VIJAY CHANDRASEKHAR   vijay.cmu at gmail.com

Education	**PhD Candidate**	**Electrical Engineering, Stanford Univ**
	GPA: 3.97/4.00	**2006-2013**
	Advisor: Prof. Bernd Girod	

Thesis: Low Bitrate Image Retrieval with Compressed Histogram of Gradient Descriptors.

Research Interests: Computer Vision, Image Processing, Multimedia Content Analysis and Retrieval, Machine Learning, Data Compression, Networked Multimedia Systems.

Ph.D. coursework includes Image Communications, Digital Communications, Statistical Signal Processing, Machine Learning, Computer Vision, Convex Optimization, Computational Photography, Structured Probabilistic Models and Techniques.

Master of Science   **Electrical Engineering, Carnegie Mellon University**
GPA: 3.97/4.00   **2004-2005**
Coursework includes Distributed Systems, Digital Signal Processing, Embedded Systems, Wireless Communications, Wireless Networks, Algorithms in DSP.

Bachelor of Science   **Electrical Engineering, Carnegie Mellon University**
GPA: 4.00/4.00   **2002-2005**
Minor: Economics, Graduated with University and College Honors

Awards

Carnegie Institute of Technology Dean's List 2002-2005
Singapore Physics Olympiad, Merit Award, Top 25 students in Singapore; Jan 2001.
A*STAR (Agency for Science, Technology and Research) NSS (National Science Scholarship), 2002, 2006
A-STAR Chairman's Honors Roll for meritorious academic performance, 2005
SIA (Singapore Airlines) Youth Scholarship-scholarship for two years of junior college studies in Singapore, 2000
National Talent Scholarship, Awarded at the national level in India, 1999

Work Experience

Scientist   **Institute for Infocomm Research**
                                                                     April 2013-
Tackling research problems/building prototypes for computer vision applications in the field of wearable computing – emerging platforms like Google Glass.

Research Intern   **Nokia Research Center, Palo Alto**
Advisor: Radek Grzeszczuk   **June-Sep 2007, June-Sep 2008**
Developed client and server side image retrieval algorithms on the Nokia N95 platform for a powerful Mobile Augmented Reality application. Work led to several publications in the area of mobile visual search and augmented reality.

Research Intern   **Google Research, Mountain View**
                                                                   June-Sep 2010
Worked on machine learning algorithms for large-scale video classification. Also worked on mobile audio search algorithms. Developed algorithms for automatic language identification in music videos. Performed survey and evaluation of audio fingerprinting schemes for mobile audio search. Work led to 2 publications.

Research Engineer   **Institute for Infocomm Research, Singapore**
Advisor: Winston KG Seah   **July 2005-July 2006**
Research Engineer in the networking department at I2R. Involved in the design of an efficient and robust under water sensor network. Tackled networking and application layer issues like topology management, localization, reliable data delivery and data routing. Developed efficient algorithms for localization in sensor networks.

Research Assistant   **Carnegie Mellon University, Pittsburgh**
Advisor: Rohit Negi   **Summer 2004**
Designed and implemented a software defined radio using Maxim 2410 RF receiver, AD6644 A/D converter, AD6620 digital down converter and TMSC6701 DSP. Implemented base band signal processing algorithms for correcting carrier frequency offset, frame synchronization, filtering and modulation/demodulation on the DSP.

Conference & Journal Publications

Number of Patents: 7 (6 filed, 1 granted)

Journal papers

1. M. Makar, S. Tsai, **V. Chandrasekhar,** D. M. Chen, B. Girod, "Interframe Coding of Canonical Patches for Low Bitrate Mobile Augmented Reality", *International Journal of Semantic Computing, Vol. 7, No. 1, March 2013.*

2. G. Takacs, **V. Chandrasekhar**, S. S. Tsai, D. M. Chen, R. Grzeszczuk, B. Girod, "Fast computation of rotation-invariant image features by an approximate radial gradient transform", *IEEE Transactions on Image Processing, Vol. 22, No. 8, August 2013.*

