

Pietro Polotti

Research Activity

September 2004 - now: Researcher at the University of Verona, Italy, with VIPS (Vision, Image Processing and Sound group).
Research activity in the fields of Sound Design and Auditory Display. Participation to the writing phase and management of European research projects.

January 2003 – Dec. 2004: Researcher at the [Politecnico di Milano](#), Italy, with the Image and Sound Processing Group ([ISPG](#)).
Author of one Workpackage and main investigator for the Politecnico in the European project TAI-CHI (Tangible Acoustic Interface for Computer-Human Interaction) during the first year of activity.
<http://www.taichi.cf.ac.uk/>

November 1999 - Dec. 2002: Research assistant at the [EPFL](#) (École Polytechnique Fédérale de Lausanne), Switzerland, with the Audio-Visual Communications Laboratory ([LCAV](#)).
Research activity in the field of Audio Coding and development of a method for the analysis and synthesis of sounds based on a multirate representation of signals.

Scientific Education

2003: PhD in Communication System Engineering, École Polytechnique Fédérale de Lausanne (EPFL), Switzerland. Thesis subject: Multirate digital signal representation for audio coding.

1999: Doctoral school in Communication Systems, École Polytechnique Fédérale de Lausanne (EPFL), Switzerland.

1997: Laurea degree in Physics, Università degli Studi, Trieste, Italy. Final grade: 110/110 cum laude.

Musical Education

1998: Diploma in Electronic Music. Music Conservatory “B. Marcello”, Venice, Italy. Final grade: 10/10.

1993: Diploma in Composition. Music Conservatory “G. Verdi”, Milan, Italy. Final grade: 9/10.

1989: Diploma in Piano. Music Conservatory “G. Tartini”, Trieste, Italy. Final grade: 10/10.

1988: Bachelor in Clarinet. Conservatory “G. Tartini”, Trieste, Italy.

Fields of interest

- Analysis, synthesis and digital processing of sound.
 - Sound design and auditory display.
 - Musical informatics.
 - New musical interfaces.
 - Computational techniques for digital signal processing.
 - Composition of electroacoustic music.
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Participation to national and international research projects

- Co-author of a European project entitled “Closing the Loop Of Sound Evaluation and Design (CLOSED). Starting date: 1st July, 2006.
 - Authors: D. Rocchesso and P. Polotti (UNIVERONA, Verona, Italy), P. Susini (IRCAM, Paris, France), Y. Visell and K. Franinovic (HGKZ, Zurich, Switzerland).
 - Duration: 3 years
- Co-responsible of the research for VIPS within the EU project IST- 003773 S2S² (Sound to Sense, Sense to Sound), <http://www.s2s2.org>. Starting date: 1st June, 2004.
 - Coordinator: Nicola Bernardini (MIU-FT, Florence and Music Conservatory of Padua, Italy). Local Coordinator: Davide Rocchesso.
 - Duration: 3 years
- Author of one Workpackage and responsible for the research during the first year of the European project IST-507882 TAI-CHI (Tangible Acoustic Interface for Computer-Human Interaction), <http://www.taichi.cf.ac.uk/>. Starting date: 1st January, 2004.
 - Authors, A. Crevoisier (EIVD, Yverdon Switzerland), A. Camurri (DIST, UniGenova, Italy), M. Yang (MEC, Cardiff, UK), P. Polotti (Politecnico di Milano).
 - Duration: 3 years
- Participant to the project “Adapted Representations for the Analysis, Synthesis and Processing of Audio Signals” financed by the Fonds National Suisse (FNS), Funds n. 21-57220.99, 1999-2002.
- Delegated for Switzerland in the European COST Action - G6 “Digital Audio Effects” 1999-2001.

