

# Ross Cutler

## I. CONTACT AND WEB SITES

- Email: ross.cutler@outlook.com and ross.cutler@microsoft.com
- Microsoft: <https://www.microsoft.com/en-us/research/people/rcutler>
- Github: <https://rosscutler.github.io>
- LinkedIn: <https://www.linkedin.com/in/rosscutler>
- Google Scholar: <https://scholar.google.com/citations?user=Qee1AwMAAAAJ>  
– Citations=10,302, h-index=50, i10-index=120
- Location: Bellevue, Washington, USA

## II. EDUCATION

|  |      |
|--|------|
| <i>Ph.D. Computer Science</i><br>University of Maryland, College Park, Maryland                      | 2000 |
| <i>M.S. Computer Science</i><br>University of Maryland, College Park, Maryland                       | 1996 |
| <i>B.S. Computer Science, Physics, Mathematics</i><br>University of Maryland, College Park, Maryland | 1992 |

## III. PROFESSIONAL EXPERIENCE

### *Microsoft Corp.*

Partner Applied Scientist 2014 – Present

- As the manager of IC3-AI, I lead a team of applied scientists and engineers within the Intelligent Conversation and Communications Cloud (IC3) division of Office. We apply AI to enhance call quality and reliability, as well as to create innovative user experiences. Our technology is used by hundreds of millions of users worldwide, and our AI models ship in Teams, Skype, Windows, Azure, and Xbox.

Principal Architect 2005 - 2014

- As an Audio/Video Architect for Skype/Lync, I focused on enhancing the quality of AV calls. I led a team of data scientists and machine learning experts to achieve this goal. Additionally, I oversaw the AV certification team, ensuring that devices are fully compatible with Skype/Lync for optimal performance. Products shipped include Lync, Skype, Microsoft RoundTable, Video Kinect, and Polycom CX300.

System Architect 2003 - 2005

- I started the incubation of the RoundTable product, transforming it from a research project to a shipping product. My responsibilities included writing the business plan, fundraising, camera design, video processing, acoustics, active speaker detection, audio quality, and industrial design. I also managed the RoundTable IP strategy and successfully filed over 30 patents related to the product.

Researcher 2000 - 2003

- As a researcher at Microsoft Research, I developed innovative hardware and software technologies to enhance communication, including meeting room recording and teleconferencing. I initiated the RingCam project, which ultimately led to the RoundTable product. My research expertise includes omnidirectional video, camera calibration, sound source localization, and event detection.

### *University of Maryland, College Park, Maryland*

Researcher, Dept. of Computer Science 1996 - 2000

- Airborne Video Surveillance project: developed real-time human/vehicle trackers, object classifiers, and video indexing. Lead integrator for activity monitoring system, which recognizes human and vehicle activities from airborne video.
- Designed and implemented the Keck Laboratory for the Analysis of Visual Motion (a 64-camera system designed for real-time vision applications).

- Conducted research on speaker detection, periodic motion, gesture recognition, and human activity monitoring. Developed video capture software for six different frame grabbers (the first PC-based system to capture uncompressed video to disk/memory).

*University of Pennsylvania*

Consultant

1999 - 2000

- Developed real-time stereo depth estimation software used in real-time 3D video conferencing (immersive telepresence).

*ImageCorp, College Park, Maryland*

Consultant

1999 - 2000

- Developed a real-time system to track head motion of drivers in vehicles. Also developed a 1394 camera driver and a real-time C++ video processing library.

*Scientech, Rockville, Maryland*

Consultant

1992 - 2000

- Developed risk analysis algorithms and applications for complex systems (e.g., nuclear reactors, large software systems).

*Johns Hopkins University, Baltimore, Maryland*

Research Staff, Dept. of Neuroscience

1988 - 2000

- Developed data acquisition, analysis, and experiment control applications for single/multi-neuron recording in animals and humans (laboratory and operating room). Used for research and treatment of pain, Alzheimer's, and Parkinson's disease.

#### IV. REFEREED JOURNAL PAPERS

- 1) C. Zhang, P. Yin, Y. Rui, R. Cutler, P. Viola, X. Sun, N. Pinto, and Z. Zhang, "Boosting-based multimodal speaker detection for distributed meeting videos," *IEEE Transactions on Multimedia*, vol. 10, no. 8, pp. 1541–1552, 2008
- 2) Z. Liu, M. Cohen, D. Bhatnagar, R. Cutler, and Z. Zhang, "Head-size equalization for improved visual perception in video conferencing," *IEEE Transactions on Multimedia*, vol. 9, no. 7, pp. 1520–1527, 2007
- 3) C. BenAbdelkader, R. G. Cutler, and L. S. Davis, "Gait recognition using image self-similarity," *EURASIP Journal on Advances in Signal Processing*, vol. 2004, no. 4, pp. 1–14, 2004
- 4) I. Haritaoglu, R. Cutler, D. Harwood, and L. S. Davis, "Backpack: Detection of people carrying objects using silhouettes," *Computer Vision and Image Understanding*, vol. 81, no. 3, pp. 385–397, 2001
- 5) R. Cutler and L. S. Davis, "Robust real-time periodic motion detection, analysis, and applications," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 22, no. 8, pp. 781–796, 2000

