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MULTIDISCIPLINARY RESEARCH INTERESTS

Signal processing	Real, complex wavelets and multiresolution analysis; Filter banks; Nonseparable multidimensional cases
Approximation theory	Uniform, nonuniform splines; Interpolation, approximation error; Variational approximation problems; Sparse approximation, finite rate of innovation
Statistics	Detection and estimation; Signal/Image denoising, Stein's Unbiased Risk Estimate; Generalized stochastic processes, fractional Brownian motions (fBm)
Modelling	Auditory system, psychoacoustics
Physics	Wave propagation, optics, holography
Applications	Functional Magnetic Resonance Imaging (fMRI); Electro-Encephalography (EEG); Biomedical imaging; Optical Coherence Tomography (OCT)

EDUCATION

1986	“Diplôme d'ingénieur ¹ ” from <i>École Polytechnique</i> ² –Palaiseau, France: strong emphasis on mathematical analysis (integration, distribution theory and statistics) and theoretical physics (quantum mechanics, wave propagation, statistical physics)
1988	“Diplôme d'ingénieur” from <i>École Nationale Supérieure des Télécommunications (ENST)</i> –Paris, France: emphasis on electrical engineering and communications
1996	PhD in electrical engineering from ENST (with highest honours): <i>Fractional Octave Band Iterated Filter Banks—Application to Audio Sound Processing</i> advised by Prof. Pierre DUHAMEL

POSITIONS

2008–present	<i>The Chinese University of Hong Kong</i> : Professor in the <i>Electronic Engineering Department</i>
1998–2007	<i>Swiss Federal Institute of Technology in Lausanne (EPFL)</i> : Project leader, then “Scientific Adjunct” in the <i>Biomedical imaging Laboratory</i> headed by Prof. Michael UNSER; responsible for the mathematical aspects of Image Processing
1988–present	“Ingénieur des Télécommunications” then “Ingénieur en Chef des Télécommunications ³ ” (since 1997) in the French Telecommunication administration, on sabbatical leave since 1998
1994–1998	<i>France Telecom Research & Development</i> –Paris: researcher in audio and image processing within the <i>Groupware and Videotelephony</i> department
1988–1993	<i>France Telecom Research & Development</i> –Paris: researcher in wave propagation (1988–1990) then in signal processing (wavelets, filterbanks) within the <i>Centre de Recherche en Physique de l'Environnement Terrestre et Planétaire</i> ⁴

¹Equivalent to a Master of Science Degree

²The most prestigious higher education institution in France (see <http://en.wikipedia.org/wiki/Polytechnique>)

³Chief Telecommunication Engineer

⁴Research Center in Physics of the Environment of the Earth and the Planets

PROFESSIONAL ACTIVITIES

Associate Editor	<i>IEEE Transactions on Image Processing</i> (2002–2006) <i>IEEE Transactions on Signal Processing</i> (2006–) <i>Elsevier Signal Processing</i> (2008–)
Chair	Program Committee for <i>WavE 2006</i> (Lausanne)
Member	IEEE Signal Processing Society <i>Signal Processing Theory and Methods</i> Technical Committee (2008–) Program Committee for <i>EUSIPCO 2004</i> (Vienna), <i>SPIE Wavelet X</i> , <i>BioMed 2006–2008</i> (Innsbrück), <i>ICIP 2006</i> special session organizer “signal/image reconstruction from sparse measurements” (with P.L. Dragotti and M. Vetterli)
Session Chair	<i>SPIE Wavelet VII</i> and <i>X</i> , <i>Pacific Rim Conference on Mathematics</i> 2001 (Taipeh), <i>International Conference on Superresolution Imaging</i> 2005 (Hong Kong)
Reviewer	Various <i>IEEE Transactions</i> , <i>IEEE conferences</i> , <i>SIAM</i> publications and research grant proposals
Jury	Member of PhD committees

AWARDS

IEEE Signal Processing Society’s 2003 **Best Paper Award** for the article entitled *Wavelets, fractals, and radial basis functions* (with M. Unser) [35, Journal]

IEEE Signal Processing Society’s 2006 **Best Paper Award** for the article entitled *Sampling signals with finite rate of innovation* (with M. Vetterli and P. Marziliano) [33, Journal]

Co-author on ICIP’05 **Best Student Paper Award** for the article entitled *Beyond interpolation: Optimal reconstruction by quasi-interpolation* (with L. Condat and M. Unser) [13, Conference]

TEACHING

1997–1999	Courses on wavelets for undergraduates at ENIC (New School for Communication Engineers in Lille, France)
1998–present	Supervision of undergraduate and Master students Thesis co-adviser for PhD students in the Biomedical Imaging Group
2003–2007	<i>Signals and Systems</i> to Microengineering students and Life-Science students at EPFL
2008	ELE4430 (<i>Digital Image Processing</i>), ELE3310 (<i>Basic Electromagnetic Theory</i>) and ERG3910 (<i>Methodology of Research</i>) to engineering students at CUHK

PERSONAL DATA

French citizen, married, born 18/04/1964

PUBLICATIONS⁵

Patents

- [1] M. Vetterli, P. Marziliano, and T. Blu, “Sampling methods, reconstruction methods and devices for sampling and/or reconstructing signals,” International Patent WO200278197, 2002. *This technology has been transferred to Qualcomm Inc.* (2007).
- [2] T. Blu, M. Unser, P. Thévenaz, and M. Sühling, “Interpolation Method and Apparatus,” International Patent WO2003021474, 2003.