Contributes

- **SOUND ANALYSIS, SYNTHESIS AND PROCESSING**
Development of an original method for the analysis and synthesis of voiced sounds based on a pseudo-periodic $1/f$ -like model of the sound spectrum. This method represents a valuable result in the context of data compression and audio coding and transmission in the perspective of the MPEG-1 and MPEG-4 standards and of a Structured Audio approach to audio coding [2], [5], [7], [8], [9], [10], [18], [27], [28], [29], [31], [32], [33], [34], [35].
- **SOUND DESIGN AND AUDITORY DISPLAY**
Contribute to the definition of a taxonomy and new methodologies in this relatively new research field. Sound design activity for the implementation of various sonically augmented interactive artifacts and for architectonic contexts [1], [4], [5], [6], [12], [13], [16], [17], [19], [20], [22], [25], [36], [37].
- **NEW MUSICAL INTERFACES**
Development of a system for the sonification of gesture [11], [15]. Development of new instruments based on augmented everyday objects [14]. Development of a prototype of tangible interface based on the localization of the interactions of the user with the interface, by means of the analysis of the acoustic waves produced by the interactions themselves [21], [23], [24], [30]. The techniques developed in the context of in-solid acoustics refer to seismology methods and to the data recording and processing techniques by means of microphone arrays.
- **MUSIC INFORMATICS**
Application of sound analysis, synthesis and processing methods to music. An example is given by the possibility to separate the pseudo-harmonic components of voiced-sounds from the noisy components by means of the HBWT. For example it is easy to separate in a sound of a violin the harmonic part from the noise due to the bow friction [9], [21], [23], [26], [27].
- **WAVELET TRANSFORMS**
Definition of the Harmonic-Band Wavelet Transform (HBWT) and extension to the pitch-synchronous and non-harmonic cases by means of frequency warping techniques [7], [8], [10], [27], [28], [31], [34]. While multirate signal representations by means of wavelet transforms encountered a great development in the field of image processing, that of the HBWT is one of the very few cases of an effective application of the wavelet to audio processing.

Publications

Journals, Books and Manuscripts

- [1] D. Rocchesso, P. Polotti, S. Delle Monache, "Designing Continuous Sonic Interaction", *International Journal of Human Computer Studies (IJHCS)*, submitted.**
- [2] P. Polotti, "A Pitch-Synchronous Extension of Fractal Additive Synthesis via Time-Varying Cosine Modulated Filter Banks", *IEEE Signal Processing Letter*, Vol. 15, 2008.*
- [3] D. Rocchesso, P. Polotti, eds. *Sound to Sense, Sense to Sound. A State of the Art in Sound and Music Computing*. Logos Verlag, Berlin, 2008.**
- [4] A. De Goetzen, P. Polotti, D. Rocchesso. "Sound Design and Auditory Display", Chap. 10 in *Sound to Sense, Sense to Sound. A State of the Art in Sound and Music Computing*. Logos Verlag, Berlin, 2008.*
- [5] G. Widmer, D. Rocchesso, V. Valimaki, C. Erkut, F. Gouyon, D. Pressnitzer, Henri Penttinen, P. Polotti and G. Volpe, "Sound and Music Computing: Research Trends and Some Key Issues", *Journal of New Music Research*, Vol. 36, No. 3, pp. 169 – 184.

- [6] Contributor to the Sound and Music Computing Roadmap, edited by the S2S² Consortium: <http://www.smcnetwork.org/roadmap>. April, 2007. ***
- [7] P. Polotti, G. Evangelista, "Fractal Additive Synthesis: a Deterministic/Stochastic Model for Sound Synthesis by Analysis", *IEEE Signal Processing Magazine*, pp. 105-115, March, 2007. *
- [8] PhD Thesis: "Fractal Additive Synthesis: Spectral Modeling of Sound for Low Rate Coding of High Quality Audio". Apr. 2003. [Online]. Available: <http://library.epfl.ch/theses/?nr=2711>.
Advisors: M. Vetterli, G. Evangelista, École Polytechnique Fédérale de Lausanne, Switzerland, Audio-Visual Communications Laboratory (EPFL-LCAV). *
- [9] P. Polotti, G. Evangelista, "Fractal Additive Synthesis by means of Harmonic-Band Wavelets", *Computer Music Journal*, 25(3), pp. 22-37, Fall, 2001. *
- [10] P. Polotti, G. Evangelista, "Analysis and Synthesis of Pseudo-Periodic 1/f-like Noise by means of Wavelets with Applications to Digital Audio", *EURASIP Journal on Applied Signal Processing*, Hindawi Publishing Corporation, Vol. 2001, No. 1, pp. 1-14, March, 2001. *

