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Research Highlights

The research aims to develop and disseminate interdisciplinary scholarship focused on the scientific understanding of human communication and behavior, and the creation of human-centered technologies that are robust, equitable, and importantly, inspired by societal needs in national security, health and education.

Below are broad research areas with representative publications. A complete set of papers is available at:
Publications http://sail.usc.edu/publications/
Google Scholar: https://scholar.google.com/citations?user=8EDHmYkAAAAJ

- **Computational Speech Communication Science**
- **Speech and Language Processing Technologies**
- **Computational Media Intelligence: Multimedia Content Processing and Media Informatics**
- **Emotions Research and Affective Computing**
- **Behavioral Machine Intelligence: Behavioral Signal Processing and Behavioral Informatics**
  - **Applications in Health**
- **Bio-signals and systems**
- **Foundations of Human-centered Signal Analysis and Interpretation**
- **Child-centric Speech and Multimodal Processing and Applications**
  - **Child-centric Applications: Autism Spectrum Disorder**
  - **Child-centric Applications: Other**
- **Audio and music processing**
- **Dataset Papers**

Computational Speech Communication Science: By creating and applying multimodal signal processing techniques that include novel imaging with speech, audio, and other physiological signal processing and modeling, in conjunction with linguistically informed computational and empirical studies, Narayanan has made fundamental contributions to speech science, much of it published in numerous articles that are widely cited. His early work contributed to improved understanding of some of the basic speech sound mechanisms such as fricatives and liquids. A major highlight is the development and demonstration for the first time of a real-time magnetic resonance imaging that offers veritable means for studying human speech production. These have led to computational discovery of speech primitives that are cognitively meaningful, and physically interpretable. In addition to spawning new speech science and linguistics research, the work is used in clinical applications and as a teaching resource. Narayanan's work has also provided the most comprehensive account of acoustic properties of children's speech with broad impact on many engineering and non- engineering studies that have followed.

1. S. Narayanan, K. Nayak, S. Lee, A. Sethy, & D. Byrd (2004). An approach to real-time magnetic resonance imaging for speech production. *J. Acoust. Soc. Am.*, *115*, 771-1776.
2. V. Ramanarayanan, L. Goldstein, & S. Narayanan (2013). Spatio-temporal articulatory movement primitives during speech production—extraction, interpretation and validation. *J. Acoust. Soc. Am., 134*(2), 1378-1394.
3. S. Lee, A. Potamianos, & S. Narayanan (1999). Acoustics of children's speech: Developmental changes of temporal and spectral parameters. *J. Acoust. Soc. Am., 105*, 1455-1468. (JASA "Selected Research Article")
4. S. Narayanan K, Haker & A. Alwan (2000). An articulatory study of fricative consonants using magnetic resonance imaging. *J. Acoust. Soc. Am.,* 98 (3), 1325-1347
5. Vikram Ramanarayanan, Sam Tilsen, Michael Proctor, Johannes Töger, Louis Goldstein, Krishna Nayak, Shrikanth Narayanan. Analysis of Speech Production Real-Time MRI. *Computer Speech & Language*. 52:-1-22, 2018
6. V. Ramanarayanan, A. Lammert, L. Goldstein & S. Narayanan (2014). Are articulatory settings mechanically advantageous for speech motor control? *PLoS ONE*, 9(8): e104168.
7. Christina Hagedorn, Jangwon Kim, Uttam Sinha, Louis Goldstein, Shrikanth S Narayanan, "Complexity of vocal tract shaping in glossectomy patients and typical speakers: A principal component analysis", *The Journal of the Acoustical*

Society of America, vol. 149, no. 6, pp. 4437-4449, 2021.

8. Rachel Alexander, Tanner Sorensen, Asterios Toutios, Shrikanth Narayanan, "A modular architecture for articulatory synthesis from gestural specification", *The Journal of the Acoustical Society of America*, vol. 146, no. 6, pp. 4458-4471, 2019.

9. Tanner Sorensen, Asterios Toutios, Louis Goldstein, Shrikanth Narayanan, "Task-dependence of articulator synergies", *The Journal of the Acoustical Society of America*, vol. 145, no. 3, pp. 1504-1520, 2019.

