

# Sensory Systems Technical Committee Activity Report

IEEE Circuits and Systems Society

Activities for May 2004 through March 2005

**Chair:** Orly Yadid-Pecht, University of Calgary, Canada and Ben-Gurion University, Israel, [oyp@ee.bgu.ac.il](mailto:oyp@ee.bgu.ac.il)

**Previous Chair:** Ralph Etienne-Cummings, Johns Hopkins University, [retienne@jhu.edu](mailto:retienne@jhu.edu)

**Chair Elect:** Andre van Schaik, University of Sydney, Australia, [andre@ee.usyd.edu.au](mailto:andre@ee.usyd.edu.au)

**Secretary:** Shih-Chi Liu, Institut für Neuroinformatik, Switzerland, [shih@ini.phys.ethz.ch](mailto:shih@ini.phys.ethz.ch)

**Secretary Elect:** Denise Wilson, University of Washington, [wilson@ee.washington.edu](mailto:wilson@ee.washington.edu)

## Summary of Activities

The Sensory Systems (SS) committee of the IEEE Circuits and Systems Society focuses on the theory, analysis, design, and practical implementation of sensors, actuators, micro-electro-mechanical systems and processing electronics, and their applications.

Committee members are renowned experts, who are both committed to, and active within, the field. The committee membership currently stands at 43 members, up from last year by 8 new members. At ISCAS 2004 changes to the bylaws of the Sensory Systems TC were approved and Prof. Denise Wilson was elected as the Secretary Elect for the SSTC.

*The following details the CASS-related Sensory Systems activity by the committee and its members.*

- 1. Participation in ISCAS track paper reviews:** We had a total of 57 papers originally submitted to the track. At least two reviews were arranged for each paper. Acceptance rate was 72%.
- 2. Best Paper Award:** 10 best papers were selected as candidates for the best paper award.
- 3. Journal Special Issues:** In June 2004 we have published a special issue on “Smart Sensors” in the AICSP journal. We are aiming for another at the TCASI.
- 4. Out Reach:** Members of our TC serve on program committees of various conferences such as SPIE, NIPS, ISSCC, ICECS, BIS and many others. A book on CMOS imagers was published by Kluwer and attracts significant attention from members in the field.
- 5. Technical Committee Membership.** We have recruited a group of TC members that cover all the thrusts of our TC. The committee has members from academia, national labs and industry. We have also attempted to diversify the membership to include senior and junior scientists, as well as women and minorities. In addition, our members serve on the editorial boards of various Journals, such as IEEE TVLSI, TSensors, TCAS and AICSP journal.  
(Appendix A contains a full list of current TC members)
- 6. Future Plans:** Extend visibility of TC via special issues, books, workshops etc. Special Issue on Sensors, planned to be published at the TCASI.
- 7. Technology Leadership:**

Orly Yadid-Pecht	- Chair of the Technical Committee on Sensors, <i>IEEE ISCAS, 2004</i> - <i>Distinguished Lecturer, IEEE CASS, 2004-2005.</i> - <i>IEEE Achievement Award, received for the ICECS2004.</i> - <i>Runner up Best Paper for ICECS 2004.</i>
Ralph Etienne-Cummings	- 2003 Best Paper Award, <i>EURASIP Journal of Applied Signal Processing, 2004</i> - Appointed Associate Director for Education and Outreach, <i>ERC on CISST at Johns Hopkins University, 2004-Present</i>
André van Schaik	- Chair Elect of the Technical Committee on Sensors, <i>IEEE ISCAS, 2004</i> - Secretary IEEE, Joint CASS and SSCC, NSW chapter, Australia - <i>Distinguished Lecturer, INE 2004</i>
Tobi Delbruck	- Co-organized 2003 and 2004 NIPS (Neural Information Processing Systems) Demonstrations Track - One of 10 best papers at ISCAS 2004 for bias generator paper. - Runner up best paper from ISCAS 2004 Sensory Systems for self-biased photoreceptor paper.
Shih-Chii Liu	- Secretary of the Sensory Systems Technical Committee, <i>IEEE ISCAS, 2004</i>

## 8. Publications:

### **Journal Publications:**

(Appendix B contains full list of Journal publications)

Orly Yadid-Pecht	- 9 publications
Ralph Etienne-Cummings	- 3 publications
André van Schaik	- 5 publications
Diego Barrettino	- 8 publications
Tobi Delbruck	- 1 publications
Piotr Dudek	- 2 publications
Shih-Chii Liu	- 2 publications

### **Regular Refereed Conference Publications:**

(Appendix C contains full list of Regular Refereed Conference publications)

Orly Yadid-Pecht	- 15 publications
Ralph Etienne-Cummings	- 10 publications
André van Schaik	- 6 publications
Diego Barrettino	- 7 publications
Tobi Delbruck	- 3 publications
Piotr Dudek	- 3 publications
Shih-Chii Liu	- 3 publications