Conferences

- [11] M. Goïna, P. Polotti, "Principi elementari per una sonificazione del gesto", *Proceedings of 17th CIM Colloquio di Informatica Musicale*, Venice, Italy, Oct. 2008. **
- [12] S. Delle Monache, D. Devallez, P. Polotti, and D. Rocchesso, "Sviluppo di un'interfaccia audio-aptica basata sulla profondita' spaziale", *Proceedings of 17th CIM Colloquio di Informatica Musicale*, Venice, Italy, Oct. 2008. ***
- [13] P. Polotti, C. Benzi, "Rhetorical Schemes for Audio Communication" *Proceedings of the International Conference on Auditory Display (ICAD2008)*, Paris, France, June 23-26, 2008. *
- [14] S. Delle Monache, P. Polotti, S. Papetti and D. Rocchesso, "Sonically Augmented Found Objects". *Proceedings of the New Interfaces for Musical Expression (NIME) conference*. Genoa, Italy, June 5-7, 2008. **
- [15] M. Goïna, P. Polotti, "Elementary Gestalts for Gesture Sonification", *Proceedings of the NIME conference*. Genoa, Italy, June 5-7, 2008. **
- [16] P. Polotti, S. Delle Monache, S. Papetti, D. Rocchesso, "Gamelunch: Forging a Dining Experience through Sound", *Proceedings of the ACM CHI 2008*, Florence, April 7-11, 2008. **
- [17] D. Rocchesso and P. Polotti, "Designing Continuous Multisensory Interaction". *Proceedings of the ACM CHI workshop - Sonic interaction design*. Florence, Italy. April 6, 2008. **
- [18] R. Bresin, S. Delle Monache, F. Fontana, S. Papetti, P. Polotti and Y. Visell "Auditory feedback through continuous control of crumpling sound synthesis". *Proceedings of the ACM CHI workshop - Sonic interaction design*. Florence, Italy. April 6, 2008. ***
- [19] S. Delle Monache, P. Polotti, S. Papetti and D. Rocchesso, "Gamelunch: a Physics-based Sonic Dining Table", in *Proceedings of the International Computer Music Conference 2007 (ICMC2007)*. Copenhagen, Denmark, August 27-31, 2007. **
- [20] P. Susini, N. Misdariis, G. Lemaitre, O. Houix, D. Rocchesso, P. Polotti, K. Franinovic, Y. Visell, K. Obermayer, H. Purwins, K. Adiloglu, "Closing the Loop of Sound Evaluation and Design", *Proc. of the Second ISCA/DEGA Tutorial and Research Workshop on Perceptual Quality of Systems*, Berlin, Germany, 4-6 September 2006. **
- [21] P. Polotti, M. Sampietro, A. Sarti, S. Tubaro and A. Crevoisier "Acoustic Localization of Tactile Interactions for the Development of Novel Tangible Interfaces", *Proc. of the 8th Int. Conference on Digital Audio Effects (DAFX-05)*, Madrid, Spain, September 20-22, 2005. *
- [22] Davide Rocchesso, Pietro Polotti, "There is no Such Thing as Sound Design, in 2005", *Inspirational Ideas*, International Computer Music Conference (ICMC05), Barcelona, Spain, September 5-9, 2005. **

- [23] Alain Crevoisier and Pietro Polotti. "Tangible Acoustic Interfaces and their Applications for the Design of New Musical Instruments", *Proceedings of the New Interfaces for Musical Expression (NIME) conference*, Vancouver, Canada, May 26-28, 2005. **
- [24] P. Polotti, A. Crevoisier and A. Sarti, "In-solid Source Localization for the Development of Tangible Acoustic Interfaces", *IV Workshop sulle Tecnologie per la musica (Audio Digitale e Musica Elettronica)*, Università di Roma "La Sapienza", Roma, 9 June, 2004. *
- [25] M. Foco, P. Polotti, A. Sarti, S. Tubaro, "Sound Spatialization Based on Fast Beam Tracing in the Dual Space", *Proceedings of the COST G-6 Conference on Digital Audio Effects (DAFx-03)*, Londra, Gran Bretagna, Sept. 2003. ***
- [26] G. Faraone, S. Johansson, P. Polotti, "The influence of the practice of basso continuo on the intonation of a professional singer in the time of Monteverdi", Stockholm Music Acoustics Conference 2003, Stockholm, Sweden, August, 2003. **
- [27] P. Polotti, G. Evangelista, F. Menzer "Inharmonic Sound Spectral Modelling by Means of Fractal Additive Synthesis", *Proceedings of the COST G-6 Conference on Digital Audio Effects (DAFx-02)*, Hamburg, Germany, Sept. 2002. *
- [28] P. Polotti, "Fractal Additive Synthesis: A Pitch-Synchronous Extension of the Method for the Analysis and Synthesis of Natural Voiced-Sounds", *Proceedings of the ICMC 2002*, Göteborg, Sweden, Sept. 2002. *
- [29] P. Polotti, G. Evangelista, "Multiresolution Sinusoidal/Stochastic Model for Voiced-Sounds", *Proceedings of the COST G-6 Conference on Digital Audio Effects (DAFx-01)*, Limerick, Ireland, Dec. 2001. *
- [30] A. Crevoisier, P. Polotti, "A New Musical Interface Using Acoustic Tap Tracking". *Mosart Workshop on Current Research Directions in Computer Music*, Barcelona, Spain, Nov. 15-17, 2001. **
- [31] P. Polotti, G. Evangelista, "Harmonic-Band Wavelet Coefficient Modeling for Pseudo-Periodic Sound Processing", *Proceedings of the COST G-6 Conference on Digital Audio Effects (DAFx-00)*, Verona, Italy, Dec. 2000. *
- [32] P. Polotti, G. Evangelista "Sound Modeling by means of Harmonic-Band Wavelets: New Results and Experiments", *Proc. of XIII CIM*, pp. 43-46, L'Aquila, Italy, Sept. 2000. *
- [33] P. Polotti, G. Evangelista, "Time-Spectral Modeling of Sounds by Means of Harmonic-Band Wavelets", *Proceedings of the ICMC 2000*, pp. 388-391, Berlin, Germany, August 2000. *
- [34] P. Polotti, G. Evangelista, "Dynamic Models of Pseudo-Periodicity", *Proc. of DAFx99*, Trondheim, Norway, Dec. 1999. *
- [35] G. Evangelista, P. Polotti, " Analysis and Synthesis of Pseudoperiodic $1/f$ -like noise by means of Multiband Wavelets ", *Proceedings of CIM 98, 12th international meeting of computer music*, Gorizia, Italy, Sept. 1998. *