10. Adam C. Lammert, Christine H. Shadle, Shrikanth S. Narayanan, Thomas F. Quatieri, "Speed-accuracy tradeoffs in human speech production", *PLOS ONE*, Public Library of Science, vol. 13, no. 9, pp. 1-25, 2018

11. Yihe Zu, Shrikanth S. Narayanan, Yoon-Chul Kim, Krishna S. Nayak, Christina Bronson-Lowe, Brenda Villegas, Melody Ouyoung, Uttam Sinha, "Evaluation of swallow function post tongue cancer treatment using real-time MRI: A pilot study", *JAMA Otolaryngology - Head & Neck Surgery*, vol. 139, no. 12, pp. 1312-1319, 2013.

Complete list of papers: https://sail.usc.edu/span/publications.php

Speech and Language Processing Technologies**:**   Narayanan's wide-ranging contributions include the development of novel mathematical and engineering methods for automatic analysis, interpretation and synthesis of human communication and interaction signals. His work uniquely integrates deriving information about *what*, i.e., signal content (e.g., what is spoken, in what language, dialog/discourse details), *how*, i.e., signal style/expression including models of speech prosody and *who*, i.e., signal source with applications to automatic speaker recognition, and biometrics. Sample papers:

1. Tae Jin Park, Naoyuki Kanda, Dimitrios Dimitriadis, Kyu J. Han, Shinji Watanabe, Shrikanth Narayanan. A review of speaker diarization: Recent advances with deep learning. Computer Speech & Language. 72: 101317, 2022

2. Prashanth Gurunath Shivakumar, Shrikanth Narayanan. End-to-End Neural Systems for Automatic Children Speech Recognition: An Empirical Study. Computer Speech & Language. 72:101289, 2022

3. Monisankha Pal, Manoj Kumar, Raghuveer Peri, Tae Jin Park, So Hyun Kim, Catherine Lord, Somer Bishop, and Shrikanth Narayanan. Meta-learning with Latent Space Clustering in Generative Adversarial Network for Speaker Diarization. *IEEE/ACM Transactions on Audio, Speech and Language Processing*. 29: 1204-1219, 2021

4. Arindam Jati, Chin-Cheng Hsu, Monisankha Pal, Raghuveer Peri, Wael AbdAlmageed, Shrikanth Narayanan. Adversarial Attack and Defense Strategies for Deep Speaker Recognition Systems. *Computer Speech & Language. 68:* 101199, 2021

5. Haoqi Li, Brian Baucom, Shrikanth Narayanan, Panayiotis Georgiou. Unsupervised Speech Representation Learning for Behavior Modeling using Triplet Enhanced Contextualized Networks. *Computer Speech & Language.* 2021

6. Md Nasir, Brian Baucom, Shrikanth Narayanan, Panayiotis Georgiou. Modeling Vocal Entrainment in Conversational Speech using Deep Unsupervised Learning. *IEEE Transactions on Affective Computing.* 2020

7. M. Kumar, S. Kim, C. Lord, T. Lyon, S. Narayanan. Leveraging Linguistic Context in Dyadic Interactions to Improve Automatic Speech Recognition for Children. *Computer Speech & Language. 63,* 2020

8. Tae Jin Park, Kyu Han, Manoj Kumar, Shrikanth Narayanan. Auto-Tuning Spectral Clustering for Speaker Diarization Using Normalized Maximum Eigengap. *IEEE Signal Processing Letters.* 27(1): 381-385, December 2020

9. Ruchir Travadi and Shrikanth Narayanan. Total Variability Layer in Deep Neural Network Embeddings for Speaker Verification. *IEEE Signal Processing Letters.* 26(6): 893-897. June 2019

10. K. Audhkhasi, A. Zavou, P. Georgiou & S. Narayanan (2014). Theoretical analysis of diversity in an ensemble of automatic speech recognition systems. *IEEE/ACM Transactions on Audio, Speech and Language Processing*, 22(3).

