

Gerasimos Potamianos

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- Research** Multimodal speech processing with applications to human-computer interaction and ambient intelligence. Particular emphasis on audio-visual speech processing, automatic speech recognition, multimedia signal processing and fusion, computer vision for human detection and tracking.
- Education**
- Ph.D.**, November **1994**, Electrical and Computer Engineering,
THE JOHNS HOPKINS UNIVERSITY, Baltimore, Maryland. GPA: 3.97/4.00
Advisor: Prof. John Goutsias. *Dissertation:* “Stochastic Simulation Algorithms for Partition Function Estimation of Markov Random Field Images.”
- M.S.E.**, June **1990**, Electrical and Computer Engineering,
THE JOHNS HOPKINS UNIVERSITY, Baltimore, Maryland. GPA: 3.97/4.00
Advisor: Prof. John Goutsias.
- Diploma**, July **1988**, Electrical Engineering and Computer Science,
NATIONAL TECHNICAL UNIVERSITY OF ATHENS, Greece. GPA: 9.5/10.0
Advisor: Prof. John Diamessis. *Thesis:* “Designing 2-D IIR Digital Filters Using Continued Fractions.”
- Experience**
- Feb. 2012 – Present: **Associate Professor**, *Department of Computer and Communication Engineering*, UNIVERSITY OF THESSALY, Volos, Greece.
Has been teaching courses in the areas of signal and speech processing. Ongoing research activities include work on far-field automatic speech recognition as part of FP7 EU project DIRHA, in collaboration with the Information Analysis and Modeling Unit of the Athena Research and Innovation Center in Greece, and work on audio-visual speech processing as part of PEOPLE-IRG project AVISPIRE, in collaboration with the Institute of Informatics and Telecommunications of the National Centre for Scientific Research (NCSR), “Demokritos”, in Athens, Greece.
- Apr. 2009 – Jan. 2012: **Director of Research** (Rank A Researcher), *Institute of Informatics and Telecommunications*, NATIONAL CENTRE FOR SCIENTIFIC RESEARCH (NCSR), “DEMOKRITOS”, Athens, Greece.
Has been a member of the Software and Knowledge Engineering Laboratory of the Institute, working on multimodal speech processing, bridging existing lab expertise on text, image, and video processing technologies, as recipient of Marie Curie Grant (PEOPLE-IRG) for project AVISPIRE. Has also served as the Technical Coordinator of FP7 EU project SYNC3.
- Oct. 2008 – March 2009: **Senior Researcher** (Rank B), *Institute of Computer Science*, FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS (FORTH), Herakleion, Crete, Greece.
Has been a member of the Telecommunications and Networks Laboratory at FORTH, working within the ambient intelligence program of the Institute.
- Sept. 1999 – Sept. 2008: **Research Staff Member** and **Manager** (Feb. 2007 – Sept. 2008), *Multimodal Conversational Technologies Department*, IBM T. J. WATSON RESEARCH CENTER, Yorktown Heights, New York.
Led the development and integration of multiple input modalities, natural language processing, and dialog management into conversational platforms and solutions, as manager of a research group within the User Interface / Human Language Technology Department at the IBM T. J. Watson Research Center. From July 2008 till Sept. 2008, has also led efforts in the speech-to-speech translation area, supervising a combined group of over twenty researchers.

Own research work has focused on audio-visual speech technologies with applications to human-computer interaction and ambient intelligence. Effort has concentrated on a variety of problems including visual speech representation, fusion algorithms for large-vocabulary continuous audio-visual speech recognition, bimodal speech enhancement, speaker recognition, audio-visual speech activity detection, far-field automatic speech recognition, 2D and 3D person tracking, and real-time algorithmic implementation, with emphasis on applications to the automobile and smart rooms/homes. Most recent efforts have been driven by three FP6 European research projects (CHIL, NETCARITY, and DICIT).

Aug. 1996 – July 1998 and Sept. 1998 – Aug. 1999: **Senior Technical Staff Member**, *Speech and Image Processing Lab*, AT&T LABS-RESEARCH, Murray Hill / Florham Park, New Jersey. Conducted research on audio-visual automatic speech recognition and synthesis. Work accomplishments include: Algorithms for speaker independent face localization and segmentation, visual feature extraction, audio-visual information fusion, collection of large audio-visual corpora, development of a real-time audio-visual speech recognition prototype system, and algorithms for visual unit selection in audio-visual speech synthesis.

Nov. 1994 – June 1996: **Postdoctoral Fellow**, *Center for Language and Speech Processing*, THE JOHNS HOPKINS UNIVERSITY, Baltimore, Maryland. Conducted research, under the direction of Prof. F. Jelinek, towards the development of statistical language models for continuous speech recognition, using decision trellises, decision trees, as well as traditional n-gram approaches.

July 1994 – Oct. 1994: **Summer Intern / Coop Member of Technical Staff**, *Integrated Systems Laboratory*, TEXAS INSTRUMENTS, Dallas, Texas. Developed a statistical channel model for digital video transmission over a coaxial cable system. Published two Texas Instruments technical reports.

Jan. 1994 – May 1994: **Teaching Assistant**, *Center for Language and Speech Processing and Department of Electrical and Computer Engineering*, THE JOHNS HOPKINS UNIVERSITY, Baltimore, Maryland. Helped with the design of research projects for the “Statistical Models for Language Analysis” graduate-level course, as well as with the grading for the “Image Analysis” graduate-level course.

June 1990 – Dec. 1993: **Research Assistant**, *Department of Electrical and Computer Engineering*, THE JOHNS HOPKINS UNIVERSITY, Baltimore, Maryland. Developed, implemented, and analyzed new algorithms for partition function estimation, maximum likelihood parameter estimation, and hypothesis testing of Markov random field images.

Sept. 1989 – May 1990: **Instructor**, *G.W.C. Whiting School of Engineering, Continuing Professional Programs*, THE JOHNS HOPKINS UNIVERSITY, Baltimore, Maryland. Taught two Electrical Engineering laboratory courses.

July – Aug. 1987: **Summer Intern**, WSZ-ELEKTRONIK GMBH, Wolfratshausen, Germany. Participated in a program of the International Association for the Exchange of Students for Technical Experience (IAESTE). Took active part in the design, manufacturing and testing of amplifier systems, a project supervised by Siemens, Munich.

