

# Keith Vertanen

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## EDUCATION

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- Ph.D. University of Cambridge, 2009  
Thesis: "Efficient Correction Interfaces for Speech Recognition"  
Advisor: Sir David J.C. MacKay FRS
- M.Phil. University of Cambridge, Computer Speech, Text and Internet Technology, 2004  
Thesis: "Efficient Computer Interfaces Using Continuous Gestures, Language Models, and Speech"  
Advisors: Sir David J.C. MacKay FRS and Steve Young FREng
- M.S. Oregon State University, Computer Science, 1999  
Thesis: "A Parallel Implementation of a Fluid Flow Simulation using Smoothed Particle Hydrodynamics"  
Advisor: Michael Quinn
- B.A. University of Minnesota, Morris, double major: Computer Science (honors) and Math, 1997  
Undergraduate research project: "Scheduling Problems in a Practical Allocation Model"  
Advisor: Dian Lopez

## PROFESSIONAL EXPERIENCE

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Assistant Professor, Michigan Technological University	2015-present
Associate Professor, Montana Tech	2014-2015
Assistant Professor, Montana Tech	2011-2014
Lecturer, Princeton University	2010-2011
Postdoctoral Research Associate, University of Cambridge	2009-2010
Instructor, Oregon State University	1999
Teaching Assistant, Oregon State University	1997-1999

## RESEARCH DESCRIPTION

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I specialize in designing intelligent interactive systems that leverage uncertain input technologies. A particular focus of my research is on systems that enhance the capabilities of users with permanent or situationally-induced disabilities. My broader interests include human-computer interaction (HCI), speech and language processing, mobile interfaces, and crowdsourcing. Below I summarize my existing work in three main areas.

## AWARDS

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- NSF CAREER Award, 2018.
- Google Faculty Research Award, 2016.
- Best paper, CHI 2015 (lead author).
- Best honorable mention, ETRA 2012 (co-author).
- Best student paper, ASSETS 2012 (co-author).

Institute of Computing and Cybersystems Achievement Award, Michigan Tech, 2018.

Distinguished Researcher Award, Montana Tech, 2014.

Exceptional instructor evaluation score, Michigan Tech, Spring 2018, Spring 2017, Spring 2016.

## REFEREED PUBLICATIONS

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Student co-authors denoted by \*. Conference acceptance rates listed where available.