Book Chapters

- [1] T. Blu and J. Lebrun, “Analyse temps-fréquence linéaire II: représentations de type ondelettes,” in *Temps-fréquence, concepts et outils*, F. Hlawatsch and F. Auger, Eds., Traitement du Signal et de l’Image, chapter 4, pp. 101–138. Hermès, Paris, France, 2005, in French.
- [2] T. Blu and J. Lebrun, “Linear time-frequency analysis II: wavelet representations,” in *Time-Frequency Analysis, Concepts and Tools*, F. Hlawatsch and F. Auger, Eds., Digital Signal and Image Processing, chapter 4. ISTE, London, UK, 2007, English translation of [1].
- [3] P. Thévenaz, T. Blu, and M. Unser, “Image interpolation and resampling,” in *Handbook of Medical Imaging, Processing and Analysis*, I.N. Bankman, Ed., chapter 25, pp. 393–420. Academic Press, San Diego CA, USA, 2000.

PhD Thesis

- [1] T. Blu, “Bancs de filtres itérés en fraction d’octave — Application au codage de son,” *PhD dissertation* (Iterated Rational Filter Banks with an Application to Audio Coding), ENST Paris, Nr. 96 E 009 (1996), in French.

Journal Articles

- [1] B. Forster, T. Blu, D. Van De Ville, and M. Unser, “Shift-invariant spaces from rotation-covariant functions,” *Applied and Computational Harmonic Analysis*, 2007, in press.
- [2] S. Ramani, D. Van De Ville, T. Blu, and M. Unser, “Non-ideal sampling and regularization theory,” *IEEE Transactions on Image Processing*, 2007, in press.
- [3] T. Blu and F. Luisier, “The SURE-LET approach to image denoising,” *IEEE Transactions on Image Processing*, vol. 16, no. 11, pp. 2778–2786, November 2007.
- [4] D. Van De Ville, M.L. Seghier, F. Lazeyras, T. Blu, and M. Unser, “WSPM: Wavelet-based statistical parametric mapping,” *NeuroImage*, vol. 37, no. 4, pp. 1205–1217, October 2007.
- [5] C. Vonesch, T. Blu, and M. Unser, “Generalized Daubechies wavelet families,” *IEEE Transactions on Signal Processing*, vol. 55, no. 9, pp. 4415–4429, September 2007.
- [6] P.L. Dragotti, M. Vetterli, and T. Blu, “Sampling moments and reconstructing signals of finite rate of innovation: Shannon meets Strang-Fix,” *IEEE Transactions on Signal Processing*, vol. 55, no. 5, pp. 1741–1757, May 2007, Part 1.
- [7] M. Unser and T. Blu, “Self-similarity: Part I—Splines and operators,” *IEEE Transactions on Signal Processing*, vol. 55, no. 4, pp. 1352–1363, April 2007.
- [8] T. Blu and M. Unser, “Self-similarity: Part II—Optimal estimation of fractal processes,” *IEEE Transactions on Signal Processing*, vol. 55, no. 4, pp. 1364–1378, April 2007.
- [9] F. Luisier, T. Blu, and M. Unser, “A new SURE approach to image denoising: Interscale orthonormal wavelet thresholding,” *IEEE Transactions on Image Processing*, vol. 16, no. 3, pp. 593–606, March 2007.
- [10] B. Bathellier, D. Van De Ville, T. Blu, M. Unser, and A. Carleton, “Wavelet-based multi-resolution statistics for optical imaging signals: Application to automated detection of odour activated glomeruli in the mouse olfactory bulb,” *NeuroImage*, vol. 34, no. 3, pp. 1020–1035, February 1, 2007.