#### V. REFEREED CONFERENCE PAPERS

- 1) E. Indenbom, N.-C. Ristea, A. Saabas, T. Pärnamaa, J. Gužvin, and R. Cutler, "DeepVQE: Real Time Deep Voice Quality Enhancement for Joint Acoustic Echo Cancellation, Noise Suppression and Dereverberation," in *INTERSPEECH*, 2023
- 2) L. Diener, M. Purin, S. Sootla, A. Saabas, R. Aichner, and R. Cutler, "PLCMOS - a data-driven non-intrusive metric for the evaluation of packet loss concealment algorithms," in *INTERSPEECH*, 2023
- 3) X. Gitiaux, A. Khant, C. Reddy, J. Gupchup, and R. Cutler, "Aura: Privacy-preserving augmentation to improve test set diversity in noise suppression applications," in *ICASSP*, 2023
- 4) Q. Fu, S.-W. Fu, Y. Fan, Y. Wu, Z. Chen, J. Gupchup, and R. Cutler, "Real-time speech interruption analysis: From cloud to client deployment," in *ICASSP*, 2023
- 5) G. Mittag, B. Naderi, V. Gopal, and R. Cutler, "LSTM-based Video Quality Prediction Accounting for Temporal Distortions in Videoconferencing Calls," in *ICASSP*, 2023
- 6) R. Cutler, A. Saabas, B. Naderi, N. Ristea, and R. Aichner, "ICASSP 2023 Speech Signal Improvement Challenge," in *ICASSP*, 2023
- 7) R. Cutler, A. Saabas, T. Pärnamaa, M. Purin, E. Indenbom, N.-C. Ristea, H. Gamper, S. Braun, and R. Aichner, "ICASSP 2023 acoustic echo cancellation challenge," in *ICASSP*, 2023
- 8) H. Dubey, V. Gopal, R. Cutler, A. Aazami, S. Matusevych, S. Braun, S. E. Eskimez, M. Thakker, T. Yoshioka, H. Gamper, and R. Aichner, "ICASSP 2023 deep noise suppression challenge," in *ICASSP*, 2023
- 9) S.-W. Fu, Y. Fan, Y. Hosseinkashi, J. Gupchup, and R. Cutler, "Improving meeting inclusiveness using speech interruption analysis," in *ACM Multimedia*, 2022
- 10) C. K. Reddy, V. Gopal, H. Dubey, S. Matusevych, R. Cutler, and R. Aichner, "Musicnet: Compact convolutional neural network for real-time background music detection," in *INTERSPEECH*, 2022