Others

- [36] Soundscape consultant for a concourse of Architecture "Il giardino di Pitagora" (Pitagora's Garden) <http://www.europaconcorsi.com/db/rec/concorso.php?id=10555&lingua=ita>
- [37] Soundscape consultant for a concourse of Architecture "Riprogettare la città moderna (quartiere di Rozzòl Melara)" <http://www.europaconcorsi.com/db/rec/concorso.php?id=10197&lingua=ita>

Legend:

- * principal author, major contributor,
 ** equal contributor,
 *** secondary contribution (not principal).

Reviewer activity

Reviewer of journal and conferences papers: IEEE Signal Processing Magazine , EURASIP Journal of Applied Signal Processing (JASP), Conference on Digital Audio Effect (DAFx), International Conference on Auditory Display (ICAD), Sound and Music Computing conference (SMC).

Teaching

2008-now: Associate Professor at the Conservatory “G. Tartini”, Trieste, Italy. Teaching: Electronic Music.

2005-07: Associate Professor at the Conservatory “G. Verdi”, Como, Italy. Teaching: Electronic Music.

2004-05: Co-author of a course on-line of Informatics (<http://cnx.org/content/col110299/latest/>) for the claVES, Course in Visual Arts and Performance at Industrial Design and Arts of IUAV, Venice, Italy.

2003-06: Assistant Professor by the University of Trieste, Italy. Teaching: Laboratory of Musical Informatics.

2000-05: Assistant Professor by the Conservatory “G. Tartini”, Trieste, Italy. Teaching: “Digital Sound Processing”.

2003-05: Assistant Professor of the course of “Advanced Techniques for Audio Signal Processing” by the Politecnico di Milano, Master degree in Computer Science Engineering, Milan, Italy.

2000-01: Teaching Assistant in the course “Digital Audio”, Master degree in Communication Systems at the EPFL, Lausanne, Switzerland.

1999-2007: Teaching Electronic Music at the LaSDIM (Laboratory for the Experimentation and Didactics of Musical Informatics), Contemporary Music Section, Civica Scuola di Musica, Milan, Italy.

Advisor responsibilities and tutoring

- **2003-now:** Advisor for diploma works at the Conservatory “G.Tartini” of Trieste, Italy.
 - **2003-2004:** Advisor for diploma works first level thesis at the Politecnico di Milano, Milan, Italy.
 - **2000-2002:** Tutor for semester projects at the Communication Systems School, EPFL, Lausanne, Switzerland.
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Seminars

April 15, 2008: Seminar entitled “Sonic Augmented Found Objects. Physically-based sound modeling for the design of new musical interfaces” held with D. Rocchesso by the ICST of the Academy of Arts of Zuerich (ZHdK), Switzerland.

December 17, 2007: Masterclass entitled “Oggetti e Suono. L’evidenza attraverso la contraddizione”, held within the activities of Elettrosensi 2007, Conservatory of Como, Italy.

November 16, 2007: Seminar entitled “La cattura dell’azione: nuove interfacce musicali” organized by the University of Verona and the Italian Association of Acoustic by the Auditorium Montemezzi of the Conservatory of Verona, Italy.