- Publications**
- Sixteen Articles in Journals and Books.
 - Eighty-three Articles in Conference and Workshop Proceedings.
 - Seven Technical Reports.
 - Three Editorials in Special Journal Issues.
 - Two Short Courses / Tutorials.
 - Seven Granted Patents.
 - Approximately 800 Works Citing these Publications.
 - Publication Impact: h-index = 15; g-index = 25.
- Presentations**
- Invited speaker at ASRU 2009, Merano, Italy.
 - Lecturer at the NCSR “Demokritos” Summer School 2009 and 2010, Athens, Greece.
 - Keynote speaker at the VisHCI 2006 workshop, Canberra, Australia.
 - Panelist at the MMSP 2006 workshop, Victoria, Canada.
 - Tutorial speaker at the ICIP 2003 conference, Barcelona, Spain.
 - Guest lecturer at the “Topics in Signal Processing: Speech Recognition” course, Electrical Eng. Dept., Columbia University, NY, Spring Semester, 2004; Fall Semester, 2005.
 - Plenary speaker at the AVSP 2003 workshop, St. Jorioz, France.
 - Instructor at the ELSNET 2001 summer school, Prague, Czech Republic.
 - Forty-six conference paper presentations (1989 – 2012).
 - Numerous invited presentations at Universities and Industrial Research Labs.
- Activities**
- Member of the IEEE Speech and Language Technical Committee (SLTC), 2009 – 2011.
 - Guest Editor of the special issue on Interactive Multimedia for the IEEE Transactions on Multimedia, Sept. 2011.
 - Guest Editor of the special issue on Multimodal Speech Processing for the IEEE Transactions on Audio, Speech and Language Processing, March 2009.
 - Special session organizer on “Multimodal Speech Technology” at Acoustics’08 Conference.
 - Guest Editor of the special issue on Joint Audio-Visual Speech Processing of the EURASIP Journal of Applied Signal Processing, Nov. 2002.
 - Area Chair, EUSIPCO 2008, MLMI 2008, ICMI-MLMI 2009 Conferences.
 - Area Coordinator, Interspeech 2008, 2009 Conferences.
 - Technical Program Committee Member, IMAP 2007, AVSP 2011, EUSIPCO 2012.
 - Member of the Christian Benoit Award Committee (2007, 2009).
 - Member of the European Biometrics Forum Award Committee (2006 – 2008).
 - Participant at the CLSP’00 Summer Workshop, Center for Language and Speech Processing, the Johns Hopkins University, Baltimore, MD (July – Aug. 2000).
 - Reviewer for numerous journals (Speech Communication J.; Computer Speech and Language; J. of Visual Communication and Image Representation; IEEE Trans. on Image Processing; IEEE Trans. on Signal Processing; IEEE Trans. on Systems, Man, and Cybernetics; IEEE Trans. on Audio, Speech and Language Processing; IEEE Trans. on Multimedia; IEEE Signal Processing Magazine; Information Fusion; SPIE Optical Engineering).
 - Reviewer for numerous conferences (ASRU, AVSP, EUSIPCO, ICASSP, ICME, ICMI, Interspeech, IS ADEPT, MLMI, MMSP, PETRA).

Skills

Research: In-depth knowledge of signal and image processing, speech recognition, language modeling, pattern recognition, multimedia signal processing, and computer vision. Eight years academic and twelve years of industrial research experience in the U.S., as well as four years of experience in research centers and academia in Greece. Recent work focuses on audio-visual speech processing, speech recognition, and computer vision for robust and natural human-computer interaction and ambient intelligence.

Supervision: While at IBM Research, he has been manager of the Multimodal Conversational Technologies Department (2007 – 2008), having supervised over twenty researchers. Also, a team lead for audio-visual speech technologies research work (2003 – 2008). and a mentor and supervisor of nine summer students (2000 – 2008). While at NCSR “Demokritos”, he has coordinated a four-member team as part of the SYNC3 EU-funded project activities, and supervised one Ph.D. student under a joint NCSR “Demokritos”/ University of Texas at Arlington Ph.D. program. As a recently appointed Associate Professor at the University of Thessaly, he has been supervising three students on their Diploma Theses.

Projects, Proposals, Collaborations: While at IBM, he has participated in various proposal writing efforts resulting in funding by DARPA, the European Union (FP6), internal IBM divisions, and external IBM customers, and he has successfully completed collaborations within multi-partner consortia including the NETCARITY and DICIT FP6 projects, as well as the CHIL FP6 integrated project, where he led the speech-technology work-package. As a Research Director at NCSR “Demokritos” he has successfully concluded the Technical Coordination of the SYNC3 FP7 project. Currently, he has been leading work-package tasks of the DIRHA FP7 project and is the beneficiary researcher of PEOPLE-IRG project AVISPIRE. Additional current and past collaborations with faculty at US and European Universities and Research Centers within the framework of research proposals.

Teaching: Instructor and teaching assistant at the Johns Hopkins University (1990, 1994); short-course and tutorial speaker (ELSNET 2001; ICIP 2003); has given invited lectures at Columbia University as part of a course on “Automatic Speech Recognition” (Spring 2004; Fall 2005); has taught “*Signals and Systems*” at the National Technical University of Athens and at the University of Thessaly as a part-time instructor (Spring 2011 and Fall 2011, respectively) and “*Speech Processing*” at the latter (Fall 2011); currently teaching “*Digital Signal Processing*” and “*Advanced Topics in Signal Processing*” at the University of Thessaly as an Associate Professor (Spring 2012).

Coursework: Has completed numerous courses in signal and image processing, pattern recognition, information theory, control, nonlinear systems, probability, and statistics.

Computer Skills: Extensive programming experience in C, C++, PERL, and Python; good working knowledge of Matlab, Splus, Mathematica, and HTK.

Languages: Fluent in Greek (mother tongue) and English; some knowledge of German; elementary reading capability of French.

Honors

Recipient of *Marie-Curie International Reintegration Grant* for Project “AVISPIRE” (Audio-Visual Speech Processing in Realistic Environments), Oct. 2009 – Feb. 2013.