⁵Most papers are freely available at <http://www.ee.cuhk.edu.hk/~tblu/>

- [11] P. Marziliano, M. Vetterli, and T. Blu, “Sampling and exact reconstruction of bandlimited signals with additive shot noise,” *IEEE Transactions on Information Theory*, vol. 52, no. 5, pp. 2230–2233, May 2006.
- [12] D. Van De Ville, T. Blu, and M. Unser, “Surfing the brain—An overview of wavelet-based techniques for fMRI data analysis,” *IEEE Engineering in Medicine and Biology Magazine*, vol. 25, no. 2, pp. 65–78, March-April 2006.
- [13] B. Forster, T. Blu, and M. Unser, “Complex B-Splines,” *Applied and Computational Harmonic Analysis*, vol. 20, no. 2, pp. 261–282, March 2006.
- [14] M. Jacob, T. Blu, C. Vaillant, J.H. Maddocks, and M. Unser, “3-D shape estimation of DNA molecules from stereo cryo-electron micro-graphs using a projection-steerable snake,” *IEEE Transactions on Image Processing*, vol. 15, no. 1, pp. 214–227, January 2006.
- [15] D. Van De Ville, T. Blu, and M. Unser, “Isotropic polyharmonic B-Splines: Scaling functions and wavelets,” *IEEE Transactions on Image Processing*, vol. 14, no. 11, pp. 1798–1813, November 2005.
- [16] F. Precioso, M. Barlaud, T. Blu, and M. Unser, “Robust real-time segmentation of images and videos using a smooth-spline snake-based algorithm,” *IEEE Transactions on Image Processing*, vol. 14, no. 7, pp. 910–924, July 2005.
- [17] M. Unser and T. Blu, “Generalized smoothing splines and the optimal discretization of the Wiener filter,” *IEEE Transactions on Signal Processing*, vol. 53, no. 6, pp. 2146–2159, June 2005.
- [18] M. Unser and T. Blu, “Cardinal exponential splines: Part I—Theory and filtering algorithms,” *IEEE Transactions on Signal Processing*, vol. 53, no. 4, pp. 1425–1438, April 2005.
- [19] D. Van De Ville, T. Blu, and M. Unser, “On the multidimensional extension of the quincunx sub-sampling matrix,” *IEEE Signal Processing Letters*, vol. 12, no. 2, pp. 112–115, February 2005.
- [20] D. Van De Ville, T. Blu, and M. Unser, “Integrated wavelet processing and spatial statistical testing of fMRI data,” *NeuroImage*, vol. 23, no. 4, pp. 1472–1485, December 2004.
- [21] M. Jacob, T. Blu, and M. Unser, “Efficient energies and algorithms for parametric snakes,” *IEEE Transactions on Image Processing*, vol. 13, no. 9, pp. 1231–1244, September 2004.
- [22] D. Van De Ville, T. Blu, M. Unser, W. Philips, I. Lemahieu, and R. Van de Walle, “Hex-splines: A novel spline family for hexagonal lattices,” *IEEE Transactions on Image Processing*, vol. 13, no. 6, pp. 758–772, June 2004.
- [23] T. Blu, P. Thévenaz, and M. Unser, “Linear interpolation revitalized,” *IEEE Transactions on Image Processing*, vol. 13, no. 5, pp. 710–719, May 2004.
- [24] M. Liebling, T. Blu, and M. Unser, “Complex-wave retrieval from a single off-axis hologram,” *Journal of the Optical Society of America A*, vol. 21, no. 3, pp. 367–377, March 2004.
- [25] T. Blu, P. Thévenaz, and M. Unser, “Complete parameterization of piecewise-polynomial interpolation kernels,” *IEEE Transactions on Image Processing*, vol. 12, no. 11, pp. 1297–1309, November 2003.
- [26] M. Unser and T. Blu, “Mathematical properties of the JPEG2000 wavelet filters,” *IEEE Transactions on Image Processing*, vol. 12, no. 9, pp. 1080–1090, September 2003.
- [27] M. Unser and T. Blu, “Wavelet theory demystified,” *IEEE Transactions on Signal Processing*, vol. 51, no. 2, pp. 470–483, February 2003.
- [28] K. Ichige, T. Blu, and M. Unser, “A study on spline functions and their applications to digital signal and image processing,” *The Telecommunications Advancement Foundation*, vol. 18, no. 7(1), pp. 358–365, January 2003.
- [29] M. Liebling, T. Blu, and M. Unser, “Fresnelets: New multiresolution wavelet bases for digital holography,” *IEEE Transactions on Image Processing*, vol. 12, no. 1, pp. 29–43, January 2003.
- [30] J. Kybic, T. Blu, and M. Unser, “Generalized sampling: A variational approach—Part II: Applications,” *IEEE Transactions on Signal Processing*, vol. 50, no. 8, pp. 1977–1985, August 2002.
- [31] J. Kybic, T. Blu, and M. Unser, “Generalized sampling: A variational approach—Part I: Theory,” *IEEE Transactions on Signal Processing*, vol. 50, no. 8, pp. 1965–1976, August 2002.

- [32] A. Muñoz Barrutia, T. Blu, and M. Unser, “ ℓ_p -Multiresolution analysis: How to reduce ringing and sparsify the error,” *IEEE Transactions on Image Processing*, vol. 11, no. 6, pp. 656–669, June 2002.
- [33] M. Vetterli, P. Marziliano, and T. Blu, “Sampling signals with finite rate of innovation,” *IEEE Transactions on Signal Processing*, vol. 50, no. 6, pp. 1417–1428, June 2002, IEEE Signal Processing Society’s 2006 **best paper award**.
- [34] M. Jacob, T. Blu, and M. Unser, “Sampling of periodic signals: A quantitative error analysis,” *IEEE Transactions on Signal Processing*, vol. 50, no. 5, pp. 1153–1159, May 2002.
- [35] T. Blu and M. Unser, “Wavelets, fractals, and radial basis functions,” *IEEE Transactions on Signal Processing*, vol. 50, no. 3, pp. 543–553, March 2002, IEEE Signal Processing Society’s 2003 **best paper award**.
- [36] A. Muñoz Barrutia, T. Blu, and M. Unser, “Least-squares image resizing using finite differences,” *IEEE Transactions on Image Processing*, vol. 10, no. 9, pp. 1365–1378, September 2001.
- [37] T. Blu, P. Thévenaz, and M. Unser, “MOMS: Maximal-order interpolation of minimal support,” *IEEE Transactions on Image Processing*, vol. 10, no. 7, pp. 1069–1080, July 2001.
- [38] M. Jacob, T. Blu, and M. Unser, “An exact method for computing the area moments of wavelet and spline curves,” *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 23, no. 6, pp. 633–642, June 2001.
- [39] P. Thévenaz, T. Blu, and M. Unser, “Interpolation revisited,” *IEEE Transactions on Medical Imaging*, vol. 19, no. 7, pp. 739–758, July 2000.
- [40] M. Unser and T. Blu, “Fractional splines and wavelets,” *SIAM Review*, vol. 42, no. 1, pp. 43–67, March 2000.
- [41] T. Blu and M. Unser, “Quantitative Fourier analysis of approximation techniques: Part II—Wavelets,” *IEEE Transactions on Signal Processing*, vol. 47, no. 10, pp. 2796–2806, October 1999.
- [42] T. Blu and M. Unser, “Quantitative Fourier analysis of approximation techniques: Part I—Interpolators and projectors,” *IEEE Transactions on Signal Processing*, vol. 47, no. 10, pp. 2783–2795, October 1999.
- [43] T. Blu and M. Unser, “Approximation error for quasi-interpolators and (multi-) wavelet expansions,” *Applied and Computational Harmonic Analysis*, vol. 6, no. 2, pp. 219–251, March 1999.
- [44] P. Blanc, T. Blu, T. Ranchin, L. Wald, and R. Aloisi, “Using iterated rational filter banks within the ARSIS concept for producing 10 m Landsat multispectral images,” *International Journal of Remote Sensing*, vol. 19, no. 12, pp. 2331–2343, August 1998.
- [45] T. Blu, “A new design algorithm for two-band orthonormal rational filter banks and orthonormal rational wavelets,” *IEEE Transactions on Signal Processing*, vol. 46, no. 6, pp. 1494–1504, June 1998.
- [46] T. Blu, “Iterated filter banks with rational rate changes connection with discrete wavelet transforms,” *IEEE Transactions on Signal Processing*, vol. 41, no. 12, pp. 3232–3244, December 1993.