3. G. Takacs, **V. Chandrasekhar**, S. S. Tsai, D. M. Chen, R. Grzeszczuk, B. Girod, "Rotation Invariant Fast Features for Large Scale Recognition and Real-time Tracking", *Signal Processing: Image Communication, Vol. 28, No. 4, April 2013.*

4. D. Chen, S. S. Tsai, **V. Chandrasekhar,** R. Vedantham, R. Grzeszczuk, B. Girod, "Residual enhanced visual vector as a compact signature for mobile visual search", *Signal Processing, Vol. 93, No. 8, August 2013*

5. B. Girod, **V. Chandrasekhar,** D. M. Chen, N. M. Cheung, R. Grzeszczuk, Y. Reznik, G. Takacs, S. S. Tsai and R. Vedantham, "Mobile Visual Search", *Proceedings of Special Issue: Mobile Media Search, IEEE Signal Processing Magazine, 2011.*

6. **V. Chandrasekhar**, G. Takacs, D. M. Chen, S. S. Tsai, R. Grzeszczuk, Y. Reznik, and B. Girod, "Compressed Histogram of Gradients: A low bitrate descriptor", *Proceedings of Special Issue on Mobile Vision, International Journal on Computer Vision, 2011.*

7. B. Girod, **V. Chandrasekhar,** R. Grzeszczuk, and Y. Reznik, "Mobile Visual Search: architectures, technologies, and emerging MPEG standard," *IEEE Multimedia*, vol. 18, no. 3, pp. 86-94, 2011.

Conference papers

1. V. Chandrasekhar, D. Chen, M. Makar, S. Tsai, G. Takacs, B. Girod, "Feature Matching Performance of Compact Descriptors for Visual Search", *Proceedings of Data Compression Conference (DCC),* Snowbird, Utah, March 2014.

2. V. Chandrasekhar, W. Min, L. Xiaoli, C. Tan, L. Liyuan and Joo-Hwee Lim, "Incremental Graph Clustering for Efficient Retrieval from Streaming Egocentric Video Data", *Proceedings of International Conference on Pattern Recognition,* Stockholm, Sweden, August, 2014.

3. C. Tan, H. Goh, V. Chandrasekhar, L. Liyuan, Joo-Hwee Lim, "Understanding the Nature of First Person Videos: Characterization and Classification Using Low Level Features", *Proceedings of CVPR Workshop on Egocentric Vision,* Columbus, OH, June 2014.

4. Vijay Chandrasekhar, Wu Min, Xiao Li, Cheston Tan, Bappaditya Mandal, Liyuan Li, Joo Hwee Lim , "Efficient Retrieval from Large-Scale Egocentric Visual Data Using a Sparse Graph Representation", *Proceedings of CVPR Workshop on Egocentric Vision,* Columbus, OH, June 2014.

5. M. Makar, S. S. Tsai, **V. Chandrasekhar,** D. M. Chen, B. Girod, "Inter-frame Coding of Canonical Patches for Mobile Augmented Reality", *Proceedings of IEEE International Symposium on Multimedia (ISM),* Irvine, CA, December 2012 *(Top 5 Papers).*

6. S. S. Tsai, D. Chen, **V. Chandrasekhar,** G. Takacs, M. Makar, R. Grzeszczuk, and B. Girod, "Improved coding for image feature location information", Proceedings of *SPIE Applications of Digital Image Processing (ADIP)*, San Diego, CA, August 2012.

7. G. Takacs, **V. Chandrasekhar**, S. S. Tsai, D. M. Chen, R. Grzeszczuk, B. Girod, "Rotation Invariant Fast Features for Large Scale Recognition and Real-time Tracking", *Proceedings of SPIE Applications of Digital Image Processing,* San Diego, CA, August 2012.

8. M. Makar, H. Lakshman, **V. Chandrasekhar**, "Gradient Preserving Quantization", *Proceedings of International Conference on Image Processing (ICIP),* Orlando, Florida, September 2012. . *(Best Paper Award Finalist)*

9. **V. Chandrasekhar,** Y. Reznik, G. Takacs, D. M. Chen, S. S. Tsai, R. Grzeszczuk, and B. Girod, "Compressing Feature Sets with Digital Search Trees", *Proceedings of Mobile Vision Workshop, International Conference on Computer Vision (ICCV),* Barcelona, Spain, November 2011.

