Corina-Alda Naforniță, Habilitation thesis, Abstract

I have received the Ph.D. degree in Electronics and Telecommunications in 2008, from the Technical University of Cluj-Napoca, Romania. In 2003, I joined the Department of Communications at "Politehnica" University of Timisoara, where I currently hold the position of Associate Professor (since 2013). My activity is carried out in the framework of the [Intelligent Signal Processing Adelaida Mateescu Research Centre](), at Politehnica Univ. Timisoara. My research interests include: signal and image processing, statistical signal processing, multimedia security, watermarking, wavelets, radar signal processing.

Consequently, this thesis covers the research activities published in papers, books and book chapters in the period 2008-2014, which were performed after the PhD thesis.

My PhD thesis was written under the guidance of **Professor Monica Borda** (from Technical University of Cluj-Napoca) and **Professor Alexandru Isar** (from Politehnica University Timisoara), with the subject of *Contributions to Image watermarking in the wavelet domain*. My research efforts in the **image watermarking** field were continued, for example I have proposed using the Hyperanalytic Wavelet domain to embed the watermark, or to use turbocodes for a high degree of robustness.

I have co-authored research papers in the field of **image denoising** using the Hyperanalytic Wavelet transform in collaboration with Professor Alexandru Isar, dr. Ioana Firoiu, Professor Dorina Isar and Professor Jean-Marc Boucher (Telecom Bretagne, Brest, France).

I have co-authored a paper that presents the implementation of a new complex 2D wavelet transform, namely the **Hyperanalytic wavelet transform, (HWT)**; this was used for watermarking and denoising with a better performance than other quasi shift-invariant complex transforms. A research preoccupation was the **statistical analysis of 2D wavelet transforms** including the 2D Discrete Wavelet Transform (DWT) and the HWT.

I suggested **improving the directional selectivity** of the HWT by using **H**yperanalytic **Wavelet Packets Transform** (HWPT). For anisotropic images, to distinguish between preferential directions, we have proposed to use the HWPT, and on each direction the smoothness is estimated via the **Hurst exponent**.

I have improved further the **Hurst exponent estimation** techniques by applying a **LASSO based regularization** in the wavelet domain and I applied this estimation method to solve an image denoising problem where the regularity is considered to vary piecewise.

We have considered the HWT coefficients being circularly distributed, with complex Gaussian distribution. We computed a closed form for the **Kullback-Leibler divergence for the Complex Generalized Gaussian Distribution (CGGD)**.

A new method for **texture clustering** based on the information-geometry tools (barycentric distribution for each cluster) is proposed. These activities were carried out in the framework of an international research project Brancusi, funded by UEFISCDI and EGIDE, for which I was grant director on the Romanian side. The grant director on the French side was Professor Yannick Berthoumieu, ENSEIRB MATMECA, Bordeaux, France.

Image contrast enhancement was performed for images that were exposed to non-uniform lightening, using a complex wavelet transform and a bivariate model for the coefficients. The method implies both denoising and contrast enhancement in the Double Tree Complex Wavelet Transform (DTCWT) domain.

Recently, in the framework of an European Project (FP7-ARTRAC), I have worked in the field of **RADAR signal processing**, proposing denoising to improve probability of detection for the envelope detector; as well as a method to build the range-Doppler map for multiple targets in the automotive field.

Other research activities were biomedical signal processing (electrocardiograms and magnetocardiograms signals), such as denoising, compression and wander baseline reduction. In communications we proposed methods for the reduction of the Peak-to-Average Power Ratio (PAPR) of the Orthogonal Frequency Division Multiplexing (OFDM) transmitted signal.

I am an IEEE member since 2003, reviewer for several journals and Technical Program Committee (TPC) member for prestigious international conferences. In April-June 2011 I was invited researcher at Lab. Intégration du Matériau au Système, ENSEIRB Bordeaux and in Sept-Oct. 2009 I was Invited Professor at "Lab. Intégration du Matériau au Système", Universite Bordeaux I, where I awarded an EGIDE scholarship for research (Oct. 2009).

I am currently Scientific Secretary for the Scientific Bulletin of "Politehnica" University of Timisoara, Transactions on Electronics and Communications (2006-) and I served as Publication chair for the IEEE International Symposium of Electronics and Telecommunications, editions 2014, 2012 and 2010 and member in the organizing committee for editions 2004, 2006 and 2008. In 2012 and 2014 I was also a Session Chair at the ISETC symposium. In 2002 and 2004 I received a Diploma for Excellence in Research from the Dean of the Faculty of Electronics and Telecommunications.