- 11) P. Panda, M. J. Nicholas, M. Gonzalez-Franco, K. Inkpen, E. Ofek, R. Cutler, K. Hinckley, and J. Lanier, "Alltogether: Effect of avatars in mixed-modality conferencing environments," in *2022 Symposium on Human-Computer Interaction for Work*, pp. 1–10, 2022
- 12) G. Yi, W. Xiao, Y. Xiao, B. Naderi, S. Möller, G. Mittag, R. Cutler, Z. Zhang, D. S. Williamson, F. Chen, F. Yang, and S. Shang, "Non-intrusive Objective Speech Quality Assessment (NISQA) Challenge for Online Conferencing Applications," in *INTERSPEECH*, 2022
- 13) L. Diener, S. Sootla, A. Saabas, S. Branets, and R. Cutler, "INTERSPEECH 2022 Audio Deep Packet Loss Concealment Challenge," in *INTERSPEECH*, 2022
- 14) R. Cutler, A. Saabas, T. Parnamaa, M. Purin, H. Gamper, S. Braun, K. Sørensen, and R. Aichner, "ICASSP 2022 Acoustic Echo Cancellation Challenge," in *ICASSP*, 2022
- 15) H. Dubey, V. Gopal, R. Cutler, S. Matushevych, S. Braun, S. E. Eskimez, M. Thakker, T. Yoshioka, H. Gamper, and A. Robert, "ICASSP 2022 Deep Noise Suppression Challenge," in *ICASSP*, 2022
- 16) M. Purin, S. Sootla, M. Sponza, A. Saabas, and R. Cutler, "Aecmos: A speech quality assessment metric for echo impairment," in *ICASSP*, 2022
- 17) C. K. Reddy, V. Gopal, and R. Cutler, "DNSMOS P.835: A non-intrusive perceptual objective speech quality metric to evaluate noise suppressors," in *ICASSP*, 2022
- 18) R. Cutler, A. Saabas, T. Parnamaa, M. Loide, S. Sootla, M. Purin, H. Gamper, S. Braun, K. Sorensen, R. Aichner, *et al.*, "INTERSPEECH 2021 acoustic echo cancellation challenge," in *INTERSPEECH*, 2021
- 19) B. Naderi and R. Cutler, "Subjective evaluation of noise suppression algorithms in crowdsourcing," in *INTERSPEECH*, 2021
- 20) R. Cutler, Y. Hosseinkashi, J. Pool, S. Filipi, R. Aichner, Y. Tu, and J. Gehrke, "Meeting effectiveness and inclusiveness in remote collaboration," in *Proceedings of the ACM on Human-Computer Interaction*, vol. 5, pp. 1–29, ACM New York, NY, USA, 2021
- 21) B. Naderi, S. Möller, and R. Cutler, "Speech quality assessment in crowdsourcing: Comparison category rating method," in *QoMEX*, 2021
- 22) C. K. Reddy, H. Dubey, V. Gopal, R. Cutler, S. Braun, H. Gamper, R. Aichner, and S. Srinivasan, "ICASSP 2021 deep noise suppression challenge," in *ICASSP*, pp. 6623–6627, IEEE, 2021
- 23) R. Cutler, B. Naderi, M. Loide, S. Sootla, and A. Saabas, "Crowdsourcing approach for subjective evaluation of echo impairment," in *ICASSP*, pp. 406–410, IEEE, 2021
- 24) C. K. Reddy, V. Gopal, and R. Cutler, "DNSMOS: A non-intrusive perceptual objective speech quality metric to evaluate noise suppressors," in *ICASSP*, pp. 6493–6497, IEEE, 2021
- 25) K. Sridhar, R. Cutler, A. Saabas, T. Parnamaa, M. Loide, H. Gamper, S. Braun, R. Aichner, and S. Srinivasan, "Icassp 2021 acoustic echo cancellation challenge: Datasets, testing framework, and results," in *ICASSP*, pp. 151–155, IEEE, 2021
- 26) C. K. Reddy, H. Dubey, K. Koishida, A. Nair, V. Gopal, R. Cutler, S. Braun, H. Gamper, R. Aichner, and S. Srinivasan, "INTERSPEECH 2021 deep noise suppression challenge," in *INTERSPEECH*, 2021
- 27) C. K. Reddy, V. Gopal, R. Cutler, E. Beyrami, R. Cheng, H. Dubey, S. Matushevych, R. Aichner, A. Aazami, S. Braun, *et al.*, "The INTERSPEECH 2020 deep noise suppression challenge: Datasets, subjective testing framework, and challenge results," in *INTERSPEECH*, 2020
- 28) Y. Xia, S. Braun, C. K. Reddy, H. Dubey, R. Cutler, and I. Tashev, "Weighted speech distortion losses for neural-network-based real-time speech enhancement," in *ICASSP*, pp. 871–875, IEEE, 2020
- 29) R. Cutler, R. Mehran, S. Johnson, C. Zhang, A. Kirk, O. Whyte, and A. Kowdle, "Multimodal active speaker detection and virtual cinematography for video conferencing," in *ICASSP*, pp. 4527–4531, IEEE, 2020
- 30) B. Naderi and R. Cutler, "An open source implementation of ITU-T recommendation P.808 with validation," in *INTERSPEECH*, 2020
- 31) J. Pool, E. Beyrami, V. Gopal, A. Aazami, J. Gupchup, J. Rowland, B. Li, P. Kanani, R. Cutler, and J. Gehrke, "Lumos: A library for diagnosing metric regressions in web-scale applications," in *Proceedings of the 26th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining (KDD)*, pp. 2562–2570, 2020
- 32) G. Mittag, R. Cutler, Y. Hosseinkashi, M. Revow, S. Srinivasan, N. Chande, and R. Aichner, "DNN No-Reference PSTN Speech Quality Prediction," in *ICASSP*, 2020
- 33) C. K. Reddy, R. Cutler, and J. Gehrke, "Supervised classifiers for audio impairments with noisy labels," in *INTERSPEECH*, 2020
- 34) C. K. Reddy, E. Beyrami, J. Pool, R. Cutler, S. Srinivasan, and J. Gehrke, "A scalable noisy speech dataset and online subjective test framework," in *INTERSPEECH*, 2020
- 35) A. R. Avila, H. Gamper, C. Reddy, R. Cutler, I. Tashev, and J. Gehrke, "Non-intrusive speech quality assessment using neural networks," in *ICASSP*, pp. 631–635, IEEE, 2019
- 36) J. Gupchup, E. Beyrami, M. Ellis, Y. Hosseinkashi, S. Johnson, and R. Cutler, "On design of problem token questions in quality of experience surveys," in *2018 Tenth International Conference on Quality of Multimedia Experience (QoMEX)*, pp. 1–3, IEEE, 2018