- [1] **Vertanen, K.**, Gaines, D. \*, Fletcher, C. \*, Stanage, A.M. \*, Watling, R. \*, Kristensson, P.O. VelociWatch: Designing and Evaluating a Virtual Keyboard for the Input of Challenging Text. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2019, to appear)*. Acceptance rate: 24%
- [2] Dudley, J.J. \*, **Vertanen, K.**, Kristensson, P.O. Fast and Precise Touch-Based Text Entry for Head-Mounted Augmented Reality with Variable Occlusion. *ACM Transactions on Computer-Human Interaction (TOCHI 2018)*, 25(6): Article 30, 40 pages.
- [3] **Vertanen, K.**, Fletcher, C. \*, Gaines, D. \*, Gould, J. \*, Kristensson, P.O. The Impact of Word, Multiple Word, and Sentence Input on Virtual Keyboard Decoding Performance. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2018)*. Acceptance rate: 26%
- [4] Walker, J. \*, Li, B. \*, **Vertanen, K.**, Kuhl, S. Efficient Typing on a Visually Occluded Physical Keyboard. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2017)*, 5457-5461. Acceptance rate: 25%
- [5] **Vertanen, K.**, Memmi, H. \*, Emge, J. \*, Reyas, S. \*, and Kristensson, P.O. VelociTap: Investigating Fast Mobile Text Entry using Sentence-Based Decoding of Touchscreen Keyboard Input. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2015)*, 659-668. **Best paper**. Acceptance rate: 23%
- [6] Kristensson, P.O. and **Vertanen, K.** The Inviscid Text Entry Rate and its Application as a Grand Goal for Mobile Text Entry. In *Proceedings of the ACM International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI 2014)*, 335-338. Acceptance rate: 21%
- [7] Rough, D. \*, **Vertanen, K.**, and Kristensson, P.O. An Evaluation of Dasher with a High-Performance Language Model as a Gaze Communication Method. In *Proceedings of the ACM International Working Conference on Advanced Visual Interfaces (AVI 2014)*, 169-176. Acceptance rate: 28%
- [8] Weir, D. \*, Pohl, H., Rogers, S., **Vertanen, K.**, and Kristensson, P.O. Uncertain Text Entry on Mobile Devices. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2014)*, 2307-2316. Acceptance rate: 23%
- [9] **Vertanen, K.** and Kristensson, P.O. Complementing Text Entry Evaluations with a Composition Task. *ACM Transactions on Computer-Human Interaction (TOCHI 2014)*, 21(2): Article 8, 33 pages.
- [10] Oulasvirta, A., Reichel, A., Li, W., Zhang, Y., Bachnynskyi, M., **Vertanen, K.**, and Kristensson, P.O. Improving Two-thumb Text Entry on Touchscreen Devices. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2013)*, 2765-2774. Acceptance rate: 20%
- [11] Trinh, H. \*, Waller, A., **Vertanen, K.**, Kristensson, P.O., and Hanson, V.L. iSCAN: A Phoneme-based Predictive Communication Aid for Nonspeaking Individuals. In *Proceedings of the ACM SIGACCESS Conference on Computers and Accessibility (ASSETS 2012)*, 57-64. **Best student paper**. Acceptance rate: 28%

- [12] **Vertanen, K.** and Kristensson, P.O. Spelling as a Complementary Strategy for Speech Recognition, In *Proceedings of the International Conference on Spoken Language Processing (Interspeech 2012)*, 2291-2294. Acceptance rate: 52%
- [13] Kristensson, P.O. and **Vertanen, K.** The Potential of Dwell-Free Eye-Typing for Fast Assistive Gaze Communication. In *Proceedings of the ACM Symposium on Eye-Tracking Research and Applications (ETRA 2012)*, 241-244. **Best paper honorable mention.** Acceptance rate (short papers): 65%
- [14] Kristensson, P.O. and **Vertanen, K.** Performance Comparison of Phrase Sets and Presentation Styles for Text Entry Evaluations. In *Proceedings of the ACM International Conference on Intelligent User Interfaces (IUI 2012)*, 29-32. Acceptance rate: 23%
- [15] Kristensson, P.O. and **Vertanen, K.** Asynchronous Multimodal Text Entry using Speech and Gesture Keyboards. In *Proceedings of the International Conference on Spoken Language Processing (Interspeech 2011)*, 581-584. Acceptance rate: 58%
- [16] **Vertanen, K.** and Kristensson, P.O. The Imagination of Crowds: Conversational AAC Language Modeling using Crowdsourcing and Large Data Sources. In *Proceedings of the ACL Conference on Empirical Methods in Natural Language Processing (EMNLP 2011)*, 700-711. Acceptance rate: 23%.
- [17] **Vertanen, K.** and Kristensson, P.O. A Versatile Dataset for Text Entry Evaluations Based on Genuine Mobile Emails. In *Proceedings of the ACM International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI 2011)*, 295-298. Acceptance rate (short papers): 18%
- [18] **Vertanen, K.** and Kristensson, P.O. Getting it Right the Second Time: Recognition of Spoken Corrections. In *Proceedings of the IEEE Workshop on Spoken Language Technology (SLT 2010)*, 277-282. Acceptance rate: 52%
- [19] **Vertanen, K.** and Kristensson, P.O. Intelligently Aiding Human-Guided Correction of Speech Recognition. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI 2010)*, 1698-1701. Acceptance rate: 25%
- [20] **Vertanen, K.** and MacKay, D.J.C. Speech Dasher: Fast Writing using Speech and Gaze. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2010)*, 595-598. Acceptance rate: 22%
- [21] **Vertanen, K.** and Kristensson, P.O. Automatic Selection of Recognition Errors by Respeaking the Intended Text. In *Proceedings of the IEEE Workshop on Automatic Speech Recognition and Understanding (ASRU 2009)*, 130-135. Acceptance rate: 42%
- [22] **Vertanen, K.** and Kristensson, P.O. Recognition and Correction of Voice Web Search Queries. In *Proceedings of the International Conference on Spoken Language Processing (Interspeech 2009)*, 1863-1866. Acceptance rate: 58%
- [23] **Vertanen, K.** and Kristensson, P.O. Parakeet: A Continuous Speech Recognition System for Mobile Touch-Screen Devices. In *Proceedings of the ACM International Conference on Intelligent User Interfaces (IUI 2009)*, 237-246. Acceptance rate: 25%
- [24] **Vertanen, K.** and Kristensson, P.O. On the Benefits of Confidence Visualization in Speech Recognition. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2008)*, 1497-1500. Acceptance rate: 22%
- [25] **Vertanen, K.** Combining Open Vocabulary Recognition and Word Confusion Networks. In

*Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICAASP 2008)*, 4325-4328. Acceptance rate: 50%

- [26] **Vertanen, K.** Speech and Speech Recognition during Dictation Corrections. In *Proceedings of the International Conference on Spoken Language Processing (Interspeech 2006)*, 1890-1893. Acceptance rate: 64%
- [27] Hollermann, L., Hsu, T., Lopez, D., and **Vertanen, K.** Scheduling Problems in a Practical Allocation Model. *Journal of Combinatorial Optimization (1997)*, 129-149.

## **WORKSHOP, POSTER & DEMO PUBLICATIONS (PEER REVIEWED)**

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- [28] **Vertanen, K.** Towards Improving Predictive AAC using Crowdsourced Dialogues and Partner Context. In *Proceedings of the ACM SIGACCESS Conference on Computers and Accessibility (ASSETS 2017, poster)*, 347-348.
- [29] **Vertanen, K.** Towards Fluid Speech-based Text Interaction. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2017, workshop)*.
- [30] **Vertanen, K.**, Dunlop, M., Bi, X., Montague, K., Arif, A.S., Azenkot, S. Ubiquitous Text Interaction. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2017, workshop proposal)*. Acceptance rate: 45%
- [31] **Vertanen, K.** Counting Fingers: Eyes-Free Text Entry without Touch Location. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2016, workshop)*.
- [32] Walker, J. \*, Kuhl, S., **Vertanen, K.** Decoder-Assisted Typing using an HMD and a Physical Keyboard. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2016, workshop)*.
- [33] **Vertanen, K.**, Dunlop, M., Clawson, J., Kristensson, P.O., Arif, A.S. Inviscid Text Entry and Beyond. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2016, workshop proposal)*. Acceptance rate: 45%
- [34] **Vertanen, K.** and MacKay, D.J.C. Speech Dasher: A Demonstration of Text Input Using Speech and Approximate Pointing. In *Proceedings of the ACM SIGACCESS Conference on Computers and Accessibility (ASSETS 2014, demo)*, 353-354.
- [35] Trinh, H., Waller, A., **Vertanen, K.**, Kristensson, P.O., and Hanson, V.L. Phoneme-based Predictive Text Entry Interface. In *Proceedings of the ACM SIGACCESS Conference on Computers and Accessibility (ASSETS 2014, demo)*, 351-352.
- [36] **Vertanen, K.**, Emge, J. \*, Memmi, H. \*, and Kristensson, P.O. Text Blaster: A Multi-Player Touchscreen Typing Game. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2014, demo)*, 379-382.
- [37] Clawson, J., Brewster, S., Dunlop, M., Kristensson, P.O., Isokoski, P., Oulasvirta, A., **Vertanen, K.**, and Waller A. The Usability of Text Entry Systems Now and in the Future. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2014, special interest group proposal)*, 1139-1142.
- [38] **Vertanen, K.**, Memmi, H. \*, and Kristensson, P.O. The Feasibility of Eyes-Free Touchscreen Keyboard Typing. In *Proceedings of the ACM SIGACCESS Conference on Computers and Accessibility (ASSETS 2013, poster)*, Article No. 69. Acceptance rate: 60%
- [39] **Vertanen, K.** A Collection of Conversational AAC-like Communications. In *Proceedings of the ACM*