Elected *Member* of the *IEEE Speech and Language Technical Committee* (2009 – 2011).

Co-author of paper that was awarded the *Best Student Paper Award* at the 2007 Interspeech Conference, in Antwerp, Belgium.

Contributed significantly to the 2006 *North American Frost & Sullivan Award for Excellence in Research* in the speech recognition field awarded to the IBM Corporation. Award explicitly emphasizes IBM Research work on audio-visual speech recognition.

Received the *Best Paper Award* at the 2005 International Conference on Multimedia and Expo. (ICME), in Amsterdam, the Netherlands (among over 800 submitted papers).

Received a number of internal IBM Research awards for work on audio-visual speech recognition, including the 2002 IBM *Research Accomplishment Award*.

Invited to the summer 2000 research *workshop* (WS2000) at the Center for Language and Speech Processing at the Johns Hopkins University (July – Aug. 2000).

Awarded a *post-doctoral* fellowship with the Center for Language and Speech Processing at the Johns Hopkins University (Nov. 1994 – July 1996).

Awarded a *post-doctoral* fellowship through the Human Capital and Mobility Program of the Commission of the European Communities for post-doctoral study with IRISA, Rennes, France (1994 – 1995), that he later declined.

Awarded one of the five annual *Abel Wolman Fellowships* of the G.W.C. Whiting School of Engineering for the first academic year as an entering graduate student at the Johns Hopkins University (Sept. 1988 – May 1989).

Given *full financial support* during graduate study at the Johns Hopkins University, as an instructor, research, and teaching assistant (Sept. 1989 – June 1994).

Awarded *full tuition fellowship* for the entire duration of graduate study at the Johns Hopkins University (Sept. 1988 – Nov. 1994).

Awarded prizes from the *Greek National Scholarship Foundation* for academic performance during the years of undergraduate study (1983 – 1988). Received a financial award from the *National Technical Chamber of Greece* (1987).

Memberships

Member of the International Institute of Electrical and Electronics Engineers (IEEE).

Member of the National Technical Chamber of Greece.

Personal

Born in 1965; Dual U.S. and Greek Citizenship.

Journal Articles

- (J08) D. Mostefa, N. Moreau, K. Choukri, **G. Potamianos**, S.M. Chu, A. Tyagi, J.R. Casas, J. Turmo, L. Christoforetti, F. Tobia, A. Pnevmatikakis, V. Mylonakis, F. Talantzis, S. Burger, R. Stiefelbogen, K. Bernardin, and C. Rochet, “The CHIL audiovisual corpus for lecture and meeting analysis inside smart rooms,” *Journal of Language Resources and Evaluation*, vol. 41, pp. 389–407, 2007.
- (J07) Z. Zhang, **G. Potamianos**, A.W. Senior, and T.S. Huang, “Joint face and head tracking inside multi-camera smart rooms,” *Signal, Image and Video Processing*, vol. 1, pp. 163–178, 2007.
- (J06) J. Huang, **G. Potamianos**, J. Connell, and C. Neti. “Audio-visual speech recognition using an infrared headset,” *Speech Communication*, vol. 44, no. 4, pp. 83–96, 2004.
- (J05) **G. Potamianos**, C. Neti, G. Gravier, A. Garg, and A.W. Senior, “Recent advances in the automatic recognition of audio-visual speech,” Invited, *Proceedings of the IEEE*, vol. 91, no. 9, pp. 1306–1326, 2003.
- (J04) **G. Potamianos**, C. Neti, G. Iyengar, A.W. Senior, and A. Verma, “A cascade visual front end for speaker independent automatic speechreading,” *International Journal of Speech Technology, Special Issue on Multimedia*, vol. 4, pp. 193–208, 2001.
- (J03) **G. Potamianos** and F. Jelinek, “A study of n-gram and decision tree letter language modeling methods,” *Speech Communication*, vol. 24, no. 3, pp. 171–192, 1998.
- (J02) **G. Potamianos** and J. Goutsias, “Stochastic approximation algorithms for partition function estimation of Gibbs random fields,” *IEEE Transactions on Information Theory*, vol. 43, no. 6, pp. 1948–1965, 1997.
- (J01) **G.G. Potamianos** and J. Goutsias, “Partition function estimation of Gibbs random field images using Monte Carlo simulations,” *IEEE Transactions on Information Theory*, vol. 39, no. 4, pp. 1322–1332, 1993.

Book Chapters

- (B08) **G. Potamianos**, C. Neti, J. Luetttin, and I. Matthews, “Audio-visual automatic speech recognition: An overview,” (To Appear In:) *Audio-Visual Speech Processing*, E. Vatikiotis-Bateson, G. Bailly, and P. Perrier (Eds.), Ch. 9, Cambridge University Press, 2012.
- (B07) K. Kumar, **G. Potamianos**, J. Navratil, E. Marcheret, and V. Libal, “Audio-visual speech synchrony detection by a family of bimodal linear prediction models,” *Multibiometrics for Human Identification*, B. Bhanu and V. Govindaraju (Eds.), Ch. 2, pp. 31–50, Cambridge University Press, 2011.
- (B06) A. Waibel, R. Stiefelbogen, R. Carlson, J. Casas, J. Kleindienst, L. Lamel, O. Lanz, D. Mostefa, M. Omologo, F. Pianesi, L. Polymenakos, **G. Potamianos**, J. Soldatos, G. Sutschet, and J. Terken, “Computers in the human interaction loop,” *Handbook of Ambient Intelligence and Smart Environments*, H. Nakashima, H. Aghajan, and J.C. Augusto (Eds.), Part IX, pp. 1071–1116, Springer, 2010.
- (B05) P. Lucey, **G. Potamianos**, and S. Sridharan, “Visual speech recognition across multiple views,” *Visual Speech Recognition: Lip Segmentation and Mapping*, A. Wee-Chung Liew and S. Wang (Eds.), ch. X, pp. 294–325, Information Science Reference (IGI), 2009.
- (B04) **G. Potamianos**, L. Lamel, M. Wölfel, J. Huang, E. Marcheret, C. Barras, X. Zhu, J. McDonough, J. Hernando, D. Macho, and C. Nadeu, “Automatic speech recognition,” *Computers in the Human Interaction Loop*, A. Waibel and R. Stiefelbogen (Eds.), ch. 6, pp. 43–59, Springer, 2009.
- (B03) K. Bernardin, R. Stiefelbogen, A. Pnevmatikakis, O. Lanz, A. Brutti, J.R. Casas, and **G. Potamianos**, “Person tracking,” *Computers in the Human Interaction Loop*, A. Waibel and R. Stiefelbogen (Eds.), ch. 3, pp. 11–22, Springer, 2009.
- (B02) **G. Potamianos**, “Audio-visual speech recognition,” Short Article, *Encyclopedia of Language and Linguistics, Second Edition, (Speech Technology Section – Computer Understanding of Speech)*, K. Brown (Ed. In Chief), Elsevier, Oxford, United Kingdom, ISBN: 0-08-044299-4, vol. 11, pp. 800–805, 2006.
- (B01) P.S. Aleksic, **G. Potamianos**, and A.K. Katsaggelos, “Exploiting visual information in automatic speech processing,” *Handbook of Image and Video Processing, Second Edition*, Al. Bovik (Ed.), ch. 10.8, pp. 1263–1289, Elsevier Academic Press, Burlington, MA, ISBN: 0-12-119792-1, 2005.