- 37) J. Gupchup, Y. Hosseinkashi, P. Dmitriev, D. Schneider, R. Cutler, A. Jefremov, and M. Ellis, “Trustworthy experimentation under telemetry loss,” in *Proceedings of the 27th ACM International Conference on Information and Knowledge Management (CIKM)*, pp. 387–396, 2018
- 38) J. Gupchup, Y. Hosseinkashi, M. Ellis, S. Johnson, and R. Cutler, “Analysis of problem tokens to rank factors impacting quality in voip applications,” in *2017 Ninth International Conference on Quality of Multimedia Experience (QoMEX)*, pp. 1–6, IEEE, 2017
- 39) Y. Chang, R. Cutler, Z. Liu, Z. Zhang, A. Acero, and M. Turk, “Automatic head-size equalization in panorama images for video conferencing,” in *2005 IEEE International Conference on Multimedia and Expo*, pp. 506–509, IEEE, 2005
- 40) H. S. Malvar, L.-w. He, and R. Cutler, “High-quality linear interpolation for demosaicing of bayer-patterned color images,” in *ICASSP*, vol. 3, pp. iii–485, IEEE, 2004
- 41) R. Cutler, “The distributed meetings system,” in *2003 IEEE International Conference on Acoustics, Speech, and Signal Processing, 2003. Proceedings.(ICASSP’03).*, vol. 4, pp. IV–756, IEEE, 2003
- 42) R. Cutler, Y. Rui, A. Gupta, J. J. Cadiz, I. Tashev, L.-w. He, A. Colburn, Z. Zhang, Z. Liu, and S. Silverberg, “Distributed meetings: A meeting capture and broadcasting system,” in *Proceedings of the Tenth ACM International Conference on Multimedia (ACM MM)*, pp. 503–512, 2002
- 43) C. BenAbdelkader, R. Cutler, and L. Davis, “Motion-based recognition of people in eigengait space,” in *Proceedings of Fifth IEEE International Conference on Automatic Face Gesture Recognition*, pp. 267–272, IEEE, 2002
- 44) C. BenAbdelkader, R. Cutler, and L. Davis, “Stride and cadence as a biometric in automatic person identification and verification,” in *Proceedings of Fifth IEEE International Conference on Automatic Face Gesture Recognition*, pp. 372–377, IEEE, 2002
- 45) C. BenAbdelkader, R. Cutler, and L. Davis, “Person identification using automatic height and stride estimation,” in *Object Recognition Supported by User Interaction for Service Robots*, vol. 4, pp. 377–380, IEEE, 2002
- 46) C. BenAbdelkader, R. Cutler, and L. Davis, “Motion-based recognition of people using image self-similarity,” in *Proceedings of the 5th IEEE International Conference on Automatic Face and Gesture Recognition*, pp. 254–259, 2002
- 47) C. BenAbdelkader, R. Cutler, H. Nanda, and L. Davis, “Eigengait: Motion-based recognition of people using image self-similarity,” in *International Conference on Audio and Video-based Biometric Person Authentication*, pp. 284–294, Springer, Berlin, Heidelberg, 2001
- 48) R. Cutler and L. Davis, “Robust periodic motion and motion symmetry detection,” in *Proceedings IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, vol. 2, pp. 615–622, IEEE, 2000
- 49) R. Cutler and L. Davis, “Look who’s talking: Speaker detection using video and audio correlation,” in *2000 IEEE International Conference on Multimedia and Expo (ICME)*, vol. 3, pp. 1589–1592, IEEE, 2000
- 50) R. Cutler and L. Davis, “Real-time periodic motion detection, analysis, and applications,” in *Proceedings. 1999 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR)*, vol. 2, pp. 326–332, IEEE, 1999
- 51) I. Haritaoglu, R. Cutler, D. Harwood, and L. S. Davis, “Backpack: Detection of people carrying objects using silhouettes,” in *Proceedings of the Seventh IEEE International Conference on Computer Vision (ICCV)*, vol. 1, pp. 102–102, IEEE Computer Society, 1999
- 52) R. Cutler and L. Davis, “View-based detection and analysis of periodic motion,” in *Proceedings. Fourteenth International Conference on Pattern Recognition (ICPR)*, vol. 1, pp. 495–500, IEEE, 1998
- 53) R. Cutler and M. Turk, “View-based interpretation of real-time optical flow for gesture recognition,” in *Proceedings Third IEEE International Conference on Automatic Face and Gesture Recognition*, pp. 416–421, IEEE, 1998

## VI. WORKSHOP PAPERS

- 1) J. Chee, S. Braun, V. Gopal, and R. Cutler, “Performance optimizations on u-net speech enhancement models,” in *IEEE MMSP*, 2022
- 2) G. Toderici, R. Timofte, J. Ballé, E. Agustsson, N. Johnston, F. Mentzer, Z. Sinno, A. Norkin, K. Rapaka, E. Noury, R. Cutler, and L. Versari, “CVPR Challenge on Learned Image Compression,” in *CVPR Challenge on Learned Image Compression*, 2022
- 3) J. Gupchup, A. Aazami, Y. Fan, S. Filipi, T. Finley, S. Inglis, M. Asteborg, L. Carroll, R. Chari, M. Cozowicz, *et al.*, “Resonance: Replacing software constants with context-aware models in real-time communication,” in *Machine Learning for Systems, NeurIPS*, 2020
- 4) H. Gamper, C. K. Reddy, R. Cutler, I. J. Tashev, and J. Gehrke, “Intrusive and non-intrusive perceptual speech quality assessment using a convolutional neural network,” in *2019 IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA)*, pp. 85–89, IEEE, 2019
- 5) J. Fang, M. Ellis, B. Li, S. Liu, Y. Hosseinkashi, M. Revow, A. Sadovnikov, Z. Liu, P. Cheng, S. Ashok, *et al.*, “Reinforcement learning for bandwidth estimation and congestion control in real-time communications,” in *Machine Learning for Systems, NeurIPS*, 2019
- 6) A. Mondal, R. Cutler, C. Huang, J. Li, and A. Kuzmanovic, “Surecall: Towards glitch-free real-time audio/video conferencing,” in *2010 IEEE 18th International Workshop on Quality of Service (IWQoS)*, pp. 1–9, IEEE, 2010