11. S. Ananthakrishnan & S. Narayanan (2008). Automatic prosody Labeling using acoustic, lexical, and syntactic evidence. *IEEE Transactions on Audio, Speech and Language Processing*, 16(1), 216-228.

12. M. Li & S. Narayanan (2014). Simplified Supervised i-vector Modeling with application to Robust and Efficient Language Identification and Speaker Verification. *Computer, Speech, and Language*.

13. P. Ghosh, A. Tsiartas & S. Narayanan (2011). Robust voice activity detection using long-term signal variability. *IEEE Transactions on Audio, Speech and Language Processing*, 19(3): 600-613.

14. M. Van Segbroeck, R. Travadi & Shrikanth Narayanan (2015). Rapid language identification. *IEEE/ACM Transactions on Audio, Speech and Language Processing*, 23(7): 1118 - 1129, July 2015

15. Vivek Kumar Rangarajan Sridhar, Srinivas Bangalore, Shrikanth Narayanan. Enriching machine-mediated speech-to-speech translation using contextual information. *Computer, Speech, and Language*. 27(2): 492-508, February 2013

Complete list of papers: https://sail.usc.edu/publications/sorted-by-category/#speechlinks

Computational Media Intelligence: Multimedia Content Processing and Media Informatics: Design and development of computational methods and tools for multimedia processing and applications in education, arts and the media.

1. Krishna Somandepalli, Tanaya Guha, Victor Martinez, Naveen Kumar, Hartwig Adam, Shrikanth Narayanan. Computational Media Intelligence: Human-centered Machine Analysis of Media. *Proceedings of IEEE*. 109(5): 891-910, May 2021
2. Sabyasachee Baruah, Sandeep Nallan Chakravarthula, Shrikanth Narayanan. Annotation and Evaluation of Coreference Resolution in Screenplays. In Proceedings Association for Computational Linguistics, 2021.
3. Krishna Somandepalli, Rajat Hebbar, Shrikanth Narayanan. Robust Character Labeling in Movie Videos: Data Resources and Self-supervised Feature Adaptation. *IEEE Transactions on Multimedia*. 2021
4. Victor Martinez, Krishna Somandepalli, Yalda Tehranian-Uhls and Shrikanth Narayanan. Joint Estimation and Analysis of Risk Behavior Ratings in Movie Scripts. In Proceedings of The 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP), November 2020
5. Benjamin Ma, Timothy Greer, Dillon Knox, Shrikanth Narayanan. A computational lens into how music characterizes genre in film. 16(4): e0249957, *PLoS ONE*. 2021
6. Victor Martinez, Krishna Somandepalli, Karan Singla, Anil Ramakrishna, Yalda Uhls, and Shrikanth Narayanan. Violence Rating Prediction from Movie Scripts. In *In proceedings of Proceedings of Thirty-Third AAAI Conference on Artificial Intelligence*, January 2019.
7. K. Somandepalli, N. Kumar, T. Guha, & S. Narayanan (2017). Unsupervised discovery of character dictionaries in animation movies. *IEEE Transactions on Multimedia.*
8. T. Agrawal, R. Gupta, & S. Narayanan (2017). Multimodal detection of fake social media use through a fusion of classification and pairwise ranking systems. In *Proceedings of EUSIPCO*.
9. A. Ramakrishna, V. Martínez, N. Malandrakis, K. Singla & S. Narayanan (2017). Linguistic analysis of differences in portrayal of movie characters. *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics (ACL)*.
10. T. Guha, C. Huang, N. Kumar, Y. Zhu & S. Narayanan (2015). Gender representation in cinematic content: A multimodal approach. In *Proceedings of 17th ACM International Conference on Multimodal Interaction (ICMI)*.
11. Emily Mower, Maja Mataric, Shrikanth Narayanan. Human Perception of Audio-Visual Synthetic Character Emotion Expression in the Presence of Ambiguous and Conflicting Information. *IEEE Transactions on Multimedia*. 11(5):843-855, 2009
12. Zhigang Deng, Ulrich Neumann, J.P. Lewis, Tae-Yong Kim, Murtaza Bulut, and Shrikanth Narayanan. Real-Time Expressive Visual Speech Synthesis and Selected Applications in MPEG-4 Facial Animation. *IEEE Transactions On Visualization And Computer Graphics*. 12(6): 1523-1534, Nov/Dec 2006.
13. Carlos Busso, Zhigang Deng, Ulrich Neumann and Shrikanth Narayanan. Natural Head Motion Synthesis driven by Acoustic Prosody Features. Journal of *Computer Animation and Virtual Worlds* (John Wiley), vol. 16, no. 3-4, pp. 283–290, July 2005
14. Ying Li, Shrikanth Narayanan, and C.-C. Jay Kuo. Content-based Movie Analysis and Indexing Based on AudioVisual Cues. *IEEE Trans. Circuits and Systems for Video Technology*, 14(8):1073-1085, 2004.
15. Ying Li, Shrikanth Narayanan, and C.-C. Jay Kuo. Adaptive speaker identification with audiovisual cues for movie content analysis. *Pattern Recognition Letters* (Special Issue on Recent Trends in Video Computing), 25(7): 777-791, 2004