10. **V. Chandrasekhar,** S. S. Tsai, Y. Reznik, G. Takacs, D. M. Chen, and B. Girod, "Compressing a set of CHoG features", *Proceedings of SPIE Workshop on Applications of Digital Image Processing (ADIP),* San Diego, August 2011.

11. D. M. Chen, S. S. Tsai, **V. Chandrasekhar,** G. Takacs, H. Chen, R. Vedantham, R. Grzeszczuk, and B. Girod, "Residual enhanced visual vectors for on-device image matching", *Proceedings of Asilomar Conference,* Pacific Grove, CA, November 2011.

12. **V. Chandrasekhar,** M. Sharifi, D. Ross, "Survey and evaluation of audio fingerprinting schemes for mobile audio search", *Proceedings of International Symposium on Music and Information Retrieval (ISMIR),* Miami, Florida, October 2011.

13. **V. Chandrasekhar**, E. Sargin, D. Ross, "Automatic Language Identification in Music Videos", *Proceedings of International Conference on Acoustic and Signal Processing (ICASP),* Prague, Czechoslovakia, May 2011.

14. **V. Chandrasekhar,** D. Chen, S. S. Tsai, N. M. Cheung, H. Chen, G. Takacs, Y. Reznik, R. Vedantham, R. Grzeszczuk, J. Bach, and B. Girod, "The Stanford mobile visual search dataset", *Proceedings of ACM Multimedia Systems Conference (MMSys)*, San Jose, California, February 2011.

15. N. M. Cheung, D. M. Chen, **V. Chandrasekhar,** S. S. Tsai, G. Takacs, S. Halawa and B. Girod, "Restoration of Out-of-focus Lecture Video by Automatic Slide Matching", *Proceedings of ACM Multimedia Conference,* Florence, Italy, Sep 2010.

16. **V. Chandrasekhar,** S. S. Tsai, G. Takacs, D. M. Chen, N. M. Cheung, Y. Reznik,

R. Vedantham, R. Grzeszczuk and B. Girod, "Low Latency Image Retrieval with Progressive Transmission of CHoG Descriptors", *Proceedings of Mobile Cloud Media Computing, ACM Multimedia Conference,*Florence, Italy, October 2010.

17. S. S. Tsai, D. M. Chen, **V. Chandrasekhar,** G. Takacs, N. M. Cheung, R. Vedantham, R. Grzeszczuk and B. Girod, "Mobile Product Recognition", *Proceedings of ACM Multimedia Conference,*Florence, Italy, Sep 2010.

18. **V. Chandrasekhar,** D. M. Chen, A. Lin, G. Takacs, S. S. Tsai, N. M. Cheung, Y. Reznik and B. Girod, "Comparison of Local Feature Descriptors for Mobile Visual Search", *Proceedings of International Conference on Image Processing (ICIP),* Hong Kong, Sep 2010.

19. S.S.Tsai, D. M. Chen,G.Takacs, **V. Chandrasekhar,** R. Vedantham, R. Grzeszczuk, and B. Girod**, "**Fast Geometric Reranking for Image based Retrieval", *Proceedings of International Conference on Image Processing (ICIP),* Hong Kong, Sep 2010.

20. D. M. Chen, N. M. Cheung, S. S. Tsai, **V. Chandrasekhar**, G. Takacs, R. Vedantham, R. Grzeszczuk and B. Girod, "Dynamic Selection of a Feature Rich Query Frame for Accurate and Low-latency Mobile Video Search", *Proceedings of International Conference on Image Processing (ICIP),* Hong Kong, Sep 2010.

21. **V. Chandrasekhar**, M. Makar, G. Takacs, D. M. Chen, S. S. Tsai, R. Grzeszczuk and B. Girod, "Survey of SIFT compression schemes", *Proceedings of International Conference on Pattern Recognition (ICPR),* Istanbul, Turkey, August 2010.

22. Y. Reznik, **V. Chandrasekhar**, G. Takacs, D. M. Chen, S. S. Tsai and B. Girod, "Fast Quantization and Matching of Histogram-based Image Feature Descriptors", *Proceedings of SPIE Applications of Digital Image Processing Conference,* San Diego, August 2010.

