Associate Professor in Computer Science at University of Toulouse
Research activities in IRIT UMR CNRS 5505 Laboratory, Toulouse, France

Adrian BASARAB
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Research Topics: Signal and image processing for computational biomedical imaging

- Ultrasound imaging
- Inverse problems
- Image formation and reconstruction
- Multidimensional signal processing
- Motion estimation and image registration
- Machine learning

Short Bio

Adrian Basarab received the M.S. and PhD degrees in signal and image processing from the National Institute for Applied Sciences of Lyon, France, in 2005 and 2008. Since 2009 (respectively 2016) he is assistant (respectively associate) professor at the **University Paul Sabatier Toulouse 3** and a member of IRIT laboratory (UMR CNRS 5505).

His research interests include medical imaging and more particularly inverse problems (deconvolution, super-resolution, compressive sampling, beamforming, image registration and fusion) applied to ultrasound image formation, ultrasound elastography, cardiac ultrasound quantitative acoustic microscopy computed tomography and magnetic resonance imaging.

Adrian Basarab is currently associate editor for Digital Signal Processing (Elsevier) and was a member of the French National Council of Universities Section 61 - Computer sciences, Automatic Control and Signal Processing from 2010 to 2015. In 2017, he was **guest editor** (with Y. Eldar - Technion and H. Liebgott - University of Lyon) for the **IEEE TUFFC special issue** on "Sparsity driven methods in medical ultrasound". Since 2018, he is the **head of Computational Imaging and Vision research group** of IRIT laboratory.

Positions

2016	*Associate professor*, University of Toulouse
2009	*Assistant Professor*, University of Toulouse
2008	*Postdoctoral position*, Catholic University of Leuven, Belgium
2008	*Assistant Professor*, University of Lyon, France

Qualifications

2016	*Habilitation to conduct researches*, A few inverse problems in ultrasound imaging, University of Toulouse
2008	*PhD Thesis*, Motion estimation in ultrasound imaging, INSA-Lyon
2005	*Post-graduate degree* in computer science and signal and image processing, INSA-Lyon

Editorial experience

Guest editor (with Y. Eldar - Technion and H. Liebgott - University of Lyon) for IEEE TUFFC special issue on "Sparsity driven methods in medical ultrasound", 2017
Associate Editor of Digital Signal Processing (Elsevier)

Publications

31 journal publications with peer review
5 book chapters
More than 80 communications at international conferences (including 10 invited talks)
1 French patent

Complete List of Published Work:

https://www.irit.fr/-Publications-?code=6347&nom=Basarab%20Adrian

Google scholar profile:

https://scholar.google.fr/citations?hl=fr&user=I2CCHb0AAAAJ

Organized events

Co-organizer of IEEE ICASSP 2017 special session on "Inverse Problems in Ultrasound Imaging: Recent Advances and Opportunities"

Co-organizer of EUSIPCO 2016 special session on "Recent advances in medical image restoration"

Co-organizer of EUSIPCO 2015 special session on "Recent advances in biomedical signal and image processing"

Co-organizer and chair of CFA 2014 special session on "Compressed acquisition in acoustics"

Co-organizer and chair of IEEE ISBI 2013 special session on "Sparse Representations and Compressed Sensing in Medical Ultrasound Imaging"

Member of the local committee of CIMI workshop "Optimization and Statistics in Image Processing", 24 - 28 June 2013, Toulouse.

Honors

Among the winners (joint work with T. Szasz) of "Plane wave imaging challenge in ultrasound imaging", IEEE Ultrasonics Symposium, Tours, 2016

Paul Calas award (joint work with J. Michetti), French Society of Endodontics, 2016

Best student paper finalist (joint work with Z. Chen and D. Kouamé), IEEE Ultrasonics Symposium, Taiwan, 2015

Co-supervisor of junior researchers

6 **ongoing** PhD thesis, including 5 thesis on ultrasound imaging

6 PhD thesis in signal and image processing applied to ultrasound imaging **defended** (2013-2018)

18 Post-graduate students (Image and signal processing)

Funding

PI

2018-2020	1 Stic AmSud grant with PUCP (Lima) and UIS (Bucaramanga) (20k€)
2016-2017	1 national grant (30k€)
2011-2018	6 local grants (70k€), founded by the University of Toulouse