### **Books:**

1. O. Yadid-Pecht and R. Etienne-Cummings, *CMOS Imagers: from Phototransduction to Image Processing*, Kluwer Academic Publishers, May 2004

### **Book chapters:**

1. I. Shcherback and O. Yadid-Pecht, "CMOS APS MTF Modeling", in O. Yadid-Pecht and R. Etienne-Cummings, *CMOS Imagers: from Phototransduction to Image Processing*, Kluwer Academic Publishers, May 2004.
2. I. Shcherback and O. Yadid-Pecht, "Photoresponse Analysis and Pixel Shape Optimization for CMOS APS", in O. Yadid-Pecht and R. Etienne-Cummings, *CMOS Imagers: from Phototransduction to Image Processing*, Kluwer Academic Publishers, May 2004.
3. A. Fish and O. Yadid-Pecht, "Active Pixel Sensor Design – from pixels to systems", in O. Yadid-Pecht and R. Etienne-Cummings, *CMOS Imagers: from Phototransduction to Image Processing*, Kluwer Academic Publishers, May 2004.
4. R. Etienne-Cummings, M. Clapp and V. Gruev, "Focal-Plane Analog Image Processing," in O. Yadid-Pecht and R. Etienne-Cummings, *CMOS Imagers: from Phototransduction to Image Processing*, Kluwer Academic Publishers, Spring 2004

### **Invited Lectures/Papers:**

1. O. Yadid-Pecht, "Grand challenges in CMOS Imaging", invited for ICECS2004, Tel-Aviv, Israel, December 2004.  
- "Active Pixel Sensors", NSF (US) – Neuromorphic Workshop – Invited instructor, July 2004.
2. S.-C. Liu, "Reconfigurable spiking systems", Computer Science and Artificial Intelligence Lab, MIT, Cambridge, MA, Aug 2004.
3. Ralph Etienne-Cummings
  - Invited Speaker: NSF Telluride Workshop on Neuromorphic Engineering, CO, 2004.
  - Invited Speaker: Neuroscience and Cognitive Sciences, University of Maryland, College Park, MD, 2004.
  - Invited Speaker: Cornell University, Ithaca, NY, 2004.
  - Invited Speaker: University of Sydney, Sydney, Australia, 2004.
  - Invited Speaker: Edith Cowen University, Perth, Australia, 2004.
  - Invited Speaker: University of Queensland, Brisbane, Australia, 2004.
  - Invited Speaker: Johns Hopkins University, Baltimore, MD, 2004.
  - Invited Speaker: Mitre Corporation, McClean, VA, 2004.
  - Invited Speaker: NRO, Chantilly, VA, 2005.
  - Invited Speaker: Agilent Corp., Palo Alto, CA, 2005.
  - Invited Speaker: SPIE Conference, Orlando FL, 2005.
  - Invited Speaker: NSF Grantees Meeting, Washington, DC, 2005.

## 9. Workshops/conferences:

- Orly Yadid-Pecht
- Technical Program committee member and Session Chairman: SPIE Elec. Imaging Conference, San-Jose, CA, 2005.
  - Technical Program Committee member and Session Chairman: International Symposium on Circuits and Systems, 2004
  - Technical Program Committee and Session chairman: IEEE Workshop on Advanced Image Sensors, Japan, 2005.
  - General chair: IEEE ICECS 2004.
  - Organizer: CMOS Imagers Tutorial, ISCAS 2004, May 2004.
- Ralph Etienne-Cummings
- Session Chairman: International Solid-State Circuits Conference, San Francisco, CA, 2004.
  - Session Chairman: International Symposium on Circuits and Systems, 2004.
  - Panel Moderator: NSF ERC Annual Meeting, 2004.
  - Review Panel: NIH SBIR Panel, Washington, DC, Nov. 2004.
  - Organizer: CMOS Imagers Tutorial, ISCAS 2004, May 2004.
  - Organizer: NSF Telluride Neuromorphic Engineering Workshop, Telluride, CO, 2004.
  - Organizer: ISCAS 2004, Two Special Sessions on Spiking Neural Systems, Vancouver, Canada, May 2004.
- André van Schaik
- Technical Program Committee member and Session Chairman: International Symposium on Circuits and Systems, 2004.
- Piotr Dudek
- Session Chairman: IEEE International Symposium on Circuits and Systems, ISCAS 2004
- Shih-Chii Liu
- Chairman of Emerging Technologies Track, Neural Information Processing Systems Conference, Vancouver, Canada, Dec 5-10, 2005.
  - International Committee Member on Bio-Inspired Cognitive Systems Conference, BICS 2004.