Complete list of papers: https://sail.usc.edu/~ccmi/publications/

Emotions Research and Affective Computing Narayanan has made fundamental contributions to computational modeling of emotions from multimodal facets of speech and spoken language, and non-verbal cues (face, body) demonstrated its utility on a real life spoken dialog application. His work in this realm has been recognized with numerous awards: including a record six-time winner of Interspeech Paralinguistic Challenge award, 2014 ten year impact award from ACM ICMI and a Best Journal paper award from the IEEE Signal Processing Society.

1. C. M. Lee & S. Narayanan (2005). Towards detecting emotions in spoken dialogs. *IEEE Transactions on Speech and Audio Processing*, 13(2): 293-302. (IEEE Signal Processing Society Best Paper Award, 2009)
2. C. Busso, Z. Deng, S. Yildirim, M. Bulut, C. M. Lee, A. Kazemzadeh, S. Lee, U. Neumann & S. Narayanan (2014). Analysis of emotion recognition using facial expressions, speech and multimodal information, in *Proceedings of International Conf. on Multimodal Interfaces*, pp. 205-211. (ACM Ten Year Technical Impact Award)

3. M. Grimm, E. Mower, K. Kroschel, & S. Narayanan (2007). Primitives based estimation and evaluation of emotions in speech. *Speech Communication*, 49, 787-800.
4. E. Mower, M. Mataric & S. Narayanan (2011). A Framework for Automatic Human Emotion Classification Using Emotional Profiles. *IEEE Transactions on Audio, Speech and Language Processing*, 19(5), 1057-1070
5. Daniel Bone, Chi-chun Lee and Shrikanth S. Narayanan. Robust Unsupervised Arousal Rating: A rule-based framework with knowledge-inspired vocal features. IEEE Transactions on Affective Computing. 5(2): 201-213, 2014
6. Z. Yang & Shrikanth Narayanan (2016). Modeling dynamics of expressive body gestures in dyadic interactions. *IEEE Transactions on Affective Computing*.
7. Angeliki Metallinou, Athanasios Katsamanis and Shrikanth Narayanan. Tracking continuous emotional trends of participants during affective dyadic interactions using body language and speech information. *Journal Image and Vision Computing*. 31(2): 137-152, February 2013
8. Angeliki Metallinou, Martin Wollmer, Athanasios Katsamanis, Florian Eyben, Bjorn Schuller, and Shrikanth Narayanan. Context-Sensitive Learning for Enhanced Audiovisual Emotion Classification. IEEE Transactions on Affective Computing. 3(2): 184-198, April-June, 2012.
9. Chi-Chun Lee, Emily Mower, Carlos Busso, Sungbok Lee, Shrikanth Narayanan. Emotion recognition using a hierarchical binary decision tree approach. *Speech Communication*. Sensing Emotion and Affect - Facing Realism in Speech Processing. 53(9-10): 1162-1171, November-December 2011.
10. Shen Yan, Homa Hosseinmardi, Hsien-Te Kao, Shrikanth Narayanan, Krisitina Lerman and Emilio Ferrara. Affect Estimation with Wearable Sensors. *Journal of Healthcare Informatics Research*. 4(3): 261–294, March 2020
11. Shao-Yen Tseng, Shrikanth Narayanan, Panayiotis Georgiou. Multimodal Embeddings from Language Models for Emotion Recognition in the Wild. 28: 608—612, *IEEE Signal Processing Letters.* 2021
12. Che-Wei Huang and Shrikanth Narayanan. Characterizing Types of Convolution in Deep Convolutional Recurrent Neural Networks for Robust Speech Emotion Recognition. *IEEE Transactions on Affective Computing.* 2018.