*SIGACCESS Conference on Computers and Accessibility (ASSETS 2013, poster)*, Article No. 31.  
Acceptance rate: 60%

- [40] Reyal, S. \*, **Vertanen, K.**, and Kristensson, P.O. Developing Efficient Text Entry Methods for the Sinhalese Language. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2013, workshop proposal)*.
- [41] Kristensson, P.O., Brewster, S., Clawson, J., Dunlop, M., Findlater, L., Isokoski, P., Martin, B., Oulasvirta, A., **Vertanen, K.**, and Waller, A. Grand Challenges in Text Entry. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2013, workshop)*, 3315-3318. Acceptance rate: 40%
- [42] Trinh, H. \*, Waller, A., **Vertanen, K.**, Kristensson, P.O., and Hanson, V.L. Applying Prediction Techniques to Phoneme-based AAC Systems. In *Proceedings of the Workshop on Speech and Language Processing for Assistive Technologies (SLPAT 2012)*, 19-27. Acceptance rate: 62%
- [43] Kristensson, P.O., Clawson, J., Dunlop, M., Isokoski, P., Roark, B., **Vertanen, K.**, Waller, A., and Wobbrock, J. Designing and Evaluating Text Entry Methods. In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2012, workshop proposal)*, 2747-2750. Acceptance rate: 62%
- [44] **Vertanen, K.** and Kristensson, P.O. Parakeet: A Demonstration of Speech Recognition on a Mobile Touch-Screen Device. In *Proceedings of the ACM International Conference on Intelligent User Interfaces (IUI 2009, demo)*, 483-484.

## THESES

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- [45] **Vertanen, K.** Efficient Correction Interfaces for Speech Recognition. Ph.D. thesis (2009), University of Cambridge.
- [46] **Vertanen, K.** Efficient Computer Interfaces using Continuous Gestures, Language Models, and Speech. M.Phil thesis (2004), University of Cambridge.
- [47] **Vertanen, K.** A Parallel Implementation of a Fluid Flow Simulation using Smoothed Particle Hydrodynamics. Master's thesis (1999), Oregon State University.

## TECHNICAL REPORTS

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- [48] **Vertanen, K.** Baseline WSJ Acoustic Models for HTK and Sphinx: Training Recipes and Recognition Experiments. Technical report (2006), Cavendish Laboratory.

## GRANTS

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- Michigan Tech Research Excellence Fund (REF): Automatic Speech Recognition using Deep Neural Networks (2018), sole PI, \$45K.
- National Science Foundation CAREER Award: Technology Assisted Conversations (2018), sole PI, \$539K.
- Michigan Tech Institute of Computing and Cybersystems, Paul William Seed Grant: Sensing and Feedback for On-Body Input (2018), PI, \$44K.
- Google Faculty Research Award: Less is More: Investigating Abbreviated Text Input via a Game (2016), sole PI, \$47K.
- Montana Tech High Performance Computing Seed Grant (2013), sole PI, \$5K.
- Montana Tech New Faculty Seed Grant (2012), sole PI, \$5K.

- Nokia Corporation: Creating Enjoyable and Fluid Mobile Phone Touch-Screen Interfaces (2009), co-PI, \$18K.
- Nokia Corporation: A Mobile Speech Recognition Correction Interface (2006), sole PI, \$10K.
- University of Cambridge, Clerk Maxwell Scholarship (2004), \$120K.
- Overseas Research Student Award (2004), \$40K.
- University of Minnesota, Katherine E. Sullivan Scholarship, \$14K.