Editorials in Journal Special Issues

- (E03) S.-H. G. Chan, J. Li, P. Frossard, and **G. Potamianos**, “Special section on interactive multimedia,” *IEEE Transactions on Multimedia*, vol. 13, no. 5, pp. 841–843, 2011.
- (E02) H. Meng, S. Oviatt, **G. Potamianos**, and G. Rigoll, “Introduction to the special issue on multimodal processing in speech-based interactions,” *IEEE Transactions on Audio, Speech, and Language Processing*, vol. 17, no. 3, pp. 409–410, 2009.
- (E01) C. Neti, **G. Potamianos**, J. Luetin, and E. Vatikiotis-Bateson, “Editorial of the special issue on joint audio-visual speech processing,” *EURASIP Journal on Applied Signal Processing*, vol. 2002, no. 11, 2002.

Publications in Conference and Workshop Proceedings

- (C085) G. Galatas, **G. Potamianos**, and F. Makedon, “Audio-visual speech recognition using depth information from the Kinect in noisy video conditions,” (Submitted To:) *Int. Conf. Pervasive Technologies Related to Assistive Environments (PETRA)*, Crete, Greece, 2012.
- (C084) G. Galatas, **G. Potamianos**, and F. Makedon, “Audio-visual speech recognition incorporating facial depth information captured by the Kinect,” (Submitted To:) *Europ. Conf. Signal Process. (EUSIPCO)*, Bucharest, Romania, 2012.
- (C083) P. Giannoulis and **G. Potamianos**, “A hierarchical approach with feature selection for emotion recognition from speech,” (To Appear In:) *Proc. Int. Conf. Language Resources and Evaluation (LREC)*, Istanbul, Turkey, 2012.
- (C082) G. Galatas, **G. Potamianos**, D. Kosmopoulos, C. McMurrugh, and F. Makedon, “Bilingual corpus for AVASR using multiple sensors and depth information,” *Proc. Int. Conf. Auditory-Visual Speech Process. (AVSP)*, pp. 103–106, Volterra, Italy, 2011.
- (C081) N. Sarris, **G. Potamianos**, J.-M. Renders, C. Grover, E. Karstens, L. Kallipolitis, V. Tountopoulos, G. Petasis, A. Krithara, M. Gallé, G. Jacquet, B. Alex, R. Tobin, and L. Bounegru, “A system for synergistically structuring news content from traditional media and the blogosphere,” *Proc. E-Challenges Conference*, Florence, Italy, 2011.
- (C080) G. Galatas, **G. Potamianos**, A. Papangelis, and F. Makedon, “Audio visual speech recognition in noisy visual environments,” *Proc. Int. Conf. Pervasive Technologies Related to Assistive Environments (PETRA)*, Crete, Greece, 2011.
- (C079) L.-H. Kim, M. Hasegawa-Johnson, **G. Potamianos**, and V. Libal, “Joint estimation of DOA and speech based on EM beamforming,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, pp. 121–124, Dallas, TX, 2010.
- (C078) K. Kumar, J. Navratil, E. Marcheret, V. Libal, and **G. Potamianos**, “Robust audio-visual speech synchrony detection by generalized bimodal linear prediction,” *Proc. Conf. Int. Speech Comm. Assoc. (Interspeech)*, pp. 2251–2254, Brighton, United Kingdom, 2009.
- (C077) K. Kumar, J. Navratil, E. Marcheret, V. Libal, G. Ramaswamy, and **G. Potamianos**, “Audio-visual speech synchronization detection using a bimodal linear prediction model,” *Proc. IEEE Comp. Soc. Works. Biometrics, Held in Association with CVPR*, Miami Beach, FL, 2009.
- (C076) V. Libal, B. Ramabhadran, N. Mana, F. Pianesi, P. Chippendale, O. Lanz, and **G. Potamianos**, “Multimodal classification of activities of daily living inside smart homes,” *Int. Works. Ambient Assisted Living (IWAAL)*, LNCS vol. 5518, Part II, pp. 687–694, Salamanca, Spain, 2009.
- (C075) X. Zhuang, J. Huang, **G. Potamianos**, and M. Hasegawa-Johnson, “Acoustic fall detection using Gaussian mixture models and GMM supervectors,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, pp. 69–72, Taipei, Taiwan, 2009.
- (C074) J. Huang, X. Zhuang, V. Libal, and **G. Potamianos**, “Long-time span acoustic activity analysis from far-field sensors in smart homes,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, pp. 4173–4176, Taipei, Taiwan, 2009.
- (C073) **G. Potamianos**, J. Huang, E. Marcheret, V. Libal, R. Balchandran, M. Epstein, L. Seredi, M. Labsky, L. Ures, M. Black, and P. Lucey, “Far-field multimodal speech processing and conversational interaction in smart spaces,” *Proc. Joint Work. Hands-Free Speech Communication and Microphone Arrays (HSCMA)*, Trento, Italy, 2008.
- (C072) A. Leone, G. Diraco, C. Distanto, P. Siciliano, M. Grassi, A. Lombardi, G. Rescio, P. Malcovati, M. Malfatti, L. Gonzo, V. Libal, J. Huang, and **G. Potamianos**, “A multi-sensor approach for people fall detection in home environment,” *Proc. 10th Europ. Conf. Computer Vision (ECCV)*, Marseille, France, 2008.
- (C071) P. Lucey, **G. Potamianos**, and S. Sridharan, “Patch-based analysis of visual speech from multiple views,” *Proc. Int. Conf. Auditory-Visual Speech Process. (AVSP)*, pp. 69–73, Tangalooma, Australia, 2008.
- (C070) R. Balchandran, M. Epstein, **G. Potamianos**, and L. Seredi, “A multi-modal spoken dialog system for interactive TV,” *Proc. Int. Conf. Multimodal Interfaces (ICMI) – Demo Papers*, pp. 191–192, Chania, Greece, 2008.