Partner

2018-2022	French national funding (257 kEuros), PI: H. Wendt, University of Toulouse
2017-2018	1 industrial grant from Airbus (150k€)
2011-2014	1 national grant (205k€), PI: H. Liebgott, University of Lyon
2011-2014	1 regional grant (110k€), PI: D. Kouamé, University of Toulouse

Research collaborations (with recent joint publications)

H. Liebgott - University of Lyon (France)

J. Mamou - Riverside Research Institute (USA)

M. Gyongy - Pázmány Péter Catholic University (Hungary)

A. Achim - University of Bristol (UK)

J.-M. Girault - University of Tours (France)

P. Tsakalides - University of Crete (Greece)

D. Kouamé - University of Toulouse (France)

J.-Y. Tourneret - University of Toulouse (France)

Scientific and administrative responsibility

Since 2017	Direction of the Computational Imaging and Vision research group of IRIT laboratory
Since 2017	Member of the French committee awarding the best PhD thesis in signal and image processing
Since 2016	Co-direction of the Computer Science in Health Activities team of IRIT laboratory
Since 2015	Associate Editor for Digital Signal Processing journal
2012-2015	Member of the French National Council of Universities (signal and image processing division) of the French Minister of Higher Education and Research

Referee

Referee for IEEE Trans. on Ultrasonics, Ferroelectrics and Frequency Control, Ultrasound in Medicine and Biology, Ultrasonics, IEEE Trans. on Image Processing, IEEE Journal of Selected Topics in Signal Processing, IEEE Trans. on Biomedical Imaging, IEEE Trans. on Medical Imaging.

Teaching activities

In charge (with David Vanderhaeghe) of MSc Image & Multimedia, University Paul Sabatier, Toulouse.

Medical Imaging (Graduate): ultrasound, MRI, tomographic reconstruction
Image Processing (Graduate): image segmentation, image restoration
Signal Processing (Graduate): sampling, digital filtering, stochastic signal processing, beamforming

Contribution to Science

1. The limited bandwidth of ultrasound transducers and the physical phenomena related to ultrasound wave propagation through human tissues affect the quality of ultrasound images in terms of spatial resolution and contrast. Under the first order Born approximation and the assumption of weak scattering classically assumed for soft tissues, these degradations can be expressed a linear image formation model relating the tissue reflectivity function to the RF acquired data. Recently, our group proposed several methods to invert this model and to successfully recover high quality images better reflecting the tissues than native ultrasound images.

    a. M. I. Florea, **A. Basarab**, D. Kouamé, S. A. Vorobyov, "An axially-variant kernel imaging model applied to ultrasound image reconstruction", IEEE Signal Processing Letters, IEEE, Vol. 25 N. 7, p. 961-965, 2018.
    b. N. Zhao, **A. Basarab**, D. Kouamé, J.-Y. Tourneret, "Joint Segmentation and Deconvolution of Ultrasound Images Using a Hierarchical Bayesian Model based on Generalized Gaussian Priors", IEEE Transactions on Image Processing, Vol. 25, no. 8, p. 3736-3750, 2016.
    c. N. Zhao, Q. Wei, **A. Basarab**, N. Dobigeon, D. Kouamé, J.-Y. Tourneret, "Fast Single Image Super-resolution using a New Analytical Solution for l2-l2Problems", IEEE Transactions on Image Processing, Vol. 25 N. 8, p. 3683-3697, 2016.

2. Recent developments in ultrasound technologies have led to novel acquisition modes such as ultrafast or 3D imaging. While the first, based on plane wave emissions, suffers from lower image quality than standard imaging using focused beams, the second leads to huge amounts of data to be collected and processed. In 2010, our group was among the first to use compressed sensing as a an alternative to existing technologies to decrease the data volume in ultrasound imaging. These pioneer studies have been pursued by several research groups, imposing the concept of sparsity in ultrasound imaging as an important alternative to the well established Gaussian signal processing.