## 10. Professional activities:

- Orly Yadid-Pecht
- Deputy Editor in Chief: IEEE TCAS-I Journal
  - Reviewer: IEEE TCAS I, IEEE TCASII, IEEE TNN, IJNN, IEEE TSensors, IEEE TED, IEEE JSSC, SPIE, ISCAS, IEEE bi-annual workshop on Sensors
  - Program Committees: SPIE, ISCAS, IEEE bi-annual workshop on Sensors
  - Guest Editor: *Kluwer's AICSP Journal*, Special Issue on Smart Sensors, July 2004.
- Ralph Etienne-Cummings
- Session Board of Governors: IEEE CAS Society
  - Associate Editor: IEEE Sensors Journal
  - Reviewer: IEEE SJ, IEEE TCAS II, IEEE TNN, IEEE TRAA, IEEE TBME, IEEE IJSSC, NIPS, EWNS, ISCAS, Wiley, NSF, NIH
  - Program Committee: ISSCC, SPIE, BIS, ISCAS, NIPS, COSI
  - Guest Editor: *Kluwer's AICSP Journal*, Special Issue on Smart Sensors, July 2004.
- Diego Barrettino
- Member of the Sensory Systems (SS) Technical Committee, IEEE Circuits and Systems Society, since May 2002.
  - Review Committee Member of the IEEE International Symposium on Circuits and Systems (ISCAS), since August 2003.
  - Reviewer for the IEEE Journal of Solid-State Circuits, since October 2003.
  - Reviewer for the IEEE Sensors Journal, since December 2003.
  - Reviewer for the IEEE Transactions on Biomedical Engineering, since February 2005.
- Tobi Delbruck
- Reviewer TCAS
  - Reviewer AICSP
  - Reviewer IEEE Trans on Neural Networks
  - Reviewer ISCAS
- Bernabe Linares-Barranco
- Associate Editor for IEEE Trans. on Neural Networks
- Shih-Chii Liu
- Reviewer for IEEE TCAS-I Journal, IEEE TCAS-II Journal

## Appendix A

### Current list of Technical Committee Members:

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## Appendix B

### *Journal Publications:*

1. A. Fish and O. Yadid Pecht, "Adaptive thresholding for visual attention and tracking systems", *Optical Engineering*, Vol. 43, Issue 6, pp. 1278-1279, June 2004.
2. A. Belenky, A. Fish, S. Hamami, V. Milrud and O. Yadid-Pecht, "Method for expanding the dynamic range of the readout integration circuits for uncooled microbolometer sensors", *Optical Engineering*, Vol. 43, Issue 06, pp. 1274-1275, June 2004.
3. A. Fish, D. Akselrod, O. Yadid-Pecht, "A "Smart Sensor" for High Precision Image Centroid computation via a Low Resolution Winner-take-all Circuit in Conjunction with a Dynamic Element matching Algorithm", *Analog Integrated Circuits and Signal Processing journal*, Vol. 39, No. 3, pp. 251-266, June 2004.
4. S. Diller, A. Fish, O. Yadid-Pecht, "Advanced Output Chains for CMOS Image Sensors Based on an Active Column Sensor Approach – A Detailed Comparison", *Sensors & Actuators: A. Physical*, Volume 116, Issue 2, pp. 304-311, October 2004.
5. M. Herscovitz, O. Yadid-Pecht, "A modified Multi Scale Retinex Algorithm with an Improved Global Impression of Brightness for Wide Dynamic Range Pictures", *Machine Vision and Applications journal*, Volume 15, Number 4, pp. 220-228, October 2004.
6. I. Shcherback, T. Danov, O. Yadid-Pecht, "A Comprehensive CMOS APS Crosstalk Study: Photoresponse Model, Technology and Design Trends", *IEEE Trans. on Elec. Dev.*, Volume 51, Number 12, pp. 2033-2041, December 2004.
7. E. Artyomov, O. Yadid-Pecht, "Practical, computation efficient High-Order Neural Network for rotation and shift invariant pattern recognition", *International Journal on Information Theory and Applications*, Volume 11, pp. 53-57, December 2004.
8. T. Danov, I. Shcherback, O. Yadid-Pecht, "Study of CMOS APS responsivity enhancement: Ring shaped Photodiode", *IEEE Trans. on Elec. Dev.*, Volume 52, Number 1, pp. 126-129, January 2005.
9. B. Maliatski, O. Yadid-Pecht, "Hardware driven adaptive k-means clustering for real time video imaging", *IEEE TCSVT*, Vol. 15, No 1, pp. 164-166, January 2005
10. M. Clapp and R. Etienne-Cummings, "Sensing Signal Input Bearing to a Sensor Array Using Velocity-Sensitive Spatiotemporal Filters," *IEE Electronics Letters*, Vol. 40, No. 3, pp. 211-212, February 2004.
11. V. Gruev and R. Etienne-Cummings, "A Pipelined Temporal Difference Imager," *IEEE J. Solid-State Circuits*, Vol. 39, No. 3, pp. 538 – 543, March 2004.
12. R. Philipp and R. Etienne-Cummings, "A Single Chip Stereo Vision System," *Analog Integrated Circuits and Signal Processing Journal*, Vol. 7, pp. 703-712, July 2004.
13. A. van Schaik and S. Shamma, "A neuromorphic sound localizer for a smart MEMS system," *Analog Integrated Circuits & Signal Processing*, vol. 39, pp. 267-273, 2004.
14. C. Jin, A. Corderoy, S. Carlile, and A. van Schaik, "Contrasting monaural and interaural spectral cues for human sound localization," *Journal of the Acoustical Society of America*, vol. 151, pp. 3124-3141, 2004.
15. T. Delbruck and A. van Schaik, "Bias Current Generators with Wide Dynamic Range," *Analog Integrated Circuits and Signal Processing*, vol. 42, 2005.
16. V. Best, A. van Schaik, and S. Carlile, "Separation of concurrent broadband sound sources by human listeners.," *Journal of the Acoustical Society of America*, vol. 151, pp. 324-336, 2004.
17. V. Best, A. van Schaik, C. Jin, and S. Carlile, "Sharing auditory space: sound localisation in the presence of a masker," *Acta Acustica, Special issue: Workshop on spatial and binaural hearing*, 2004.