- 7) C. Zhang, P. Yin, Y. Rui, R. Cutler, and P. Viola, "Boosting-based multimodal speaker detection for distributed meetings," in *2006 IEEE Workshop on Multimedia Signal Processing*, pp. 86–91, IEEE, 2006
- 8) S. Leorin, L. Lucchese, and R. G. Cutler, "Quality assessment of panorama video for videoconferencing applications," in *2005 IEEE 7th Workshop on Multimedia Signal Processing*, pp. 1–4, IEEE, 2005
- 9) C. BenAbdelkader, R. Cutler, and L. Davis, "View-invariant estimation of height and stride for gait recognition," in *International Workshop on Biometric Authentication*, pp. 155–167, Springer, Berlin, Heidelberg, 2002
- 10) H. Nanda and R. Cutler, "Practical calibrations for a real-time digital omnidirectional camera," in *CVPR Technical Sketch*, vol. 20, 2001
- 11) R. Cutler, C. S. Shekhar, B. Burns, R. Chellappa, R. C. Bolles, and L. S. Davis, "Monitoring human and vehicle activities using airborne video," in *28th AIPR Workshop: 3D Visualization for Data Exploration and Decision Making*, vol. 3905, pp. 146–153, International Society for Optics and Photonics, 2000
- 12) L. Davis, E. Borovikov, R. Cutler, D. Harwood, and T. Horprasert, "Multi-perspective analysis of human action," in *In Third Int. Workshop on Cooperative Distributed Vision*, 2000
- 13) R. Cutler and L. Davis, "Developing real-time computer vision applications for Intel Pentium III based Windows NT workstations," in *Workstations, FRAME-RATE: Frame-rate Applications, Methods and Experiences with Regularly Available Technology and Equipment, in conjunction with IEEE International Conference on Computer Vision (ICCV)*, 1999
- 14) R. Cutler and L. Davis, "View-based detection and analysis of periodic motion," in *DARPA Image Understanding Workshop*, 1998
- 15) L. Davis, R. Chelappa, A. Rosenfeld, D. Harwood, I. Haritaoglu, and R. Cutler, "Visual surveillance and monitoring," in *DARPA Image Understanding Workshop*, 1998
- 16) R. Cutler and L. Davis, "Qualitative analysis of human actions," in *DARPA Image Understanding Workshop*, 1997

## VII. SUBMITTED

- 1) A. Gottipati and R. Cutler, "Multi-agent bandwidth estimation for legacy systems," 2023
- 2) B. Naderi and R. Cutler, "A crowdsourcing approach to video quality assessment," 2023
- 3) A. Majeedi, B. Naderi, J. Cho, Y. Hosseinkashi, R. A. Martinez, and R. Cutler, "Full reference video quality assessment for machine learning based video codecs," 2023
- 4) R. Bothra, D. Bhattacharjee, N. Natarajan, R. Bhagwan, V. Padmanabhan, and R. Cutler, "Understanding the impact of network performance on user engagement in video conferencing," 2023
- 5) Y. Hosseinkashi, J. Pool, L. Tankelevitch, R. Cutler, and C. Madan, "Meeting effectiveness and inclusiveness: large-scale measurement, identification of key features, and prediction in real-world remote meetings," 2023

## VIII. THESES

- 1) R. G. Cutler, *On the detection and analysis of oscillatory motions in video sequences*. PhD thesis, University of Maryland, College Park, 2000

## IX. POSTERS AND TECHNICAL REPORTS

- 1) R. G. Cutler, R. Duraiswami, J. H. Qian, L. S. Davis, *et al.*, "Design and implementation of the University of Maryland Keck Laboratory for the analysis of visual movement," tech. rep., 2002
- 2) R. G. Cutler, "Face recognition using infrared images and eigenfaces," tech. rep., 1996

## X. BOOK CHAPTERS

- 1) R. Cutler and K. S. Candan, "Multimedia authoring systems," in *Multimedia Database Systems*, pp. 279–296, Springer, Berlin, Heidelberg, 1996

## XI. INDUSTRY PUBLICATIONS

- 1) R. G. Cutler and *et. al.*, "Microsoft Teams and Skype for Business specifications for USB peripherals, PCs, and Microsoft Teams Room systems, versions 1-3." <https://docs.microsoft.com/en-us/skypeforbusiness/certification/test-spec>, 2016
- 2) R. G. Cutler and *et. al.*, "Microsoft Lync Specifications for USB peripherals, PCs, and Lync room systems, versions A-F." <https://docs.microsoft.com/en-us/skypeforbusiness/certification/test-spec>, 2011

## XII. INVITED TALKS

- 1) IEEE IEMCON Keynote 2022: Developing Machine Learning-Based Speech Enhancement Models for Teams and Skype
- 2) RTC @ Scale 2022: Developing Machine Learning-Based Speech Enhancement Models for Teams and Skype
- 3) Intel Speech Conference 2021: Developing Machine Learning-Based Speech Enhancement Models for Teams and Skype
- 4) INTERNOISE Keynote 2021: Developing Machine Learning-Based Speech Enhancement Models for Teams and Skype