Complete list of papers: https://sail.usc.edu/publications/sorted-by-category/#emotion

Behavioral Machine Intelligence: Behavioral Signal Processing and Behavioral Informatics Narayanan has pioneered behavioral signal processing, which attempts to map behavioral observations to constructs that support expert decision making and in creating tools for scientific discovery.
1. S. Narayanan & P. Georgiou (2013). Behavioral Signal Processing: Deriving Human Behavioral Informatics from Speech and Language. *Proceedings of IEEE*, 101(5), 1203 - 1233.
2. B. Schuller, S. Steidl, A. Batliner, F. Burkhardt, L. Devillers, C. Müller, & S. Narayanan (2013). Paralinguistics in speech and language—State-of-the-art and the challenge. *Computer, Speech, and Language*, 27(1), 4-39.
3. Z. Yang, A. Metallinou & S. Narayanan (2014). Analysis and predictive modeling of body language behavior in dyadic interactions from multimodal interlocutor cues. *IEEE Transactions on Multimedia*, 16(6), 1766-1778.
4. N. Malandrakis, A. Potamianos, E. Iosif, & S. Narayanan (2013). Distributional semantic models for affective text analysis. *IEEE Transactions on Audio, Speech and Language Processing*, 21(11), 2379-2392.
5. M. Van Segbroeck, A. Knoll, P. Levitt & Shrikanth Narayanan (2017). MUPET-Mouse Ultrasonic Profile ExTraction: A signal processing tool for rapid and unsupervised analysis of ultrasonic vocalizations. *Neuron*, 94: 465-485.
6. James Gibson, David Atkins, Torrey Creed, Zac Imel, Panayiotis Georgiou and Shrikanth Narayanan. Multi-label Multi-task Deep Learning for Behavioral Coding. *IEEE Transactions on Affective Computing*. 13(1): 508-518, 2022
7. Md Nasir, Brian Baucom, Shrikanth Narayanan, Panayiotis Georgiou. Modeling Vocal Entrainment in Conversational Speech using Deep Unsupervised Learning. *IEEE Transactions on Affective Computing*. 2020
8. Bo Xiao, Panayiotis Georgiou, Brian Baucom and Shrikanth S. Narayanan. Head Motion Modeling for Human Behavior Analysis in Dyadic Interaction. *IEEE Transactions on Multimedia*. 17(7): 1107-1119, July 2015
9. Rahul Gupta, Kartik Audhkhasi, Sungbok Lee and Shrikanth Narayanan. Detecting paralinguistic events in audio stream using context in features and probabilistic decisions. *Computer, Speech, and Language*. 36: 72-92, 2016
10. James Gibson, Athanasios Katsamanis, Francisco Romero, Bo Xiao, Panayiotis Georgiou, Shrikanth Narayanan.
Multiple Instance Learning for Behavioral Coding. IEEE Transactions on Affective Computing. 8(1): 81-94, Jan 201

Applications in Health

Design and development of computational methods and tools for health applications including notably behavioral and mental health, and neurological and neurodevelopment disorders.
1. M. Black, A. Katsamanis, B. Baucom, Chi-Chun Lee, A. Lammert, A. Christensen, P. Georgiou & S. Narayanan (2013). Toward automating a human behavioral coding system for married couples' interactions using speech acoustic features. *Speech Communication*, 55(1):1-21.
2. B. Xiao, Z. Imel, P. Georgiou, D. Atkins & S. Narayanan. ”Rate my therapist”: Automated detection of empathy in drug

and alcohol counseling via speech and language processing. *PLoS ONE*, 2015.