23. G. Takacs, **V. Chandrasekhar,** Huizhong Chen, D. M. Chen, S. S. Tsai, R. Grzeszczuk and B. Girod, "Permutable Descriptors for Orientation-Invariant Matching", *Proceedings of SPIE Applications of Digital Image Processing Conference,* San Diego, August 2010.

24. **V. Chandrasekhar**, Y. Reznik, G. Takacs, D. M. Chen, S. S. Tsai, R. Grzeszczuk and B. Girod, "Quantization Schemes for the Compressed Histogram of Gradients descriptor", *Proceedings of International Workshop on Mobile Vision, Computer Vision and Pattern Recognition (CVPR),* San Francisco, June 2010.

25. G. Takacs, **V. Chandrasekhar**, D. M. Chen, S. S. Tsai, R. Grzeszczuk and B. Girod, "Unified Real-Time Tracking and Recognition with Rotation-Invariant Fast Features", *Proceedings of Computer Vision and Pattern Recognition (CVPR) Conference,* San Francisco, June 2010.

26. D. M. Chen, S. S. Tsai, **V. Chandrasekhar**, G. Takacs, R. Vedantham, R. Grzeszczuk and B. Girod, "Inverted Index Compression for Scalable Image Matching", *Proceedings of Data Compression Conference (DCC),* Snowbird, Utah, March 2010.

27. S. Tsai, D. Chen, Gabriel Takacs, **Vijay Chandrasekhar**, Jatinder Singh, B. Girod, "Location Coding for Mobile Image Retrieval Systems", Proceedings of *Mobimedia*, London, UK, September 2009.

28. **Vijay Chandrasekhar**, D. Chen, Zhi Li, Gabriel Takacs, Sam S. Tsai, Radek Grzeszczuk, B. Girod, "Low-Rate Image Retrieval with Tree Histogram Coding", Proceedings of *Mobimedia*, London, UK, September 2009.

29. **Vijay Chandrasekhar**, Gabriel Takacs, D. Chen, S. Tsai, R. Grzeszczuk, B. Girod, "CHoG: Compressed Histogram of Gradients - A low bit rate descriptor", *Proceedings of IEEE Conference on Computer Vision and Pattern Recognition*, Miami, June 2009. . *Oral Presentation (4% acceptance).*

30. D. Chen, S. Tsai, **Vijay Chandrasekhar**, Gabriel Takacs, Jatinder Singh, B. Girod, "Tree Histogram Coding for Mobile Image Matching", *Proceedings of Data Compression Conference (DCC)*, Snowbird, Utah, March 2009.

31. **Vijay Chandrasekhar**, Gabriel Takacs, B. Girod, et. al, "Transform Coding of Feature Descriptors", *Proceedings of Visual Communication and Image Processing*, San Jose, January 2009.

32. D. Chen, S. Tsai, **Vijay Chandrasekhar**, G. Takacs, J.Singh, B.Girod, "Robust image retrieval using multi-view scalable vocabulary trees", *Proceedings of Visual Communication and Image Processing*, San Jose, January 2009.

33. Gabriel Takacs, **Vijay Chandrasekhar**, B.Girod et. al, "Outdoors Augmented Reality on Mobile Phone using Loxel based Visual Feature Organization", *Proceedings of ACM Multimedia Information Retrieval (MIR)*, Vancouver, Canada, October 2008. *Oral Presentation (20% acceptance).*

34. D. Chen, **Vijay Chandrasekhar**, G. Takacs, J. Singh, and B.Girod, "Color restoration for objects of interest using robust image features", *IEEE International Workshop on Multimedia Signal Processing (MMSP)*, Queensland, Australia, Oct. 2008.

35. **Vijay Chandrasekhar**, Gabriel Takacs, B. Girod, R. Grzeszczuk, "Feature Tracking for Mobile Augmented Reality using Video Coder Motion Vectors", *Proceedings of the Sixth IEEE and ACM International Symposium on Mixed and Augmented Reality (ISMAR 07),* Nara, Japan, November 13-16 2007.