Conference Articles

- [1] D. Kandaswamy, T. Blu, and D. Van De Ville, “Analytic sensing: Direct recovery of point sources from planar Cauchy boundary measurements,” in *Proceedings of the SPIE Conference on Mathematical Methods: Wavelet XII*, San Diego CA, USA, August 26-30, 2007, vol. 6701, in press.
- [2] I. Khalidov, D. Van De Ville, T. Blu, and M. Unser, “Construction of wavelet bases that mimic the behaviour of some given operator,” in *Proceedings of the SPIE Conference on Mathematical Methods: Wavelet XII*, San Diego CA, USA, August 26-30, 2007, vol. 6701, in press.
- [3] F. Luisier and T. Blu, “SURE-LET interscale-intercolor wavelet thresholding for color image denoising,” in *Proceedings of the SPIE Conference on Mathematical Methods: Wavelet XII*, San Diego CA, USA, August 26-30, 2007, vol. 6701, in press.
- [4] D. Van De Ville, B. Bathellier, A. Carleton, T. Blu, and M. Unser, “Wavelet-based statistical analysis for optical imaging in mouse olfactory bulb,” in *Proceedings of the Fourth IEEE International Symposium on Biomedical Imaging: From Nano to Macro (ISBI’07)*, Arlington VA, USA, April 12-15, 2007, pp. 448–451.

- [5] S.C. Sekhar, R.A. Leitgeb, M.L. Villiger, A.H. Bachmann, T. Blu, and M. Unser, “Non-iterative exact signal recovery in frequency domain optical coherence tomography,” in *Proceedings of the Fourth IEEE International Symposium on Biomedical Imaging: From Nano to Macro (ISBI’07)*, Arlington VA, USA, April 12-15, 2007, pp. 808–811.
- [6] F. Luisier and T. Blu, “Image denoising by pointwise thresholding of the undecimated wavelet coefficients: A global SURE optimum,” in *Proceedings of the Thirty-Second IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP’07)*, Honolulu HI, USA, April 15-20, 2007, pp. I-593–I-596.
- [7] S.C. Sekhar, H. Nazkani, T. Blu, and M. Unser, “A new technique for high-resolution frequency domain optical coherence tomography,” in *Proceedings of the Thirty-Second IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP’07)*, Honolulu HI, USA, April 15-20, 2007, pp. I-425–I-428.
- [8] F. Luisier, T. Blu, and M. Unser, “SURE-based wavelet thresholding integrating inter-scale dependencies,” in *Proceedings of the 2006 IEEE International Conference on Image Processing (ICIP’06)*, Atlanta GA, USA, October 8-11, 2006, pp. 1457–1460.
- [9] D. Van De Ville, B. Bathellier, R. Accolla, A. Carleton, T. Blu, and M. Unser, “Wavelet-based detection of stimulus responses in time-lapse microscopy,” in *Proceedings of the Thirty-First IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP’06)*, Toulouse, France, May 14-19, 2006, pp. V-1161–V-1164.
- [10] D. Van De Ville, T. Blu, and M. Unser, “WSPM or how to obtain statistical parametric maps using shift-invariant wavelet processing,” in *Proceedings of the Thirty-First IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP’06)*, Toulouse, France, May 14-19, 2006, pp. V-1101–V-1104.
- [11] T. Blu and M. Unser, “Optimal interpolation of fractional Brownian motion given its noisy samples,” in *Proceedings of the Thirty-First IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP’06)*, Toulouse, France, May 14-19, 2006, pp. III-860–III-863.
- [12] L. Condat, D. Van De Ville, and T. Blu, “Hexagonal versus orthogonal lattices: A new comparison using approximation theory,” in *Proceedings of the 2005 IEEE International Conference on Image Processing (ICIP’05)*, Genova, Italy, September 11-14, 2005, vol. III, pp. 1116–1119.
- [13] L. Condat, T. Blu, and M. Unser, “Beyond interpolation: Optimal reconstruction by quasi-interpolation,” in *Proceedings of the 2005 IEEE International Conference on Image Processing (ICIP’05)*, Genova, Italy, September 11-14, 2005, vol. I, pp. 33–36, **Best student paper award**.
- [14] C. Vonesch, T. Blu, and M. Unser, “Generalized biorthogonal Daubechies wavelets,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet XI*, San Diego CA, USA, July 31-August 3, 2005, vol. 5914, pp. 59141X-1–59141X-6.
- [15] I. Khalidov, T. Blu, and M. Unser, “Generalized l-spline wavelet bases,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet XI*, San Diego CA, USA, July 31-August 3, 2005, vol. 5914, pp. 59140F-1–59140F-8.
- [16] F. Luisier, T. Blu, B. Forster, and M. Unser, “Which wavelet bases are the best for image denoising?,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet XI*, San Diego CA, USA, July 31-August 3, 2005, vol. 5914, pp. 59140E-1–59140E-12.
- [17] D. Van De Ville, T. Blu, B. Forster, and M. Unser, “Semi-orthogonal wavelets that behave like fractional differentiators,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet XI*, San Diego CA, USA, July 31-August 3, 2005, vol. 5914, pp. 59140C-1–59140C-8.
- [18] C. Vonesch, T. Blu, and M. Unser, “Generalized daubechies wavelets,” in *Proceedings of the Thirtieth International Conference on Acoustics, Speech, and Signal Processing (ICASSP’05)*, Philadelphia PA, USA, March 18-23, 2005, vol. IV, pp. 593–596.
- [19] M. Jacob, T. Blu, and M. Unser, “Shape estimation of 3-D DNA molecules from stereo cryo-electron micro-graphs,” in *Proceedings of the 2004 IEEE International Conference on Image Processing (ICIP’04)*, Singapore, Singapore, October 24-27, 2004, pp. 1883–1886.
- [20] D. Van De Ville, T. Blu, B. Forster, and M. Unser, “Isotropic-polyharmonic B-Splines and wavelets,” in *Proceedings of the 2004 IEEE International Conference on Image Processing (ICIP’04)*, Singapore, Singapore, October 24-27, 2004, pp. 661–664.