3. D. Bone, M. Goodwin, M. Black, C.-C. Lee, K. Audhkhasi, & S. Narayanan. Applying Machine Learning to Facilitate Autism Diagnostics: Pitfalls and promises. *J. of Autism and Developmental Disorders*, 45(5), 1121-1136.
4. J. Kim, N. Kumar, A. Tsiartas, M. Li and S. Narayanan (2015). Automatic intelligibility classification of sentence-level pathological speech. *Computer, Speech, and Language*, 29(1): 132-144.
5. Y. Zu, S. Narayanan, Y.-C. Kim, K. Nayak, C. Bronson-Lowe, B. Villegas, M. Ouyoung & U. Sinha (2013). Evaluation of swallow function post tongue cancer treatment using real-time MRI: A pilot study. *JAMA Otolaryngology - Head & Neck Surgery*. 139(12):1312-1319
6. C. Hagedorn, M. Proctor, L. Goldstein, S. Wilson, B. Miller, M. Gorno Tempini & S. Narayanan (2017). Characterizing Articulation in Apraxic Speech Using Real-time Magnetic Resonance Imaging. *Journal of Speech, Language, and Hearing Research*, 60(4):877-891.
7. B Baucom, P. Georgiou, C. Bryan, E. Garland, F. Leifker, A. May, A. Wong, & S. Narayanan (2017). The promise and the challenge of technology-facilitated methods for assessing behavioral and cognitive markers of risk for suicide among U.S. Army National Guard personnel. *International Journal of Environmental Research and Public Health*. Special Issue on From Understanding Suicide Risk to Preventing Suicide, 14(4):361.
8. A. Timmons, T. Chaspari, S. Han, L. Perrone, S. Narayanan & G. Margolin (2017). Multimodal detection of conflict in couples using wearable technology. *IEEE Computer,* 50(3): 50-59.
9. D. Bone, S. Bishop, M. Black, M. Goodwin, C. Lord & S. Narayanan (2016). Use of machine learning to improve Autism screening and diagnostic instruments: Effectiveness, efficiency, and multi-instrument fusion. *Journal of Child Psychology and Psychiatry*, 57(8): 927-937.
10. Armen Arevian, Daniel Bone, Nikolaos Malandrakis, Victor R Martinez, Kenneth B Wells, David J Miklowitz, Shrikanth Narayanan. Clinical state tracking in serious mental illness through computational analysis of speech. *PLoS ONE.* 15(1): e0225695*, 2020

Complete list of papers: https://sail.usc.edu/publications/sorted-by-category/#bsp