- (C069) M. Grassi, A. Lombardi, G. Rescio, P. Malcovati, A. Leone, G. Diraco, C. Distanto, P. Siciliano, M. Malfatti, L. Gonzo, V. Libal, J. Huang, and **G. Potamianos**, “A hardware-software framework for high-reliability people fall detection,” *Proc. 7th IEEE Conf. on Sensors (SENSORS)*, pp. 1328–1331, Lecce, Italy, 2008.
- (C068) A. Tyagi, J.W. Davis, and **G. Potamianos**, “Steepest descent for efficient covariance tracking,” *Proc. IEEE Work. Motion and Video Computing (WMVC)*, Copper Mountain, Colorado, 2008.
- (C067) J. Huang, E. Marcheret, K. Visweswariah, and **G. Potamianos**, “The IBM RT07 evaluation systems for speaker diarization on lecture meetings,” in *Multimodal Technologies for Perception of Humans: International Evaluation Workshops CLEAR 2007 and RT 2007, Baltimore, Maryland, May 2007*, LNCS vol. 4625, pp. 497–508, Springer, Berlin, 2008.
- (C066) J. Huang, E. Marcheret, K. Visweswariah, V. Libal, and **G. Potamianos**, “The IBM Rich Transcription Spring 2007 speech-to-text systems for lecture meetings,” in *Multimodal Technologies for Perception of Humans: International Evaluation Workshops CLEAR 2007 and RT 2007, Baltimore, Maryland, May 2007*, LNCS vol. 4625, pp. 429–441, Springer, Berlin, 2008.
- (C065) V. Libal, J. Connell, **G. Potamianos**, and E. Marcheret, “An embedded system for in-vehicle visual speech activity detection,” *Proc. Int. Work. Multimedia Signal Process. (MMSP)*, pp. 255–258, Chania, Greece, 2007.
- (C064) P. Lucey, **G. Potamianos**, and S. Sridharan, “A unified approach to multi-pose audio-visual ASR,” *Proc. Conf. Int. Speech Comm. Assoc. (Interspeech)*, pp. 650–653, Antwerp, Belgium, 2007.
- (C063) J. Huang, E. Marcheret, K. Visweswariah, V. Libal, and **G. Potamianos**, “Detection, diarization, and transcription of far-field lecture speech,” *Proc. Conf. Int. Speech Comm. Assoc. (Interspeech)*, pp. 2161–2164, Antwerp, Belgium, 2007.
- (C062) P. Lucey, **G. Potamianos**, and S. Sridharan, “Pose-invariant audio-visual automatic speech recognition,” *Proc. Work. Audio-Visual Speech Process. (AVSP)*, pp. 176–180, Hilvarenbeek, The Netherlands, 2007.
- (C061) A. Tyagi, M. Keck, J.W. Davis, and **G. Potamianos**, “Kernel-based 3D tracking,” *Proc. IEEE Int. Work. Visual Surveillance (VS/CVPR)*, Minneapolis, Minnesota, 2007.
- (C060) A. Tyagi, **G. Potamianos**, J.W. Davis, and S.M. Chu, “Fusion of multiple camera views for kernel-based 3D tracking,” *Proc. IEEE Work. Motion and Video Computing (WMVC)*, Austin, Texas, 2007.
- (C059) E. Marcheret, V. Libal, and **G. Potamianos**, “Dynamic stream weight modeling for audio-visual speech recognition,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, vol. 4, pp. 945–948, Honolulu, Hawaii, 2007.
- (C058) **G. Potamianos** and P. Lucey, “Audio-visual ASR from multiple views inside smart rooms,” *Proc. Int. Conf. Multisensor Fusion and Integration for Intelligent Systems (MFI)*, pp. 35–40, Heidelberg, Germany, 2006.
- (C057) Z. Zhang, **G. Potamianos**, S.M. Chu, J. Tu, and T.S. Huang, “Person tracking in smart rooms using dynamic programming and adaptive subspace learning,” *Proc. Int. Conf. Multimedia Expo. (ICME)*, pp. 2061–2064, Toronto, Canada, 2006.
- (C056) P. Lucey and **G. Potamianos**, “Lipreading using profile versus frontal views,” *Proc. IEEE Work. Multimedia Signal Process. (MMSP)*, pp. 24–28, Victoria, Canada, 2006.
- (C055) A.W. Senior, **G. Potamianos**, S. Chu, Z. Zhang, and A. Hampapur, “A comparison of multicamera person-tracking algorithms,” *Proc. IEEE Int. Work. Visual Surveillance (VS/ECCV)*, Graz, Austria, 2006.
- (C054) **G. Potamianos** and Z. Zhang, “A joint system for single-person 2D-face and 3D-head tracking in CHIL seminars,” *Multimodal Technologies for Perception of Humans: First Int. Eval. Work. on Classification of Events, Activities and Relationships, CLEAR 2006*, R. Stiefelhagen and J. Garofolo (Eds.), LNCS vol. 4122, pp. 105–118, Southampton, United Kingdom, 2006.
- (C053) Z. Zhang, **G. Potamianos**, M. Liu, and T. Huang, “Robust multi-view multi-camera face detection inside smart rooms using spatio-temporal dynamic programming,” *Proc. Int. Conf. Automatic Face and Gesture Recog. (FGR)*, Southampton, United Kingdom, 2006.
- (C052) E. Marcheret, **G. Potamianos**, K. Visweswariah, and J. Huang, “The IBM RT06s evaluation system for speech activity detection in CHIL seminars,” *Proc. RT06s Evaluation Work. – held with Joint Work. on Multimodal Interaction and Related Machine Learning Algorithms (MLMI)*, S. Renals, S. Bengio, and J.G. Fiscus (Eds.), LNCS vol. 4299, pp. 323–335, Washington DC, 2006.
- (C051) J. Huang, M. Westphal, S. Chen, O. Siohan, D. Povey, V. Libal, A. Soneiro, H. Schulz, T. Ross, and **G. Potamianos**, “The IBM Rich Transcription Spring 2006 speech-to-text system for lecture meetings,” *Proc. RT06s Evaluation Work. – held with Joint Work. on Multimodal Interaction and Related Machine Learning Algorithms (MLMI)*, S. Renals, S. Bengio, and J.G. Fiscus (Eds.), LNCS vol. 4299, pp. 432–443, Washington DC, 2006.
- (C050) **G. Potamianos** and P. Scanlon, “Exploiting lower face symmetry in appearance-based automatic speechreading,” *Proc. Work. Audio-Visual Speech Process. (AVSP)*, pp. 79–84, Vancouver Island, Canada, 2005.