- [21] T. Blu, P. Thévenaz, and M. Unser, “High-quality causal interpolation for online unidimensional signal processing,” in *Proceedings of the Twelfth European Signal Processing Conference (EUSIPCO’04)*, Wien, Austria, September 6-10, 2004, pp. 1417–1420.
- [22] T. Blu and M. Unser, “Quantitative L^2 approximation error of a probability density estimate given by its samples,” in *Proceedings of the Twenty-Ninth International Conference on Acoustics, Speech, and Signal Processing (ICASSP’04)*, Montréal QC, CA, May 17-21, 2004, vol. III, pp. 952–955.
- [23] D. Van De Ville, T. Blu, and M. Unser, “Wavelet-based fMRI statistical analysis and spatial interpretation: A unifying approach,” in *Proceedings of the Second 2004 IEEE International Symposium on Biomedical Imaging: From Nano to Macro (ISBI’04)*, Arlington VA, USA, April 15-18, 2004, pp. 1167–1170.
- [24] F. Precioso, M. Barlaud, T. Blu, and M. Unser, “Smoothing B-Spline active contour for fast and robust image and video segmentation,” in *Proceedings of the 2003 IEEE International Conference on Image Processing (ICIP’03)*, Barcelona, Spain, September 14-17, 2003, vol. I, pp. 137–140.
- [25] M. Liebling, T. Blu, and M. Unser, “Non-linear Fresnel approximation for interference term suppression in digital holography,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing X*, San Diego CA, USA, August 3-8, 2003, vol. 5207, pp. 553–559, Part II.
- [26] B. Forster, T. Blu, and M. Unser, “A new family of complex rotation-covariant multiresolution bases in 2D,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing X*, San Diego CA, USA, August 3-8, 2003, vol. 5207, pp. 475–479, Part I.
- [27] D. Van De Ville, T. Blu, and M. Unser, “Wavelets versus resels in the context of fMRI: Establishing the link with SPM,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing X*, San Diego CA, USA, August 3-8, 2003, vol. 5207, pp. 417–425, Part I.
- [28] K. Ichige, T. Blu, and M. Unser, “Multiwavelet-like bases for high quality image interpolation,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing X*, San Diego CA, USA, August 3-8, 2003, vol. 5207, pp. 153–161, Part I.
- [29] M. Unser and T. Blu, “Fractional wavelets, derivatives, and Besov spaces,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing X*, San Diego CA, USA, August 3-8, 2003, vol. 5207, pp. 147–152, Part I.
- [30] T. Blu and M. Unser, “Harmonic spline series representation of scaling functions,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing X*, San Diego CA, USA, August 3-8, 2003, vol. 5207, pp. 120–124, Part I.
- [31] M. Liebling, T. Blu, É. Cuche, P. Marquet, C.D. Depeursinge, and M. Unser, “Local amplitude and phase retrieval method for digital holography applied to microscopy,” in *Proceedings of the SPIE European Conference on Biomedical Optics: Novel Optical Instrumentation for Biomedical Applications (ECBO’03)*, A.-M. Boccara, Ed., München, Germany, June 22-25, 2003, vol. 5143, pp. 210–214.
- [32] D. Van De Ville, T. Blu, and M. Unser, “On the approximation power of splines: Orthogonal versus hexagonal lattices,” in *Proceedings of the Fifth International Workshop on Sampling Theory and Applications (SampTA’03)*, Strobl, Austria, May 26-30, 2003, pp. 109–111.
- [33] R. van Spaendonck, T. Blu, R. Baraniuk, and M. Vetterli, “Orthogonal Hilbert transform filter banks and wavelets,” in *Proceedings of the Twenty-Eighth International Conference on Acoustics, Speech, and Signal Processing (ICASSP’03)*, Hong Kong SAR, People’s Republic of China, April 6-10, 2003, vol. VI, pp. 505–508.
- [34] T. Blu and M. Unser, “A complete family of scaling functions: The (α, τ) -fractional splines,” in *Proceedings of the Twenty-Eighth International Conference on Acoustics, Speech, and Signal Processing (ICASSP’03)*, Hong Kong SAR, People’s Republic of China, April 6-10, 2003, vol. VI, pp. 421–424.
- [35] K. Ichige, T. Blu, and M. Unser, “Interpolation of signals by generalized piecewise-linear multiple generators,” in *Proceedings of the Twenty-Eighth International Conference on Acoustics, Speech, and Signal Processing (ICASSP’03)*, Hong Kong SAR, People’s Republic of China, April 6-10, 2003, vol. VI, pp. 261–264.