    a. J. Kim, J. Mamou, P. Hill, N. Canagarajah, D. Kouamé, **A. Basarab**, A. Achim, "Approximate Message Passing Reconstruction of Quantitative Acoustic Microscopy Images", IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control, 2018.
    b. Z. Chen, **A. Basarab**, D. Kouamé, "Reconstruction of Enhanced Ultrasound Images From Compressed Measurements Using Simultaneous Direction Method of Multipliers", IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control, Vol. 63 N. 10, p. 1525-1534, 2016.
    c. Z. Chen, **A. Basarab**, D. Kouamé, "Compressive deconvolution in medical ultrasound imaging", IEEE Transactions on Medical Imaging, Vol. 35, no. 3, p. 728-737, 2016.
    d. A. Achim, **A. Basarab**, G. Tzagkarakis, P. Tsakalides and D. Kouamé, "Reconstruction of ultrasound RF echoes modelled as stable random variables", IEEE Transactions on Computational Imaging, Vol. 1, no. 2, p. 86-95, June 2015.
    e. C. Quinsac, **A. Basarab**, D. Kouamé, "Frequency domain compressive sampling for ultrasound imaging", Advances in Acoustics and Vibration, Special issue on Advances in Acoustic Sensing, Imaging, and Signal Processing, Vol. 12, p. 1-16, 2012.

3. Ultrasound beamforming is the art of combining the RF raw signals acquired by multi-element transducers. While delay-ad-sum still remains the most used method due to its real-time capabilities, techniques aiming at improving the quality of beamformed images have received a considerable attention in the literature. During the last three years, I have contributed significantly to this field by introducing a novel beamforming framework in ultrasound imaging, based on solving regularized inverse problems.

a. T. Szasz, **A. Basarab**, D. Kouamé, "Beamforming through regularized inverse problems in ultrasound medical imaging", IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control, Vol. 63 N. 12, p. 2031-2044, 2016.
b. T. Szasz, **A. Basarab**, D. Kouamé, "Strong reflector-based beamforming in ultrasound medical imaging", Ultrasonics, Vol. 66, p. 111-124, 2016.

4. Tissue motion estimation has several medical imaging applications, such as cardiac function assessment or elastography. Since my PhD thesis, I have developed several motion estimation methods. For many years, the main originality of the methods proposed by our group was the use of spatial phase images instead of native ultrasound images. More recently, I have contributed in showing the interest of dictionary learning methods in cardiac motion estimation.

a. N. Ouzir, **A. Basarab**, O. Lairez, J.-Y. Tourneret, "Robust Optical Flow Estimation in Cardiac Ultrasound images Using a Sparse Representation", IEEE Transactions on Medical Imaging, 2018..
b. N. Ouzir, **A. Basarab**, H. Liebgott, B. Harbaoui, J.-Y. Tourneret, "Motion Estimation in Echocardiography Using Sparse Representation and Dictionary Learning", IEEE Transactions on Image Processing, Vol. 27 N. 1, p. 64-77, 2018.
c. L. Wang, **A. Basarab**, P. Girard, P. Croisille, P. Clarysse, P. Delachartre, "Analytic signal phase-based myocardial motion estimation in tagged MRI sequences by a bilinear model and motion compensation", Medical Image Analysis, Vol. 24 N. 1, p. 149-162, 2015.
d. M. Alessandrini, **A. Basarab**, L. Boussel, X. Guo, A. Serusclat, D. Friboulet, D. Kouamé, O. Bernard, H. Liebgott, "A New Technique for the Estimation of Cardiac Motion in Echocardiography Based on Transverse Oscillations: a preliminary evaluation in silico and a feasibility demonstration in vivo", IEEE Transactions on Medical Imaging, Vol. 33 N. 5, p. 1148-1162, 2014.
e. M. Alessandrini, **A. Basarab**, H. Liebgott, O. Bernard, "Myocardial Motion Estimation from Medical Images Using the Monogenic Signal", IEEE Transactions on Image Processing, Vol. 22 N. 3, p. 1084-1095, 2013.

5. Super-resolution in 3D dental computed tomography using deep learning and 3D image segmentation for endodonty.

a. J. Hatvani, A. Basarab, J.-Y. Tourneret, M. Gyongy, D. Kouamé, "A Tensor Factorization Method for 3D Super-Resolution with Application to Dental CT", IEEE Transactions on Medical Imaging, 2018.
b. J. Hatvani, A. Horvath, J. Michetti, **A. Basarab**, D. Kouamé, M. Gyöngy, "Deep Learning-Based Super-Resolution Applied to Dental Computed Tomography", IEEE Transactions on Radiation and Plasma Medical Sciences, 2018.
c. J. Michetti, **A. Basarab**, F. Diemer, D. Kouamé, "Comparison of an adaptive local thresholding method on CBCT and µCT endodontic images", Physics in Medicine and Biology, IOP Science, Bristol - UK, Vol. 63, p. 1-10, 2018.