May 30, 2006: Masterclass entitled “Minimal yet Veridical, Sonification, Auditory Display and Sound Design”, in “Artescienza 2006”, Goethe Institut, 29 May– 3 June 2006, Rome, Italy.

December 16, 2004: Lecture entitled “From the Atom of Hydrogen to mp3”, within the “Doctoral Class on Modern Mathematics for Contemporary Sound Modeling”, University of Verona, 28 – 30 Sept. 2004 and 16 Dec. 2004, Verona, Italy.

December 9, 2004: Lecture entitled “Wavelets and Textures” in collaboration with Antonio de Sena, held within the “Workshop on Sound Textures” University of Verona, Italy, 8-12 Dec. 2004.

26 November 26, 2004: Seminar entitled “DSP Applications for Music” held by the “Universität für Musik und Darstellende Kunst” and “Technische Universität”, Graz, Austria.

25 October 2001: Seminar by the Universitat Pompeu Fabra, Barcelona, Spain, entitled “Multiresolution Sinusoidal/Stochastic Model for Voiced-Sounds” (<http://www.ia.upf.es/activitats/activitats.search.php3?ponente=114&buscador=no>).

Other research experiences

October-November 2001: Host researcher at the [MTG](#) (Music Technology Group) of the [Universitat Pompeu Fabra, Barcelona, Spain](#).

Collaboration to a project for "A New Musical Interface Using Acoustic Tap Tracking". A prototype of interface was presented at the [Mozart Workshop on Current Research Directions in Computer Music](#), Barcelona, November 15-17, 2001.

1996-97: Host student at the [ACEL](#) laboratory of computer music and acoustical signal processing of the University Federico II of Naples, Italy.

Theoretical study and experimental testing of a new method for the analysis and synthesis of acoustical signals based on the $1/f$ pseudo-periodic model.

Compositions and musical activity

Composition of various chamber music and electronic music pieces performed in contemporary music festivals and competitions:

- *Ren* for tape solo (2005-07) performed on the 21/06/2008 in a concert for the European day of Music in the Miramare Castle Hall in Trieste, Italy.
- G. Cospito, S. Delle Monache, P. Polotti and D. Rocchesso, “A tavola con i suoni”, everyday sound concert and performance for Gamelunch and kitchen objects. Auditorium of the Conservatory G. Verdi of Como, Italy, May 10, 2008.
- *Gamelunch* S. Delle Monache e P. Polotti, “Gamelunch - the sonic dining”, installazione sonora interattiva, presentata ad Enactive in Arts, Grenoble, Novembre 2007.
<http://acroe.imag.fr/enactive07/gamelunch.php>
- *1948* for tape solo (1998) performed in the Festival "[Musica e Scienza](#)", Rome, Italy (20/6/01), in the IX International Electroacoustic Music Festival, "[Primavera en La Habana](#)", (5/3/02), La Habana, Cuba and in [Santiago de Chile](#) (8/10/02).
- *A-Tom* for tape solo (1998) performed in the Festival "[La Terra Fertile](#)", L'Aquila, Italy (4/9/98) and in the [International Festival of Trento and Rovereto](#), Italy (19/10/1998). Edited on [CD by Ars Publica](#), 1998.
- *Intrecci* for tape solo (1994), performed on the 22/2/94 at the *Auditorium Fenzi*, Conegliano Veneto, Italy, in a concert organized by the *Teatro la Fenice* of Venice. In *La Terra Fertile* in L'Aquila, Italy (4/6/94) and in the season 1994 of the association GAMO in Florence, Italy (20/10/94).
- *Tactus* for brass instruments, percussions and piano (1992-93).
- *Permutazioni auree* for five flutes (1991), winner of the third prize at the composition competition *Castello di Belveglio*, Asti, Italy (1991). Performed within the *Rassegna di Giovani Compositori* by the Music Conservatory “G. Verdi” of Milan, Italy (27/5/91).
- *Pentacha* for voice, clarinet, violin, cello and piano (1988), broadcast on the 24/6/90 by the RAI 2nd radio channel.
- From 1993: Activity of sound director in electronic music concerts:
 - 1-6/6/98 "Musica e Scienza": Electronic Music Festival organized by the CSM (Centre for Experimental Music, Rome) at the Spazio Acquario, Rome, Italy
 - 4-5/6/97 Electronic Music Festival "Sonopoli" organized by the Teatro la Fenice of Venice, Italy.
 - 15/2/93 Electronic music concert at the Auditorium Fenzi, Conegliano Veneto, Italy
 - 22/2/94 Auditorium Fenzi, Conegliano Veneto: Electronic music concert organized by the Teatro la Fenice of Venice, Italy.