- [36] D. Van De Ville, T. Blu, and M. Unser, “Recursive filtering for splines on hexagonal lattices,” in *Proceedings of the Twenty-Eighth International Conference on Acoustics, Speech, and Signal Processing (ICASSP’03)*, Hong Kong SAR, People’s Republic of China, April 6-10, 2003, vol. III, pp. 301–304.
- [37] T. Blu, P. Thévenaz, and M. Unser, “How a simple shift can significantly improve the performance of linear interpolation,” in *Proceedings of the 2002 IEEE International Conference on Image Processing (ICIP’02)*, Rochester NY, USA, September 22-25, 2002, vol. III, pp. 377–380.
- [38] T. Blu, H. Bay, and M. Unser, “A new high-resolution processing method for the deconvolution of optical coherence tomography signals,” in *Proceedings of the First 2002 IEEE International Symposium on Biomedical Imaging: Macro to Nano (ISBI’02)*, Washington DC, USA, July 7-10, 2002, vol. III, pp. 777–780.
- [39] M. Liebling, T. Blu, É. Cuche, P. Marquet, C. Depeursinge, and M. Unser, “A novel non-diffractive reconstruction method for digital holographic microscopy,” in *Proceedings of the First 2002 IEEE International Symposium on Biomedical Imaging: Macro to Nano (ISBI’02)*, Washington DC, USA, July 7-10, 2002, vol. II, pp. 625–628.
- [40] M. Jacob, T. Blu, and M. Unser, “3-D reconstruction of DNA filaments from stereo cryo-electron micrographs,” in *Proceedings of the First 2002 IEEE International Symposium on Biomedical Imaging: Macro to Nano (ISBI’02)*, Washington DC, USA, July 7-10, 2002, vol. II, pp. 597–600.
- [41] M. Liebling, T. Blu, and M. Unser, “Fresnelets—A new wavelet basis for digital holography,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing IX*, San Diego CA, USA, July 29-August 1, 2001, vol. 4478, pp. 347–352.
- [42] M. Unser and T. Blu, “Why restrict ourselves to compactly supported basis functions?,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing IX*, San Diego CA, USA, July 29-August 1, 2001, vol. 4478, pp. 311–314.
- [43] M. Vetterli, P. Marziliano, and T. Blu, “Sampling discrete-time piecewise bandlimited signals,” in *Proceedings of the Fourth International Conference on Sampling Theory and Applications (SampTA’01)*, Orlando FL, USA, May 13-17, 2001, pp. 97–102.
- [44] J. Kybic, T. Blu, and M. Unser, “Generalized sampling: A variational approach,” in *Proceedings of the Fourth International Conference on Sampling Theory and Applications (SampTA’01)*, Orlando FL, USA, May 13-17, 2001, pp. 151–154.
- [45] M. Jacob, T. Blu, and M. Unser, “An error analysis for the sampling of periodic signals,” in *Proceedings of the Fourth International Conference on Sampling Theory and Applications (SampTA’01)*, Orlando FL, USA, May 13-17, 2001, pp. 45–48.
- [46] M. Vetterli, P. Marziliano, and T. Blu, “A sampling theorem for periodic piecewise polynomial signals,” in *Proceedings of the Twenty-Sixth International Conference on Acoustics, Speech, and Signal Processing (ICASSP’01)*, Salt Lake City UT, USA, May 7-11, 2001, vol. 6, pp. 3893–3896.
- [47] M. Jacob, T. Blu, and M. Unser, “A unifying approach and interface for spline-based snakes,” in *Progress in Biomedical Optics and Imaging, vol. 2, no. 27*, M. Sonka and K.M. Hanson, Eds., San Diego CA, USA, February 19-22, 2001, vol. 4322 of *Proceedings of the SPIE International Symposium on Medical Imaging: Image Processing (MI’01)*, pp. 340–347, Part I.
- [48] J. Kybic, T. Blu, and M. Unser, “Variational approach to tomographic reconstruction,” in *Progress in Biomedical Optics and Imaging, vol. 2, no. 27*, M. Sonka and K.M. Hanson, Eds., San Diego CA, USA, February 19-22, 2001, vol. 4322 of *Proceedings of the SPIE International Symposium on Medical Imaging: Image Processing (MI’01)*, pp. 30–39, Part I.
- [49] P. Thévenaz, T. Blu, and M. Unser, “Complete parametrization of piecewise-polynomial interpolators according to degree, support, regularity, and order,” in *Proceedings of the 2000 IEEE International Conference on Image Processing (ICIP’00)*, Vancouver BC, Canada, September 10-13, 2000, vol. II, pp. 335–338.
- [50] M. Unser, S. Horbelt, and T. Blu, “Fractional derivatives, splines and tomography,” in *Proceedings of the Tenth European Signal Processing Conference (EUSIPCO’00)*, Tampere, Finland, September 4-8, 2000, vol. IV, pp. 2017–2020.
- [51] M. Feilner, T. Blu, and M. Unser, “Analysis of fMRI data using spline wavelets,” in *Proceedings of the Tenth European Signal Processing Conference (EUSIPCO’00)*, Tampere, Finland, September 4-8, 2000, vol. IV, pp. 2013–2016.