- (C049) S.M. Chu, E. Marcheret, and **G. Potamianos**, “Automatic speech recognition and speech activity detection in the CHIL smart room,” *Proc. Joint Work. on Multimodal Interaction and Related Machine Learning Algorithms (MLMI)*, LNCS vol. 3869, pp. 332–343, Edinburgh, United Kingdom, 2005.
- (C048) Z. Zhang, **G. Potamianos**, A. Senior, S. Chu, and T. Huang, “A joint system for person tracking and face detection,” *Proc. Int. Work. Human-Computer Interaction (ICCV 2005 Work. on HCI)*, pp. 47–59, Beijing, China, 2005.
- (C047) E. Marcheret, K. Visweswariah, and **G. Potamianos**, “Speech activity detection fusing acoustic phonetic and energy features,” *Proc. Europ. Conf. Speech Comm. Technol. (Interspeech)*, pp. 241–244, Lisbon, Portugal, 2005.
- (C046) J. Jiang, **G. Potamianos**, and G. Iyengar, “Improved face finding in visually challenging environments,” *Proc. Int. Conf. Multimedia Expo. (ICME)*, Amsterdam, The Netherlands, 2005.
- (C045) D. Macho, J. Padrell, A. Abad, C. Nadeu, J. Hernando, J. McDonough, M. Wölfel, U. Klee, M. Omologo, A. Brutti, P. Svaizer, **G. Potamianos**, and S.M. Chu, “Automatic speech activity detection, source localization, and speech recognition on the CHIL seminar corpus,” *Proc. Int. Conf. Multimedia Expo. (ICME)*, Amsterdam, The Netherlands, 2005.
- (C044) P. Scanlon, **G. Potamianos**, V. Libal, and S.M. Chu, “Mutual information based visual feature selection for lipreading,” *Proc. Int. Conf. Spoken Lang. Process. (ICSLP)*, Jeju Island, Korea, 2004.
- (C043) E. Marcheret, S.M. Chu, V. Goel, and **G. Potamianos**, “Efficient likelihood computation in multi-stream HMM based audio-visual speech recognition,” *Proc. Int. Conf. Spoken Lang. Process. (ICSLP)*, Jeju Island, Korea, 2004.
- (C042) **G. Potamianos**, C. Neti, J. Huang, J.H. Connell, S. Chu, V. Libal, E. Marcheret, N. Haas, and J. Jiang, “Towards practical deployment of audio-visual speech recognition,” Invited, *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, vol. 3, pp. 777–780, Montreal, Canada, 2004.
- (C041) J. Jiang, **G. Potamianos**, H. Nock, G. Iyengar, and C. Neti, “Improved face and feature finding for audio-visual speech recognition in visually challenging environments,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, vol. 5, pp. 873–876, Montreal, Canada, 2004.
- (C040) S.M. Chu, V. Libal, E. Marcheret, C. Neti, and **G. Potamianos**, “Multistage information fusion for audio-visual speech recognition,” *Proc. Int. Conf. Multimedia Expo. (ICME)*, Taipei, Taiwan, 2004.
- (C039) **G. Potamianos**, C. Neti, and S. Deligne, “Joint audio-visual speech processing for recognition and enhancement,” *Proc. Work. Audio-Visual Speech Process. (AVSP)*, pp. 95–104, St. Jorioz, France, 2003.
- (C038) J. Huang, **G. Potamianos**, and C. Neti, “Improving audio-visual speech recognition with an infrared headset,” *Proc. Work. Audio-Visual Speech Process. (AVSP)*, pp. 175–178, St. Jorioz, France, 2003.
- (C037) **G. Potamianos** and C. Neti, “Audio-visual speech recognition in challenging environments,” *Proc. Europ. Conf. Speech Comm. Technol. (Eurospeech)*, pp. 1293–1296, Geneva, Switzerland, 2003.
- (C036) J.H. Connell, N. Haas, E. Marcheret, C. Neti, **G. Potamianos**, and S. Velipasalar, “A real-time prototype for small-vocabulary audio-visual ASR,” *Proc. Int. Conf. Multimedia Expo. (ICME)*, vol. II, pp. 469–472, Baltimore, MD, 2003.
- (C035) U.V. Chaudhari, G.N. Ramaswamy, **G. Potamianos**, and C. Neti, “Information fusion and decision cascading for audio-visual speaker recognition based on time varying stream reliability prediction,” *Proc. Int. Conf. Multimedia Expo. (ICME)*, pp. 9–12, Baltimore, MD, 2003.
- (C034) A. Garg, **G. Potamianos**, C. Neti, and T.S. Huang, “Frame-dependent multi-stream reliability indicators for audio-visual speech recognition,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, vol. I, pp. 24–27, Hong Kong, China, 2003.
- (C033) U.V. Chaudhari, G.N. Ramaswamy, **G. Potamianos**, and C. Neti, “Audio-visual speaker recognition using time-varying stream reliability prediction,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, vol. V, pp. 712–715, Hong Kong, China, 2003.
- (C032) S. Deligne, **G. Potamianos**, and C. Neti, “Audio-visual speech enhancement with AVCDCN (audio-visual codebook dependent cepstral normalization),” *Proc. Int. Conf. Spoken Lang. Process. (ICSLP)*, vol. 3, pp. 1449–1452, Denver, CO, 2002.
- (C031) R. Goecke, **G. Potamianos**, and C. Neti, “Noisy audio feature enhancement using audio-visual speech data,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, pp. 2025–2028, Orlando, FL, 2002.
- (C030) G. Gravier, S. Axelrod, **G. Potamianos**, and C. Neti, “Maximum entropy and MCE based HMM stream weight estimation for audio-visual ASR,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, pp. 853–856, Orlando, FL, 2002.
- (C029) G. Gravier, **G. Potamianos**, and C. Neti, “Asynchrony modeling for audio-visual speech recognition,” *Proc. Human Lang. Techn. Conf. (HLT)*, pp. 1–6, San Diego, CA, 2002.
- (C028) **G. Potamianos**, C. Neti, G. Iyengar, and E. Helmuth, “Large-vocabulary audio-visual speech recognition by machines