## MENTORING EXPERIENCE

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- PhD advisor (2 PhD students), Michigan Tech (2016-present).
- Undergraduate research advisor (6 undergraduate students), Michigan Tech (2016-present).
- PhD co-advisor (1 student), University of St Andrews (2012-18).
- Undergraduate research advisor (3 undergraduate students), Montana Tech (2013).
- Undergraduate research advisor (1 undergraduate student), Princeton University (2010-11).

## INDUSTRY EXPERIENCE

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Software Consultant, Wildfire Communications, 2002-2003.

Designed and built new features for Wildfire's voice-driven virtual assistant.

Software Engineer, etrieve, Inc., 1999-2002.

Lead designer of voice application for mobile access to email, contact, and calendar information.

- Team leader of the voice application group, including developing and instituting best practices.
- Responsible for reviewing the usability of etrieve's voice, web, and mobile device interfaces.
- Designed the dialog flow, prompts and grammars for the voice application.
- Created hardware and software architecture for scalable and high availability 24x7 service.

Computer Specialist, In Time, 1990-2016.

Responsible for computing and web publishing tasks within the company.

## ACADEMIC SERVICE

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Associate editor:

- International Journal of Human Computer Studies (2014-present)

Associate chair:

- CHI: ACM International Conference on Human Factors in Computing Systems (2017, 2018, 2019)
- IUI: International Conference on Intelligent User Interfaces (2015)
- MobileHCI: ACM International Conference on Human-Computer Interaction with Mobile Devices and Services (2014)

Doctoral consortium co-chair:

- ASSETS: ACM SIGACCESS Conference on Computers and Accessibility (2018)

Vice-president:

- SIG-SLPAT, Special Interest Group, Speech and Language Processing for Assistive Technologies (2015-16)

Program committee:

- ASSETS: ACM SIGACCESS Conference on Computers and Accessibility (2018)
- IUI: International Conference on Intelligent User Interfaces (2014)
- SLPAT: Workshop on Speech and Language Processing for Assistive Technologies (2012, 2013, 2019)
- MobileHCI: ACM International Conference on Human-Computer Interaction with Mobile Devices and Services (2011)
- CHI Workshop on Text Entry (2012, 2013, 2016, 2017)
- BCS-HCI: British Computer Society Conference on Human-Computer Interaction (2010)

Student research competition judge:

- ASSETS: ACM SIGACCESS Conference on Computers and Accessibility (2014)

Instructor:

- ACM SIGCHI Summer School on Computational Interaction, University of Cambridge (2018)
- ACM SIGCHI Summer School on Research Methods and Approaches to Text Entry and Other Interaction Techniques, IIT Bombay (2018)

Reviewer:

- NSF panelist, Information and Intelligent Systems Division (2018)
- TOCHI: ACM Transactions on Computer-Human Interaction (2017, 2018)
- International Journal of Human Computer Studies (2016)
- IEEE Transactions on Human-Machine Systems (2015)
- IEEE Pervasive Computing (2017)
- Computer Speech and Language (2012)
- CHI: ACM International Conference on Human Factors in Computing Systems (2010, 2011, 2012, 2013, 2014, 2015, 2016)
- IUI: International Conference on Intelligent User Interfaces (2012, 2013, 2017)
- UIST: ACM Symposium on User Interface Software and Technology (2012, 2013, 2016, 2017)
- MobileHCI: ACM International Conference on Human-Computer Interaction with Mobile Devices and Services (2013, 2015, 2016, 2017)
- NordiCHI: Nordic Conference on Human-Computer Interaction (2012)
- ICASSP: IEEE International Conference on Acoustics, Speech, and Signal Processing (2011)
- ICMI: ACM International Conference on Multimodal Interaction (2013)
- BCS-HCI: British Computer Society Conference on Human Computer Interaction (2009)

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## INVITED & CONFERENCE TALKS

The Impact of Word, Multiple Word, and Sentence Input on Virtual Keyboard Decoding Performance  
CHI '18: ACM International Conference on Human Factors in Computing Systems, April 2018.