- [52] A. Muñoz Barrutia, T. Blu, and M. Unser, “Non-uniform to uniform grid conversion using least-squares splines,” in *Proceedings of the Tenth European Signal Processing Conference (EUSIPCO’00)*, Tampere, Finland, September 4-8, 2000, vol. IV, pp. 1997–2000.
- [53] M. Jacob, T. Blu, and M. Unser, “Exact computation of area moments for spline and wavelet curves,” in *Proceedings of the Fifteenth International Conference on Pattern Recognition (ICPR’00)*, Barcelona, Spain, September 3-8, 2000, vol. III, pp. 131–134.
- [54] M. Feilner, T. Blu, and M. Unser, “Optimizing wavelets for the analysis of fMRI data,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing VIII*, San Diego CA, USA, July 31-August 4, 2000, vol. 4119, pp. 626–637.
- [55] A. Muñoz Barrutia, T. Blu, and M. Unser, “Non-Euclidean pyramids,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing VIII*, San Diego CA, USA, July 31-August 4, 2000, vol. 4119, pp. 710–720.
- [56] M. Unser and T. Blu, “Wavelets and radial basis functions: A unifying perspective,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing VIII*, San Diego CA, USA, July 31-August 4, 2000, vol. 4119, pp. 487–493.
- [57] S. Horbelt, A. Muñoz Barrutia, T. Blu, and M. Unser, “Spline kernels for continuous-space image processing,” in *Proceedings of the Twenty-Fifth IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP’00)*, Istanbul, Turkey, June 5-9, 2000, vol. IV, pp. 2191–2194.
- [58] T. Blu and M. Unser, “The fractional spline wavelet transform: Definition and implementation,” in *Proceedings of the Twenty-Fifth IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP’00)*, Istanbul, Turkey, June 5-9, 2000, vol. I, pp. 512–515.
- [59] T. Blu, P. Thévenaz, and M. Unser, “Generalized interpolation: Higher quality at no additional cost,” in *Proceedings of the 1999 IEEE International Conference on Image Processing (ICIP’99)*, Kobe, Japan, October 25-28, 1999, vol. III, pp. 667–671.
- [60] A. Muñoz Barrutia, T. Blu, and M. Unser, “Efficient image resizing using finite differences,” in *Proceedings of the 1999 IEEE International Conference on Image Processing (ICIP’99)*, Kobe, Japan, October 25-28, 1999, vol. III, pp. 662–666.
- [61] M. Feilner, T. Blu, and M. Unser, “Statistical analysis of fMRI data using orthogonal filterbanks,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing VII*, Denver CO, USA, July 19-23, 1999, vol. 3813, pp. 551–560.
- [62] M. Unser and T. Blu, “Construction of fractional spline wavelet bases,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing VII*, Denver CO, USA, July 19-23, 1999, vol. 3813, pp. 422–431.
- [63] T. Blu and M. Unser, “A theoretical analysis of the projection error onto discrete wavelet subspaces,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing VII*, Denver CO, USA, July 19-23, 1999, vol. 3813, pp. 273–281.
- [64] T. Blu, P. Thévenaz, and M. Unser, “Minimum support interpolators with optimum approximation properties,” in *Proceedings of the 1998 IEEE International Conference on Image Processing (ICIP’98)*, Chicago IL, USA, October 4-7, 1998, vol. III, pp. 242–245.
- [65] S. Matusiak, M. Daoudi, T. Blu, and O. Avaro, “Sketch-based images database retrieval,” in *Proceedings of the Fourth International Workshop on Advances in Multimedia Information Systems (MIS’98)*, Istanbul, Turkey, September 24-26, 1998, pp. 185–191.
- [66] M. Unser and T. Blu, “Comparison of wavelets from the point of view of their approximation error,” in *Proceedings of the SPIE Conference on Mathematical Imaging: Wavelet Applications in Signal and Image Processing VI*, San Diego CA, USA, July 19-24, 1998, vol. 3458, pp. 14–21.
- [67] L. Peyronny, O. Soligon, C. Roux, O. Avaro, and T. Blu, “How to construct an MPEG4 API: A videoconference application example,” in *Proceedings of the International Conference on Image and Multidimensional Digital Signal Processing (IMDSP’98)*, Alpbach, Austria, July 16, 1998, pp. 111–114.
- [68] T. Blu and M. Unser, “Quantitative L^2 error analysis for interpolation methods and wavelet expansions,” in *Proceedings of the 1997 IEEE International Conference on Image Processing (ICIP’97)*, Santa Barbara CA, USA, October 26-29, 1997, vol. I, pp. 663–666.

- [69] T. Blu, “Shift error in iterated rational filter banks,” in *Proceedings of the Eighth European Signal Processing Conference (EUSIPCO’96)*, Trieste, Italy, September 10-13, 1996, vol. II, pp. 1199–1202.
- [70] T. Blu, “An iterated rational filter bank for audio coding,” in *Proceedings of the Third IEEE Signal Processing Society International Symposium on Time-Frequency and Time-Scale Analysis (IEEE-SP’96)*, Paris, France, June 18-21, 1996, pp. 81–84.
- [71] T. Blu and O. Rioul, “Wavelet regularity of iterated filter banks with rational sampling changes,” in *Proceedings of the Eighteenth IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP’93)*, Minneapolis MN, USA, April 27-30, 1993, vol. III, pp. 213–216.
- [72] T. Blu, “Iterated rational filter banks—Underlying limit functions,” in *Proceedings of the IEEE Signal Processing Society Digital Signal Processing Workshop*, Utica IL, USA, September 13-16, 1992, pp. 1.8.1–1.8.2.
- [73] S. Mayrargue and T. Blu, “Relationship between high-resolution methods and discrete Fourier transform,” in *Proceedings of the Sixteenth IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’91)*, Toronto ON, Canada, May 14-17, 1991, vol. V, pp. 3321–3324.