## XIII. PATENTS

- 1) M. Ellis, J. Fang, J. Cho, and R. Cutler, "Service issue prioritisation based on impact using software telemetry inventors," Apr. 18 2023. US Patent 11,632,286
- 2) R. Cutler, "Dynamic detection and correction of light field camera array miscalibration," Jan. 10 2023. US Patent 11,553,123
- 3) R. Cutler, "Systems and methods of selection acknowledgement for interfaces promoting obfuscation of user operations," Dec. 13 2022. US Patent 11,526,273
- 4) J. Fang, R. Cutler, M. Ellis, D. Zhao, and T. Duong, "Reinforcement learning in real-time communications," June 28 2022. US Patent 11,373,108
- 5) R. G. Cutler, "Panoramic camera system," June 7 2022. US Patent 11,356,586
- 6) R. G. Cutler, "Systems and methods for obfuscating user selections," Apr. 12 2022. US Patent 11,301,056
- 7) R. G. Cutler, "Dynamic detection and correction of light field camera array miscalibration," Mar. 8 2022. US Patent 11,270,464
- 8) R. G. Cutler, "Systems and methods for input interfaces promoting obfuscation of user navigation and selections," Dec. 28 2021. US Patent 11,209,979
- 9) E. Martin, J. Fang, J. H. Cho, and R. G. Cutler, "Service issue prioritisation based on impact using software telemetry," Nov. 23 2021. US Patent 11,184,218
- 10) R. G. Cutler, "Systems and methods for obfuscating user selections," Oct. 12 2021. US Patent 11,144,132
- 11) R. G. Cutler, "Systems and methods of selection acknowledgement for interfaces promoting obfuscation of user operations," Sept. 28 2021. US Patent 11,132,069
- 12) R. G. Cutler, "Systems and methods for identifying user-operated features of input interfaces obfuscating user navigation," Sept. 7 2021. US Patent 11,112,881
- 13) R. G. Cutler, "Telepresence devices operation methods," Aug. 10 2021. US Patent 11,089,265
- 14) R. G. Cutler, "Systems and methods for obfuscating user navigation and selections directed by free-form input," Aug. 10 2021. US Patent 11,086,514
- 15) R. G. Cutler, "Light field camera modules and light field camera module arrays," Aug. 3 2021. US Patent 11,082,659
- 16) R. G. Cutler, "Device pose detection and pose-related image capture and processing for light field based telepresence communications," June 13 2021. US Patent 11,064,154
- 17) S. K. Velayutham, A. Ghanaie-Sichanie, and R. G. Cutler, "Content feature based video stream subscriptions," May 18 2021. US Patent 11,012,249
- 18) R. G. Cutler and A. Kelloniemi, "Videoconferencing device and method," Mar. 16 2021. US Patent 10,951,859
- 19) R. G. Cutler, S. Srinivasan, R. Mehran, K. D. Sequeira, J. A. Gupchup, and S. K. Velayutham, "Artificially generated speech for a communication session," Feb. 23 2021. US Patent 10,930,262
- 20) M. Ellis and R. Cutler, "Network problem node identification using traceroute aggregation," Dec. 1 2020. US Patent 10,855,740
- 21) R. Cutler and R. Mehran, "Privacy image generation," Sept. 29 2020. US Patent 10,789,685
- 22) A. P. Kelloniemi, R. G. Cutler, S. Malladi, and T. A. Raussi, "Method and system of varying mechanical vibrations at a microphone," Feb. 25 2020. US Patent 10,575,110
- 23) A. P. Kelloniemi, R. G. Cutler, S. Malladi, and T. A. Raussi, "Method and system of varying mechanical vibrations at a microphone," June 2 2020. US Patent 10,674,295
- 24) R. G. Cutler, "Telepresence device," Feb. 4 2020. US Patent 10,554,928
- 25) A. Tandon, R. Aichner, R. Cutler, and S. Velayutham, "Video display modification for video environments," Jan. 7 2020. US Patent 10,531,046
- 26) R. G. Cutler, A. P. Sinclair, J. A. Kauffman, and A. Krantz, "Enhanced discovery for ad-hoc meetings," Oct. 1 2019. US Patent 10,432,676
- 27) R. G. Cutler, A. P. Sinclair, J. A. Kauffman, and A. Krantz, "Enhanced discovery for ad-hoc meetings," Oct. 8 2019. US Patent 10,439,832
- 28) A. Krantz, R. G. Cutler, A. P. Sinclair, and J. A. Kauffman, "Identifying the effectiveness of a meeting from a meetings graph," May 21 2019. US Patent 10,296,861
- 29) R. Cutler and R. Mehran, "Privacy image generation system," Jan. 15 2019. US Patent 10,181,178
- 30) R. G. Cutler, S. Srinivasan, R. Mehran, K. D. Sequeira, J. A. Gupchup, and S. K. Velayutham, "Artificially generated speech for a communication session," Dec. 4 2018. US Patent 10,147,415
- 31) O. A. Whyte, R. Cutler, A. Bhattacharjee, A. P. M. Kowdle, A. Kirk, S. T. Birchfield, and C. Zhang, "Active speaker location detection," May 22 2018. US Patent 9,980,040
- 32) R. G. Cutler, A. P. Sinclair, J. A. Kauffman, and A. Krantz, "Enhanced discovery for ad-hoc meetings," Jan. 30 2018. US Patent 9,882,990
- 33) A. Tandon, R. Aichner, R. Cutler, and S. Velayutham, "Video display modification for video conferencing environments,"