Bio-signals and systems

1. Tiantian Feng, Brandon M. Booth, Brooke Baldwin-Rodrıguez, Felipe Osorno, Shrikanth Narayanan. A multimodal analysis of physical activity, sleep, and work shift in nurses with wearable sensor data. *Scientific Reports* 11, 8693 (Nature Publishing Group). 2021
2. Digbalay Bose, Krishna Somandepalli, Tymon Tai, Courtney Voelker, Shrikanth Narayanan, Amit Kochhar. Automated analysis of asymmetry in facial paralysis patients using landmark-based measures. *Facial Plastic Surgery and Aesthetic Medicine*. 2022
3. Sohyun C. Han, Hannah L. Schacter, Adela C. Timmons, Yehsong Kim, Stassja Sichko, Corey Pettit, Theodora Chaspari, Shrikanth Narayanan, and Gayla Margolin. Romantic partner presence and physiological responses in daily life: Attachment style as a moderator. *Biological Psychology*. 2021
4. Yongwan Lim, Asterios Toutios, Yannick Bliesener, Ye Tian, Sajan Goud Lingala, Colin Vaz, Tanner Sorensen, Miran Oh, Sarah Harper, Weiyi Chen, Yoonjeong Lee, Johannes Töger, Mairym Lloréns Montesserin, Caitlin Smith, Bianca Godinez, Louis Goldstein, Dani Byrd, Krishna S. Nayak, Shrikanth S. Narayanan. A multispeaker dataset of raw and reconstructed speech production real-time MRI video and 3D volumetric images. *Scientific Data* 8, 187 (Nature Publishing Group). 2021
5. Mari Ganesh Kumar, Shrikanth Narayanan, Mriganka Sur and Hema A Murthy. Evidence of Task-Independent Person-Specific Signatures in EEG using Subspace Techniques. *IEEE Transactions on Information Forensics & Security*. 16: 2856-2871, 2021
6. Karel Mundnich, Brandon M. Booth, Michelle L'Hommedieu, Tiantian Feng, Benjamin Girault, Justin L'Hommedieu, Mackenzie Wildman, Sophia Skaaden , Amrutha Nadarajan, Jennifer L. Villatte, Tiago H. Falk, Kristina Lerman, Emilio Ferrara, Shrikanth Narayanan. TILES: A longitudinal physiologic and behavioral data set of hospital workers. *Scientific Data* (Nature Press). 2020
7. Adela C. Timmons, Theodora Chaspari, Sohyun C. Han, Laura Perrone, Shrikanth S. Narayanan, and Gayla Margolin. Multimodal Detection of Conflict in Couples Using Wearable Technology. *IEEE Computer*. Special Issue on Quality-of-Life Technologies. 50(3): 50-59, March 2017
8. Adela C. Timmons, Brian R. Baucom, Sohyun C. Han, Laura Perrone, Theodora Chaspari, Shrikanth S. Narayanan, and Gayla Margolin. New Frontiers in Ambulatory Assessment: Big Data Methods for Capturing Couples' Emotions, Vocalizations, and Physiology in Daily Life. *Social Psychological and Personality Science*. 8, 552-563, 2017.
9. D. Bone, C.-C. Lee, T. Chaspari, J. Gibson, S. Narayanan. Signal Processing and Machine Learning for Mental Health Research and Clinical Applications. *IEEE Signal Processing Magazine*. 34(5): 189-196, 2017

10. Theodora Chaspari, Andreas Tsiartas, Leah I. Stein, Sharon A. Cermak, and Shrikanth S. Narayanan. Sparse Representation of Electrodermal Activity with Knowledge-Driven Dictionaries. *IEEE Transactions on Biomedical Engineering*. 62(3): 960-971, March 2015

11. Gautam Thatte, Ming Li, Sangwon Lee, Adar Emken, Murali Annavaram, Shrikanth Narayanan, Donna Spruijt-Metz, and Urbashi Mitra. Optimal Time-Resource Allocation for Energy-Efficient Physical Activity Detection. *IEEE Transactions on Signal Processing*. 59(4): 1843-1857, 2011.

12. Ming Li, Viktor Rozgic, Gautam Thatte, Sangwon Lee, Adar Emken, Murali Annavaram, Urbashi Mitra, Donna Spruijt-Metz and Shrikanth Narayanan. Multimodal Physical Activity Recognition by Fusing Temporal and Cepstral Information. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*. 18(4): 369-380, 2010

13. Anil Ramakrishna, Rahul Gupta and Shrikanth Narayanan. Joint Multi-Dimensional Model for Global and Time-Series Annotations. *IEEE Transactions on Affective Computing*. 13(1): 473-484, 2022

Foundations of Human-centered Signal Analysis and Interpretation

1. Krishna Somandepalli, Shrikanth Narayanan. Generalized Multi-view Shared Subspace Learning using View Bootstrapping. *IEEE Transactions on Signal Processing*. 69: 4774-4786, 2021

2. Rahul Gupta, Karthik Audhkhasi, Zach Jacokes, Agata Rozga and Shrikanth Narayanan. Modeling multiple time series annotations as noisy distortions of the ground truth: An Expectation-Maximization approach. *IEEE Transactions on Affective Computing*. 9(1): 76 - 89, January 2018

