 3-6 September, 2018.
10. Lombardi F, Griffiths HD and Balleri A, "Landmine internal structure detection from ground penetrating radar images", *IEEE Radar Conference 2018 (RadarConf18)*, Oklahoma City, USA, 2018.
11. Lombardi F, Griffiths HD and Balleri A, "Bistatic radar signature of buried landmines", *International Conference on Radar Systems (Radar 2017)*, Belfast, 2018.
12. Belloni C, Balleri A, Aouf N, Merlet T and Le Caillec JM, "SAR image dataset of military ground targets with multiple poses for ATR," *Proc. SPIE 10432, Target and Background Signatures III*, Warsaw, Poland, 11-14 September, 2017.
13. Kocjancic L, Balleri A and Merlet T, "Study of the frequency slope effect on the chirp waveform orthogonality", *International Conference on Radar Systems (Radar 2017)*, Belfast, 2017.
14. Liu J, Balleri A, Jahangir M and Baker C, "Investigating jammer suppression with a 3-D staring array", *International Conference on Radar Systems (Radar 2017)*, Belfast, 2017.
15. Fourtignon L *et al.*, "Directivity and ellipticity study for planar and 3D conformal RF-seeker antennas", *2017 IEEE Conference on Antenna Measurements & Applications (CAMA)*, Tsukuba, Japan, 2017.
16. Ghazalli N, Balleri A and Colone F, "Exploitation of Deterministic Signals for Passive Single-Channel Detection", *Sensor Signal Processing for Defence Conference (SSPD) 2017*, London, 2017.
17. Frazer G, Balleri A and Jacob G, "Simulations of Repeat Jamming against Anti-Ship Missile Seekers Which Use Doppler Beam Sharpening Modes", *Sensor Signal Processing for Defence Conference (SSPD) 2017*, London, 2017.
18. Balleri A, Farina A and Benavoli A, "Two-dimensional coordination of guidance and adaptive radiated waveform for interception and rendezvous problems", *18th International Radar Symposium (IRS) 2017*, Prague, 2017.

19. Lombardi F, Griffiths HD, Balleri A and Lualdi M, "Preliminary results on multi offset GPR for imaging of landmines", *9th International Workshop on Advanced Ground Penetrating Radar (IWAGPR) 2017*, Edinburgh, 2017.
20. Georgiev K, Balleri A, Stove A and Holderied M, "Bio-inspired two target resolution at radio frequencies", *IEEE Radar Conference (RadarConf) 2017*, Seattle, USA, 2017.