- Jan. 23 2018. US Patent 9,876,988
- 34) A. Tandon, W. Verthein, S. Velayutham, and R. Cutler, "Collaboration environments and views," Nov. 7 2017. US Patent 9,813,255
  - 35) R. Cutler and R. Mehran, "Privacy camera," Aug. 8 2017. US Patent 9,729,824
  - 36) O. A. Whyte, R. Cutler, A. Bhattacharjee, A. P. M. Kowdle, A. Kirk, S. T. Birchfield, and C. Zhang, "Active speaker location detection," Apr. 11 2017. US Patent 9,621,795
  - 37) R. G. Cutler, A. P. Sinclair, J. A. Kauffman, and A. Krantz, "Enhanced discovery for ad-hoc meetings," Mar. 28 2017. US Patent 9,609,066
  - 38) R. G. Cutler, "Boundary binaural microphone array," Dec. 6 2016. US Patent 9,516,417
  - 39) S. C. Forbes, R. Cutler, T. M. Moore, J. T. Buch, and A. J. Bawcutt, "Virtual contact identifier," Jan. 19 2016. US Patent 9,241,078
  - 40) R. Cutler and R. Mehran, "Privacy camera," Sept. 1 2015. US Patent 9,124,762
  - 41) R. G. Cutler, "Satellite microphones for improved speaker detection and zoom," June 30 2015. US Patent 9,071,895
  - 42) J. Watson, S. Leorin, and R. G. Cutler, "Automatic video framing," July 8 2014. US Patent 8,773,499
  - 43) R. G. Cutler, "Capture device movement compensation for speaker indexing," June 10 2014. US Patent 8,749,650
  - 44) R. Cutler, "Removing near-end frequencies from far-end sound," June 3 2014. US Patent 8,744,069
  - 45) R. G. Cutler, "Satellite microphone array for video conferencing," May 6 2014. US Patent 8,717,402
  - 46) R. G. Cutler, "Mute control in audio endpoints," Dec. 31 2013. US Patent 8,620,653
  - 47) R. G. Cutler, "Techniques for detecting a display device," Dec. 24 2013. US Patent 8,614,734
  - 48) R. G. Cutler, "Microphone array for a camera speakerphone," Sept. 3 2013. US Patent 8,526,632
  - 49) C. Zhang, P. A. Viola, P. Yin, R. G. Cutler, X. Sun, and Y. Rui, "Identification of people using multiple types of input," Aug. 13 2013. US Patent 8,510,110
  - 50) R. G. Cutler, "Endpoint echo detection," July 16 2013. US Patent 8,488,745
  - 51) R. Cutler, "Reducing echo," Apr. 30 2013. US Patent 8,433,061
  - 52) R. G. Cutler, "Eye gaze reduction," Apr. 30 2013. US Patent 8,432,432
  - 53) D. A. Rosenfeld, Z. Liu, R. G. Cutler, P. A. Chou, C. Huitema, and K. Quinn, "Interest determination for auditory enhancement," Apr. 9 2013. US Patent 8,416,715
  - 54) D. A. Florencio, A. Acero, W. Buxton, P. A. Chou, R. G. Cutler, J. Garms, C. Huitema, K. M. Quinn, D. A. Rosenfeld, Z. Zhang, *et al.*, "Audio transforms in connection with multiparty communication," Dec. 25 2012. US Patent 8,340,267
  - 55) R. G. Cutler, "Capture device movement compensation for speaker indexing," Dec. 11 2012. US Patent 8,330,787
  - 56) R. G. Cutler, "Satellite microphones for improved speaker detection and zoom," Nov. 20 2012. US Patent 8,314,829
  - 57) R. G. Cutler, "Techniques for detecting a display device," Oct. 30 2012. US Patent 8,300,080
  - 58) R. G. Cutler, "Audio start service for ad-hoc meetings," Aug. 14 2012. US Patent 8,245,043
  - 59) C. Zhang, P. A. Viola, P. Yin, R. G. Cutler, X. Sun, and Y. Rui, "Identification of people using multiple types of input," July 31 2012. US Patent 8,234,113
  - 60) R. Cutler, X. Sun, and S. Velayutham, "Identifying far-end sound," July 10 2012. US Patent 8,219,387
  - 61) R. G. Cutler, "Satellite microphone array for video conferencing," May 29 2012. US Patent 8,189,807
  - 62) R. G. Cutler, "Automatic gain and exposure control using region of interest detection," Apr. 24 2012. US Patent 8,165,416
  - 63) R. G. Cutler, "Speaker and person backlighting for improved aec and agc," Mar. 6 2012. US Patent 8,130,257
  - 64) R. Cutler, Y. Rui, and A. Gupta, "System and method for distributed meetings," Feb. 7 2012. US Patent 8,111,282
  - 65) C. Zhang, P. A. Viola, P. Yin, R. G. Cutler, X. Sun, and Y. Rui, "Identification of people using multiple types of input," Sept. 20 2011. US Patent 8,024,189
  - 66) R. Cutler, "System and method for camera calibration and images stitching," May 3 2011. US Patent 7,936,374
  - 67) K. Toyama, R. Hariharan, R. G. Cutler, J. R. Douceur, N. M. Oliver, E. K. Ringger, D. C. Robbins, and M. T. Uyttendaele, "Parsing location histories," Jan. 11 2011. US Patent 7,868,786
  - 68) R. Cutler, I. Tashev, Y. Rui, and A. Gupta, "Integrated design for omni-directional camera and microphone array," Dec. 14 2010. US Patent 7,852,369
  - 69) R. G. Cutler, "Camera lens shuttering mechanism," Oct. 12 2010. US Patent 7,812,882
  - 70) R. G. Cutler, "Minimizing dead zones in panoramic images," Aug. 24 2010. US Patent 7,782,357
  - 71) Z. Zhang, R. Cutler, Z. Liu, A. Gupta, and L.-w. He, "System and method for whiteboard and audio capture," Aug. 3 2010. US Patent 7,770,116
  - 72) R. G. Cutler, "Embedding a panoramic image in a video stream," Aug. 3 2010. US Patent 7,768,544
  - 73) R. G. Cutler, "Parametric calibration for panoramic camera systems," Apr. 13 2010. US Patent 7,697,839
  - 74) R. G. Cutler, "Automatic face extraction for use in recorded meetings timelines," Oct. 6 2009. US Patent 7,598,975
  - 75) R. G. Cutler, "Temperature compensation in multi-camera photographic devices," Oct. 13 2009. US Patent 7,602,412
  - 76) R. G. Cutler, Y. Chang, Z. Liu, and Z. Zhang, "Automatic detection of panoramic camera position and orientation table parameters," Dec. 8 2009. US Patent 7,630,571
  - 77) D. Yee and R. Cutler, "Multi-view integrated camera system with housing," Sept. 22 2009. US Patent 7,593,057