Conference Abstracts

- [1] D. Van De Ville, M. Seghier, F. Lazeyras, T. Blu, and M. Unser, “Empirical sensitivity, specificity, and bias of wavelet-based statistical parametric mapping (WSPM),” in *Thirteenth Annual Meeting of the Organization for Human Brain Mapping (HBM’07)*, Chicago IL, USA, June 10-14, 2007, CD-ROM paper no. 336 TH PM.
- [2] D. Van De Ville, M. Seghier, F. Lazeyras, T. Blu, and M. Unser, “Wavelet-based statistical analysis of fMRI data with high spatial resolution,” in *CHUV Research Day (CHUV’07)*, Lausanne VD, Switzerland, February 1, 2007, p. 185.
- [3] D. Van De Ville, T. Blu, B. Forster, and M. Unser, “Polyharmonic B-Spline wavelets: From isotropy to directionality,” in *Advanced Concepts for Intelligent Vision Systems (ACIVS’06)*, Antwerp, Belgium, September 18-21, 2006, Invited talk.
- [4] D. Van De Ville, M. Seghier, F. Lazeyras, M. Pelizzone, T. Blu, and M. Unser, “SPM versus WSPM: Sensitivity and specificity for multi-session fMRI data,” in *Twelfth Annual Meeting of the Organization for Human Brain Mapping (HBM’06)*, Florence, Italy, June 11-15, 2006, p. S94, Invited talk.
- [5] D. Van De Ville, T. Blu, and M. Unser, “WSPM: A new approach for wavelet-based statistical analysis of fMRI data,” in *Eleventh Annual Meeting of the Organization for Human Brain Mapping (HBM’05)*, Toronto ON, Canada, June 12-16, 2005, p. S17.
- [6] R.V.V.L. Langoju, T. Blu, and M. Unser, “Resolution enhancement in optical coherence tomography,” in *2004 Annual Meeting of the Swiss Society of Biomedical Engineering (SSBE’04)*, Zürich ZH, Switzerland, September 2-3, 2004, poster 9.
- [7] B. Forster, T. Blu, and M. Unser, “Complex B-Splines and wavelets,” in *Second International Conference on Computational Harmonic Analysis, Nineteenth Annual Shanks Lecture (CHA’04)*, Nashville TN, USA, May 24-30, 2004.
- [8] M. Unser and T. Blu, “A unifying spline formulation for stochastic signal processing [Or how Schoenberg meets Wiener, with the help of Tikhonov],” in *Second International Conference on Computational Harmonic Analysis, Nineteenth Annual Shanks Lecture (CHA’04)*, Nashville TN, USA, May 24-30, 2004, Plenary talk.
- [9] D. Van De Ville, T. Blu, and M. Unser, “Wspm: Wavelet processing and the analysis of fMRI using statistical parametric maps,” in *Second International Conference on Computational Harmonic Analysis, Nineteenth Annual Shanks Lecture (CHA’04)*, Nashville TN, USA, May 24-30, 2004, Invited talk.
- [10] M. Unser and T. Blu, “The spline foundation of wavelet theory,” in *International Conference on Wavelets and Splines (EIMI-WS’03)*, Saint Petersburg, Russia, July 3-8, 2003, Petersburg Department of Steklov Institute of Mathematics, Euler International Mathematical Institute, pp. 98–99.
- [11] C. Depeursinge, É. Cuche, T. Colomb, P. Massatch, A. Marian, F. Montfort, M. Liebling, T. Blu, M. Unser, P. Marquet, and P.J. Magistretti, “Digital holography applied to microscopy: A new imag-

ing modality in the sub-wavelength range,” in *Hundertvierte Jahrestagung der Deutschen Gesellschaft für angewandte Optik (DGaO)*, Münster (Westfalen), Germany, June 10-14, 2003.

- [12] T. Blu, M. Unser, and P. Thévenaz, “Optimizing basis functions for best approximation,” in *Fifth International Conference on Curves and Surfaces (ICCS’02)*, Saint Malo, France, June 27-July 3, 2002, Invited talk.
- [13] M. Unser and T. Blu, “Fractional wavelets: Properties and applications,” in *Proceedings of the First 2002 SIAM Conference on Imaging Science (SIAG-IS’02)*, Boston MA, USA, March 4-6, 2002, vol. MS1, p. 33.
- [14] M. Unser and T. Blu, “Fractional splines and wavelets: From theory to applications,” in *Joint IDR-IMA Workshop: Ideal Data Representation*, Minneapolis MN, USA, April 9-13, 2001.
- [15] T. Blu, M. Sühling, P. Thévenaz, and M. Unser, “Approximation order: Why the asymptotic constant matters,” in *Second Pacific Rim Conference on Mathematics (PRCM’01)*, Taipei, Taiwan ROC, January 4-8, 2001, pp. II.3–II.4, Invited talk.
- [16] T. Blu and M. Unser, “A quantitative Fourier analysis of the linear approximation error by wavelets,” in *Wavelet Applications Workshop*, Monte Verità TI, Switzerland, September 28-October 2, 1998.
- [17] M. Unser and T. Blu, “Spline wavelets with fractional order of approximation,” in *Wavelet Applications Workshop*, Monte Verità TI, Switzerland, September 28-October 2, 1998.