- and humans,” *Proc. Europ. Conf. Speech Comm. Technol. (Eurospeech)*, pp. 1027–1030, Aalborg, Denmark, 2001.
- (C027) **G. Potamianos** and C. Neti, “Automatic speechreading of impaired speech,” *Proc. Work. Audio-Visual Speech Process. (AVSP)*, pp. 177–182, Aalborg, Denmark, 2001.
- (C026) **G. Potamianos** and C. Neti, “Improved ROI and within frame discriminant features for lipreading,” *Proc. Int. Conf. Image Process. (ICIP)*, pp. 250–253, Thessaloniki, Greece, 2001.
- (C025) C. Neti, **G. Potamianos**, J. Luetttin, I. Matthews, H. Glotin, and D. Vergyri, “Large-vocabulary audio-visual speech recognition: A summary of the Johns Hopkins Summer 2000 Workshop,” *Proc. IEEE Work. Multimedia Signal Process. (MMSP)*, pp. 619–624, Cannes, France, 2001.
- (C024) G. Iyengar, **G. Potamianos**, C. Neti, T. Faruquie, and A. Verma, “Robust detection of visual ROI for automatic speechreading,” *Proc. IEEE Work. Multimedia Signal Process. (MMSP)*, pp. 79–84, Cannes, France, 2001.
- (C023) I. Matthews, **G. Potamianos**, C. Neti, and J. Luetttin, “A comparison of model and transform-based visual features for audio-visual LVCSR,” *Proc. Int. Conf. Multimedia Expo. (ICME)*, Tokyo, Japan, 2001.
- (C022) **G. Potamianos**, J. Luetttin, and C. Neti, “Hierarchical discriminant features for audio-visual LVCSR,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, vol. 1, pp. 165–168, Salt Lake City, UT, 2001.
- (C021) J. Luetttin, **G. Potamianos**, and C. Neti, “Asynchronous stream modeling for large-vocabulary audio-visual speech recognition,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, vol. 1, pp. 169–172, Salt Lake City, UT, 2001.
- (C020) H. Glotin, D. Vergyri, C. Neti, **G. Potamianos**, and J. Luetttin, “Weighting schemes for audio-visual fusion in speech recognition,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, vol. 1, pp. 173–176, Salt Lake City, UT, 2001.
- (C019) **G. Potamianos** and C. Neti, “Stream confidence estimation for audio-visual speech recognition,” *Proc. Int. Conf. Spoken Language Process. (ICSLP)*, vol. III, pp. 746–749, Beijing, China, 2000.
- (C018) C. Neti, G. Iyengar, **G. Potamianos**, A. Senior, and B. Maison, “Perceptual interfaces for information interaction: Joint processing of audio and visual information for human-computer interaction”, *Proc. Int. Conf. Spoken Language Process. (ICSLP)*, vol III, pp. 11-14, Beijing, China, 2000.
- (C017) **G. Potamianos**, A. Verma, C. Neti, G. Iyengar, and S. Basu, “A cascade image transform for speaker independent automatic speechreading,” *Proc. IEEE Int. Conf. Multimedia Expo. (ICME)*, vol. II, pp. 1097–1100, New York, NY, 2000.
- (C016) E. Cosatto, **G. Potamianos**, and H.P. Graf, “Audio-visual unit selection for the synthesis of photo-realistic talking-heads,” *Proc. IEEE Int. Conf. Multimedia Expo. (ICME)*, vol. II, pp. 619–622, New York, NY, 2000.
- (C015) **G. Potamianos** and A. Potamianos, “Speaker adaptation for audio-visual automatic speech recognition,” *Proc. Europ. Speech Comm. Technol. (Eurospeech)*, Budapest, Hungary, vol. 3, pp. 1291–1294, 1999.
- (C014) **G. Potamianos** and H.P. Graf, “Linear discriminant analysis for speechreading,” *Proc. IEEE Work. Multimedia Signal Process. (MMSP)*, Los Angeles, CA, pp. 221–226, 1998.
- (C013) **G. Potamianos**, H.P. Graf, and E. Cosatto, “An image transform approach for HMM based automatic lipreading,” *Proc. Int. Conf. Image Process. (ICIP)*, Chicago, IL, pp. 173–177, 1998.
- (C012) **G. Potamianos** and H.P. Graf, “Discriminative training of HMM stream exponents for audio-visual speech recognition,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, Seattle, WA, vol. 6, pp. 3733–3736, 1998.
- (C011) H.P. Graf, E. Cosatto, and **G. Potamianos**, “Machine vision of faces and facial features,” *Proc. R.I.E.C. Int. Symp. Design Archit. Inform. Process. Systems Based Brain Inform. Princ.*, Sendai, Japan, pp. 48–53, 1998.
- (C010) **G. Potamianos**, E. Cosatto, H.P. Graf, and D.B. Roe, “Speaker independent audio-visual database for bimodal ASR,” *Proc. Europ. Tutorial Research Work. Audio-Visual Speech Process. (AVSP)*, Rhodes, Greece, pp. 65–68, 1997.
- (C009) H.P. Graf, E. Cosatto, and **G. Potamianos**, “Robust recognition of faces and facial features with a multi-modal system,” *Proc. Int. Conf. Systems Man Cybern. (ICSMC)*, Orlando, FL, pp. 2034–2039, 1997.
- (C008) **G. Potamianos**, “Efficient Monte Carlo estimation of partition function ratios of Markov random field images,” *Proc. Conf. Inform. Sci. Systems (CISS)*, Princeton, NJ, vol. II, pp. 1212–1215, 1996.
- (C007) **G. Potamianos** and J. Goutsias, “A unified approach to Monte Carlo likelihood estimation of Gibbs random field images,” *Proc. Conf. Inform. Sci. Systems (CISS)*, Princeton, NJ, vol. I, pp. 84–90, 1994.
- (C006) **G. Potamianos** and J. Goutsias, “An analysis of Monte Carlo methods for likelihood estimation of Gibbsian images,” *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, Minneapolis, MN, vol. V, pp. 519–522, 1993.
- (C005) **G. Potamianos** and J. Goutsias, “On computing the likelihood function of partially observed Markov random field images using Monte Carlo simulations,” *Proc. Conf. Inform. Sci. Systems (CISS)*, Princeton, vol. I, pp. 357–362, 1992.