- 78) R. G. Cutler, "Maintenance of panoramic camera orientation," Sept. 22 2009. US Patent 7,593,042
- 79) Y. Rui, A. Gupta, J. J. Cadiz, and R. G. Cutler, "Automated online broadcasting system and method using an omni-directional camera system for viewing meetings over a computer network," Aug. 25 2009. US Patent 7,580,054
- 80) R. Cutler, "Normalized images for cameras," Aug. 18 2009. US Patent 7,576,766
- 81) R. G. Cutler and A. L. Bridgewater, "Audio/video synchronization using audio hashing," Aug. 11 2009. US Patent 7,573,868
- 82) R. Cutler, "System and process for discovery of network-connected devices at remote sites using audio-based discovery techniques," Apr. 28 2009. US Patent 7,525,928
- 83) I. Tashev, H. S. Malvar, R. Cutler, D. J. Sisolak, and J. E. Unverferth III, "Self-descriptive microphone array," Apr. 7 2009. US Patent 7,515,721
- 84) Y. Rui, A. Gupta, J. J. Cadiz, and R. G. Cutler, "Automated online broadcasting system and method using an omni-directional camera system for viewing meetings over a computer network," Apr. 7 2009. US Patent 7,515,172
- 85) H. S. Malvar, L.-w. He, and R. Cutler, "High-quality gradient-corrected linear interpolation for demosaicing of color images," Mar. 10 2009. US Patent 7,502,505
- 86) R. Cutler, "Omni-directional camera with calibration and up look angle improvements," Feb. 24 2009. US Patent 7,495,694
- 87) R. Cutler, "System and process for discovery of network-connected devices," Oct. 28 2008. US Patent 7,443,807
- 88) R. Cutler, Y. Rui, and A. Gupta, "System and method for distributed meetings," Sept. 23 2008. US Patent 7,428,000
- 89) R. Cutler, "Whiteboard view camera," July 8 2008. US Patent 7,397,504
- 90) R. Cutler, "System and process for adding high frame-rate current speaker data to a low frame-rate video," Apr. 22 2008. US Patent 7,362,350
- 91) R. Cutler, "System and process for adding high frame-rate current speaker data to a low frame-rate video using audio watermarking techniques," Apr. 8 2008. US Patent 7,355,623
- 92) S. Clarke, A. Hovhannisyan, and R. Cutler, "System and process for adding high frame-rate current speaker data to a low frame-rate video using delta frames," Apr. 8 2008. US Patent 7,355,622
- 93) R. Cutler and A. Kapoor, "System and method for audio/video speaker detection," Mar. 11 2008. US Patent 7,343,289
- 94) R. G. Cutler, "Video-based gait recognition," Feb. 12 2008. US Patent 7,330,566
- 95) Z. Liu, R. Cutler, M. Cohen, and Z. Zhang, "System and method for head size equalization in 360 degree panoramic images," Feb. 5 2008. US Patent 7,327,899
- 96) R. Cutler, "Omni-directional camera design for video conferencing," Nov. 20 2007. US Patent 7,298,392
- 97) Z. Zhang, R. Cutler, Z. Liu, A. Gupta, and L.-w. He, "System and method for whiteboard and audio capture," Aug. 21 2007. US Patent 7,260,257
- 98) R. Cutler, "System and method for camera color calibration and image stitching," Aug. 21 2007. US Patent 7,259,784
- 99) R. G. Cutler and J. Stockdell-Giesler, "Portion of an audiovisual communication device," Mar. 13 2007. US Patent D538,254
- 100) Z. Liu, R. Cutler, M. Cohen, and Z. Zhang, "System and method for head size equalization in 360 degree panoramic images," Feb. 27 2007. US Patent 7,184,609
- 101) R. Cutler, "User interface for a system and method for head size equalization in 360 degree panoramic images," Dec. 12 2006. US Patent 7,149,367
- 102) R. G. Cutler and J. Stockdell-Giesler, "Portion of an audiovisual communication device," Oct. 11 2005. US Patent D510,571
- 103) Y. Rui, A. Gupta, J. J. Cadiz, and R. G. Cutler, "Automated online broadcasting system and method using an omni-directional camera system for viewing meetings over a computer network," Aug. 30 2005. US Patent 6,937,266
- 104) R. Leban, R. G. Cutler, H. S. Malvar, and Y. Rui, "System and method for communicating audio data signals via an audio communications medium," Aug. 23 2005. US Patent 6,934,370
- 105) R. G. Cutler and J. Stockdell-Giesler, "Portion of an audiovisual communication device," Aug. 2 2005. US Patent D508,040
- 106) R. G. Cutler and J. Stockdell-Giesler, "Portion of an audiovisual communication device," Aug. 2 2005. US Patent D508,039
- 107) R. G. Cutler and J. Stockdell-Giesler, "Audiovisual communication device," June 14 2005. US Patent D506,192