I was reviewer for the following journals:
- 2006 IEEE Trans. on Information Forensics and Security,
- 2007-2008, 2011-2012 IEEE Trans. on Multimedia,
- 2009-2010 IEEE Trans. on Signal Processing,
- 2010-2011, 2013 IEEE Trans. Image Processing
- 2007-2008 EURASIP Journal on Information Security,
- 2007-2010 IET Information Security,
- 2008 Research Letters in Electronics, Elsevier
- 2008 Journal of Systems and Software Elsevier,
- 2008-2013 Signal Processing Elsevier
- 2013 IET Radar, Sonar & Navigation
- 2013 Physical Communication
- Acta Technica Napocensis

I was a TPC member and reviewer for the following conferences:
- 22nd European Signal Processing Conference,EUSIPCO 2014,September 1-5, 2014,Lisbon, Portugal
- 21st European Signal Processing Conference, EUSIPCO 2013, Marrakech, Morocco, 9-13 September 2013
- 20th European Signal Processing Conference, EUSIPCO 2012, Bucharest, Romania, 27-31 August 2012

- 18th EUNICE Conference on Information and Communications Technologies EUNICE 2012, 29-31 August 2012, Budapest, Hungary
- 4th IEEE International Workshop on Information Forensics and Security, WIFS 2012, Tenerife, Spain, December 2-5, 2012

I was a reviewer for the following conferences:
- ICASSP 2014, IEEE International Conference on Acoustics, Speech, and Signal Processing,May 4-9, 2014 - Florence, Italy
- ISCAS 2014 IEEE International Symposium on Circuits and Systems, 1-5 june 2014, Melbourne, Australia
- 21st European Signal Processing Conference, EUSIPCO 2013, Marrakech, Morocco, 9-13 September 2013,
- 11-th International Symposium on Signals, Circuits and Systems, July 11-12, 2013, Iasi, Romania.
- 13th International Conference on Optimization of Electrical and Electronic Equipment OPTIM 2012, May 24-26, 2012, Brasov, Romania,
- 2nd IEEE International Conference on Information Science and Technology, ICIST 2012, 23- 25 May 2012, Wuhan, China
- IEEE International Symposium on Electronics and Telecommunications, Timisoara, November 15-16, 2012, ISETC 2012
- Statistical Signal Processing Workshop, 28-30 June 2011, Nice, France, SSP 2011
- IEEE International Symposium on Electronics and Telecommunications, November 11-12, 2010, Timisoara, ISETC 2010,
- 8-th International Symposium on Signals, Circuitsand Systems, ISSCS 2007, Iasi, July 12-13,2007

Grants (director):
- 2011-2012 - bilateral program Brancusi EGIDE/ANCS, Romanian Director, "Classification de textures fondée sur la théorie des ondelettes hyper-analytiques et les copules", French Director: Prof. Yannick Berthoumieu grant no. 510/31.03.2011, period 2011-2012, partners UPT, IPB-ENSEIRB MATMECA, funded by ANCS-UEFISCDI and EGIDE
- 2004-2006 – national grant TD, CNCSIS code 47, Digital watermarking for still images in the transform domain funding by CNCSIS

Grants (member):
- 2014- ongoing, Quality of Services Improvement for GNSS Localisation in Constraint Environment by Image Fusing Techniques (IMFUSING), Contract with European Space Agency, ESA, nr. 4000111852/14/NL/Cbi, contractor UPT, subcontractor Thales Alenia (2014)
- 2014- ongoing, SEOM SY4Sci Synergy - Ocean Virtual Laboratory (OVL), Contract with European Space Agency, ESA, nr. 4000112389/14/I-NB, contractor OceanDataLab, subcontractor UPT
- 2011-2014 – FP7 EU program, Advanced Radar Tracking and Classification for Enhanced Road Safety ARTRAC
- 2013-2014 – PC7 EU program, Advanced Radar Tracking and Classification for Enhanced Road Safety ARTRAC, funded by UEFISCDI
- 2009-2011 – national grant – The use of wavelet theory for decision making, funded by CNCSIS, ID 930, 2009-2011
- 2007-2009 – national grant, Improvement of research & development basis in the field of communications at the Faculty of Electronics and Telecommunications, Politehnica Univ. of Timisoara, funded by ANCS, CAPACITATI PN II, 2007-2009, 77/CP/II/13.09.2007

- 2005-2007 – national grant, Performance increase of digital receptors using wavelet theory, funded by CNCSIS, code 637/A/CNCSIS
- 2004-2006 – national grant, Modern methods for image analysis and image processing, 2004-2006, funded by CNCSIS
- 2011-2012 – member of target group Doctoral School in support of research in the European context ("Scoala doctorala in sprijinul cercetarii in context european"), POSDRU program 21/1.5/G/13798 2010-2012

Scholarships:
- Oct. 2009 -EGIDE scholarship for research, LAPS, Bordeaux, France
- Sep. 2005-ECRYPT scholarship, Summer School for Multimedia Security, University of Salzburg, Austria, 21-24 Sept. 2005

Awards:
- 2012: Nominated for the Information Forensics and Security Technical Committee IEEE