- (C004) **G. Potamianos** and J. Goutsias, "A novel method for computing the partition function of Markov random field images using Monte Carlo simulations," *Proc. Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, Toronto, Canada, vol. 4, pp. 2325–2328, 1991.
- (C003) **G. Potamianos** and J. Diamessis, "Frequency sampling design of 2-D IIR filters using continued fractions," *Proc. Int. Symp. Circuits Systems (ISCAS)*, New Orleans, LA, pp. 2454–2457, 1990.
- (C002) J. Diamessis and **G. Potamianos**, "A novel method for designing IIR filters with nonuniform samples," *Proc. Conf. Inform. Sci. Systems (CISS)*, Princeton, NJ, vol. 1, pp. 192–195, 1990.
- (C001) J. Diamessis and **G. Potamianos**, "Modeling unequally spaced 2-D discrete signals by rational functions," *Proc. Int. Symp. Circuits Systems (ISCAS)*, Portland, OR, pp. 1508–1511, 1989.

Thesis

G. Potamianos, *Stochastic Simulation Algorithms for Partition Function Estimation of Markov Random Field Images*, The Johns Hopkins University, 1994.

Technical Reports

- (T07) C. Neti, **G. Potamianos**, J. Luetttin, I. Matthews, H. Glotin, D. Vergyri, J. Sison, A. Mashari, and J. Zhou, "Audio-Visual Speech Recognition: Final Workshop 2000 Report", *Technical Report*, Center for Language and Speech Processing, The Johns Hopkins University, Baltimore, MD, 2000.
- (T06) **G. Potamianos** and F. Jelinek, "A study of n-gram and decision tree letter language modeling methods," *Research Notes, Center for Language and Speech Processing Technical Report*, no. 13, The Johns Hopkins University, Baltimore, MD, 1997.
- (T05) **G. Potamianos** and J. Goutsias, "Stochastic Approximation Algorithms for Partition Function Estimation of Gibbs Random Fields," *Technical Report JHU/ECE*, no. 95-27, Department of Electrical and Computer Engineering, The Johns Hopkins University, Baltimore, 1995.
- (T04) **G. Potamianos** and A. Gatherer, "Coaxial cable system channel impairments and their effects to the transmission of QAM modulated signals," *Technical Activity Report*, Integrated Systems Laboratory, Texas Instruments, Dallas, 1994.
- (T03) **G. Potamianos**, A. Gatherer, and G. Wyman, "Coaxial cable channel impulse response characterization," *Technical Activity Report*, Integrated Systems Laboratory, Texas Instruments, Dallas, 1994.
- (T02) **G. Potamianos** and J. Goutsias, "Analysis of stochastic simulation algorithms for partition function estimation of Gibbs images," *Technical Report JHU/ECE*, no. 93-05, Department of Electrical and Computer Engineering, The Johns Hopkins University, Baltimore, 1993.
- (T01) **G. Potamianos** and J. Goutsias, "Stochastic simulation techniques for partition function approximation of Gibbs random field images," *Technical Report JHU/ECE*, no. 91-02, Department of Electrical and Computer Engineering, The Johns Hopkins University, Baltimore, 1991.

U.S. Patents

- (P07) S.M. Chu, V. Goel, E. Marcheret, and **G. Potamianos**, *Method for Likelihood Computation in Multi-Stream HMM Based Speech Recognition*, Patent No.: US007480617B2, Jan. 20, 2009.
- (P06) S. Deligne, C.V. Neti, and **G. Potamianos**, *Audio-Visual Codebook Dependent Cepstral Normalization*, Patent No.: US007319955B2, Jan. 15, 2008.
- (P05) J.H. Connell, N. Haas, E. Marcheret, C.V. Neti, and **G. Potamianos**, *Audio-Only Backoff in Audio-Visual Speech Recognition System*, Patent No.: US007251603B2, July 31, 2007.
- (P04) U.V. Chaudhari, C. Neti, **G. Potamianos**, and G.N. Ramaswamy, *Automated Decision Making Using Time-Varying Stream Reliability Prediction*, Patent No.: US007228279B2, June 5, 2007.
- (P03) P. de Cuetos, G.R. Iyengar, C.V. Neti, and **G. Potamianos**, *System and Method for Microphone Activation Using Visual Speech Cues*, Patent No.: US006754373B1, June 22, 2004.
- (P02) E. Cosatto, H.P. Graf, **G. Potamianos**, and J. Schroeter, *Audio-Visual Selection Process for the Synthesis of Photo-Realistic Talking-Head Animations*, Patent No.: US006654018B1, Nov. 25, 2003.
- (P01) E. Cosatto, H.P. Graf, and **G. Potamianos**, *Robust Multi-Modal Method for Recognizing Objects*, Patent No.: US006118887A, Sep. 12, 2000.