VelociTap: Investigating Fast Mobile Text Entry using Sentence-Based Decoding of Touchscreen  
Keyboard Input

CHI '15: ACM International Conference on Human Factors in Computing Systems, April 2015.

Complementing Text Entry Evaluations with a Composition Task  
CHI '14: ACM International Conference on Human Factors in Computing Systems, April 2014.

The Feasibility of Eyes-Free Touchscreen Keyboard Typing  
Department of Computer Science, University of Washington, October 2013.

Efficient Correction Interfaces for Speech Recognition  
School of Computer Science, University of St Andrews, June 2013.

The Potential of Dwell-Free Eye-Typing for Fast Assistive Gaze Communication  
ETRA '12: ACM Symposium on Eye-Tracking Research and Applications, March 2012.

Intelligently Aiding Human-Guided Correction of Speech Recognition  
AAAI '10: AAAI Conference on Artificial Intelligence, July 2010.

Efficient Correction Interfaces for Speech Recognition  
MIT Computer Science and Artificial Intelligence Lab, May 2010.

Efficient Correction Interfaces for Speech Recognition  
Google, April 2010.

Speech Dasher: Fast Writing using Speech and Gaze  
CHI '10: ACM International Conference on Human Factors in Computing Systems, April 2010.

Recognition and Correction of Voice Web Search Queries  
Interspeech '09: International Conference on Spoken Language Processing, September 2009.

Parakeet: A Continuous Speech Recognition System for Mobile Touch-Screen Devices  
IUI '09: ACM International Conference on Intelligent User Interfaces, February 2009.

On the Benefits of Confidence Visualization in Speech Recognition  
CHI '08: ACM International Conference on Human Factors in Computing Systems, April 2008.

## POSTERS & DEMOS

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Towards Improving Predictive AAC using Crowdsourced Dialogues and Partner Context  
ASSETS '17: ACM SIGACCESS Conference on Computers and Accessibility, October 2017.

Speech Dasher: A Demonstration of Text Input using Speech and Approximate Pointing  
ASSETS '14: ACM SIGACCESS Conference on Computers and Accessibility, October 2014.

The Feasibility of Eyes-Free Touchscreen Keyboard Typing  
ASSETS '13: ACM SIGACCESS Conference on Computers and Accessibility, October 2013.

A Collection of Conversational AAC-like Communications  
ASSETS '13: ACM SIGACCESS Conference on Computers and Accessibility, October 2013.

Spelling as a Complementary Strategy for Speech Recognition  
Interspeech '12: International Conference on Spoken Language Processing, September 2012.

Getting it Right the Second Time: Recognition of Spoken Corrections  
SLT '10: IEEE Workshop on Spoken Language Technology, December 2010.

Automatic Selection of Recognition Errors by Respeaking the Intended Text  
ASRU '09: IEEE Workshop on Automatic Speech Recognition and Understanding, December 2009.



Parakeet: A Demonstration of Speech Recognition on a Mobile Touch-Screen Device  
IUI '09: ACM International Conference on Intelligent User Interfaces, February 2009.

Combining Open Vocabulary Recognition and Word Confusion Networks  
ICASSP '08: IEEE International Conference on Acoustics, Speech, and Signal Processing, March 2008.

Speech Dasher – A Novel Interface for Correcting Speech Recognition Errors  
ICASSP '08: IEEE International Conference on Acoustics, Speech, and Signal Processing, March 2008.

Speech and Speech Recognition during Dictation Corrections  
Interspeech '06: International Conference on Spoken Language Processing, September 2006.

Speech Dasher: An Efficient Interface Using Speech and Gestures  
NIPS '04: Conference on Neural Information Processing Systems, December 2004.

## REFERENCES

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Furnished upon request.