36. **Vijay R Chandrasekhar**, Winston KG Seah, Yoo Sang Choo, How Voon Ee, "Localization in Underwater Sensor Networks: Survey and challenges", *Proceedings of the ACM Workshop on Underwater Networks (WUWNETS),ACM MobiCom*, Los Angeles, CA, Sep 25-29, 2006.

37. **Vijay R. Chandrasekhar**, Zhi Ang Eu, Winston KG Seah, Venkatesh Pillai, "Experimental Analysis of Area Localization Scheme for Sensor Networks", *Proceedings of IEEE Wireless Communications and Networking Conference (WCNC),* Hong Kong, March 11-15, 2007.

38. **Vijay Chandrasekhar**, Winston KG Seah, "Area Localization Scheme for Sensor Networks", *Proceedings of IEEE OCEANS Asia Pacific Conference*, Singapore, May 16-19, 2006.

39. Jeffrey HS Tay, **Vijay Chandrasekhar** and Winston KG Seah, "Selective Iterative Multilateration for Hop Count-Based Localization in Wireless Sensor Networks", *Proceedings of the Workshop on Mobile Location-Aware Sensor Networks (MDM),* Nara, Japan, May 9-13, 2006.

40. Jeffrey HS Tay, **Vijay Chandrasekhar** and Winston KG Seah, "Range-free Localization Using Dynamic Hop Size Computation in Wireless Sensor Networks", *Proceedings of the IEEE Conference on Industrial Informatics (INDIN)*, Singapore, August 16-18, 2006.

Key MPEG Contributions

1. **V. Chandrasekhar,** G. Takacs, D. Chen, S. Tsai, M. Makar, R. Vedantham, R. Grzeszczuk, and B. Girod, "Stanford-Nokia response to CE2 (128 KB) with low memory descriptors", M24759, February 2012 (*100th, Geneva*).

2. D. Chen, **V. Chandrasekhar,** G. Takacs, S. Tsai, M. Makar, R. Vedantham, R. Grzeszczuk, and B. Girod, "Improvements to the test model with a low memory global descriptor", M24757, February 2012 (*100th, Geneva*).

3. S. Tsai, D. Chen, **V. Chandrasekhar,** G. Takacs, M. Makar, R. Grzeszczuk, and B.

Girod, "Response to CE3 -- feature point location coding", M24758, February 2012 (*100th, Geneva*).

4. M. Makar, **V. Chandrasekhar,** H. Lakshman, S. Tsai, G. Takacs, D. Chen, and B. Girod, "Update on canical patch encoding with variable size patches", M24756, February 2012 (*100th, Geneva*).

5. **V. Chandrasekhar,** D. Chen, G. Takacs, S. Tsai, M. Makar, R. Vedantham, R. Grzeszczuk, and B. Girod, "Improvements to the test model under consideration with low memory descriptors", M23580, February 2012 (*99th, San Jose*).

6. D. Chen, **V. Chandrasekhar,** G. Takacs, S. Tsai, M. Makar, R. Vedantham, R. Grzeszczuk, and B. Girod, "Improvements to the test model under consideration with a global descriptor", M23578, February 2012 (*99th, San Jose*).

7. S. Tsai, D. Chen, **V. Chandrasekhar,** G. Takacs, M. Makar, R. Grzeszczuk, and B. Girod, "Improvements to the location coder in the test model under consideration", M23579, February 2012 (*99th, San Jose*).

8. M. Makar, **V. Chandrasekhar,** H. Lakshman, S. Tsai, G. Takakcs, D. Chen, and B. Girod, "Canonical patch encoding for compact descriptors for visual search", M23577, February 2012 (*99th, San Jose*).

9. **V. Chandrasekhar,** G. Kirsch, G. Takacs, D. Chen, S. Tsai, R. Vedantham, R. Grzeszczuk, and B. Girod, "Stanford Aptina Nokia Features: Response to call for proposals on compact descriptors for visual search", M22554, November 2011 (*98th, Geneva*).

10. G. Takacs, V. Chandrasekhar, D. Chen, S. Tsai, R. Vedantham, R. Grzeszczuk, and B. Girod, "Stanford Nokia Integrated Fast Features: Response to call for proposals on compact descriptors for visual search", M22553, November 2011 (*98th, Geneva*).

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