3. Colin Vaz, Shrikanth Narayanan. Extending the Beta Divergence to Complex Values. *Pattern Recognition Letters*. 144, 105-111, April 2020

4. Karel Mundnich, Brandon M Booth, Benjamin Girault, Shrikanth Narayanan. Generating Labels for Regression of Subjective Constructs using Triplet Embeddings. *Pattern Recognition Letters*. 128: 385-392, 2019

5. Benjamin Girault, Antonio Ortega and Shrikanth Narayanan. Irregularity-Aware Graph Fourier Transforms. *IEEE Transactions on Signal Processing*. 66(21): 5746-5761, 2018

6. Ruchir Travadi and Shrikanth Narayanan. Efficient Estimation and Model Generalization for the Total Variability Model. *Computer Speech & Language*. 53:43–64, January 2019

7. Theodora Chaspari, Andreas Tsiartas, Panagiotis Tsilifis, and Shrikanth Narayanan. Markov Chain Monte Carlo Inference of Parametric Dictionaries for Sparse Bayesian Approximations. *IEEE Transactions on Signal Processing*. 64(12): 3077-3092, June 2016

8. Kartik Audhkhasi and Shrikanth Narayanan. A Globally-Variant Locally-Constant Model for Fusion of Labels from Multiple Diverse Experts Without Using Reference Labels. *IEEE Transactions on Pattern Analysis and Machine Intelligence*. 35(4): 769-783, April 2013

9. Jorge Silva and Shrikanth Narayanan. On Signal Representations within the Bayes Decision Framework. *Pattern Recognition*. 45(5): 1853-1865, 2012

10. Jorge Silva and Shrikanth Narayanan. Nearly Optimal Estimation of Mutual Information based on a Complexity Regularized Tree-Structured Partition. *IEEE Transactions on Information Theory*. 58(3): 1940 - 1952, March 2012.

11. Jorge Silva and Shrikanth Narayanan. Upper Bound Kullback-Leibler Divergence for Transient Hidden Markov Models. *IEEE Transactions on Signal Processing*. 56(9): 4176 - 4188, September 2008.

12. Jorge Silva and Shrikanth Narayanan. Information Divergence Estimation based on Data-Dependent Partitions. *Journal of Statistical Planning and Inference*. 140(11)-3180-3198, 2010

13. Jorge Silva and Shrikanth Narayanan. Non-Product Data-Dependent Partitions for Mutual Information Estimation: Strong Consistency and Applications. *IEEE Transactions on Signal Processing*. 58(7): 3497-3511, July 2010

14. Jorge Silva and Shrikanth Narayanan. Discriminative Wavelet Packet Filter Bank Selection for Pattern Recognition. *IEEE Transactions on Signal Processing*. 57(5): 1796-1810, 2009

15. Jorge Silva and Shrikanth Narayanan. Upper Bound Kullback-Leibler Divergence for Transient Hidden Markov Models. *IEEE Transactions on Signal Processing*. 56(9): 4176 - 4188, September 2008

16. Jorge Silva and Shrikanth Narayanan. Average Divergence Distance as a Statistical Discrimination Measure for Hidden Markov Models. *IEEE Transactions on Speech, Audio and Language Processing,* vol. 14, issue 3, pp. 890-906, May 2006

17.

Child-centric Speech and Multimodal Processing and Applications

1. Prashanth Gurunath Shivakumar, Shrikanth Narayanan. End-to-End Neural Systems for Automatic Children Speech Recognition: An Empirical Study. *Computer Speech & Language*. 72:101289, 2022
2. Manoj Kumar, So Hyun Kim, Catherine Lord, Thomas D Lyon, Shrikanth Narayanan. Leveraging Linguistic Context in Dyadic Interactions to Improve Automatic Speech Recognition for Children. *Computer Speech & Language. 63,* 2020
3. Manoj Kumar, So Hyun Kim, Catherine Lord, and S. Narayanan. Improving Speaker Diarization for Naturalistic Child-Adult Conversational Interactions using Contextual Information. *J. Acoust. Soc. Am.* 147(2): EL196-200, February 2020
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