18. D. Barrettino, M. Graf, M. Zimmermann, C. Hagleitner, A. Hierlemann, H. Baltes, "A Smart Single-Chip Micro-Hotplate-Based Gas Sensor System in CMOS-Technology", *International Journal on Analog Integrated Circuits and Signal Processing*, Vol. 39, pp. 275-287, 2004.
19. M. Graf, D. Barrettino, M. Zimmermann, A. Hierlemann, H. Baltes, S. Hahn, N. Bârsan and U. Weimar, "CMOS Monolithic Metal-Oxide Sensor System Compromising a Microhotplate and Associated Circuitry", *IEEE Sensors Journal*, Vol. 4, pp. 9-16, 2004.
20. D. Barrettino, M. Graf, W.H. Song, K.U. KIRSTEIN, A. Hierlemann, and H. Baltes, "Hotplate-Based Monolithic CMOS Microsystems for Gas Detection and Material Characterization for Operating Temperatures up to 500°C", *IEEE Journal of Solid-State Circuits*, Vol. 39, pp. 1202-1207, 2004.
21. M. Graf, D. Barrettino, S. Taschini, C. Hagleitner, A. Hierlemann, and H. Baltes "Metal Oxide-Based Monolithic Complementary Metal Oxide Semiconductor Gas Sensor Microsystem", *Analytical Chemistry*, Vol. 76, pp.4437-4445, 2004.
22. S. Hafizovic, D. Barrettino, T. Volden, J. Sedivy, K. KIRSTEIN, O. Brand, and A. Hierlemann, "Single-Chip Mechatronic Microsystem for Surface Imaging and Force Response Studies", *Proceedings of the National Academy of Sciences*, Vol. 101, No. 49, pp.17011-17015, 2004.
23. M. Graf, R. Jurischka, D. Barrettino, and A. Hierlemann, "3-D Nonlinear Modelling of Microhotplates in CMOS Technology for Use as Metal-Oxide-Based Gas Sensors", *Journal of Micromechanics and Microengineering*, Vol. 15, pp. 190-200, 2005.
24. D. Barrettino, S. Hafizovic, T. Volden, J. Sedivy, and A. Hierlemann, "CMOS Monolithic Mechatronic Microsystem for Surface Imaging and Force Response Studies", *IEEE Journal of Solid-State Circuits*, Vol. 40, Issue 4, 2005.
25. M. Graf, S. Muller, D. Barrettino, and A. Hierlemann, "Transistor Heater for Microhotplate-Based Metal-Oxide Microsensors", *IEEE Electron Device Letters* (in press)
26. P.Dudek and P.J.Hicks, "A General-Purpose Processor-per-Pixel Analog SIMD Vision Chip", *IEEE Transactions on Circuits and Systems - I: Analog and Digital Signal Processing*, vol. 520, no. 1, pp. 13-20, January 2005.
27. T. Delbruck, A. van Schaik (2004). *Bias current generators with wide dynamic range*. Accepted to *Analog VLSI and Signal Processing*.
28. T. Delbruck, S.C. Liu. (2004). *A silicon visual system as a model animal (preprint)*. *Vision Research*, vol. 44, issue 17, pp. 2083-2089
29. T. Delbruck and S.-C. Liu, "A silicon early visual system as a model animal", *Vision Research*, Vol. 44, Issue 17, pp. 2083-2089, 2004.
30. S.-C. Liu and R. Douglas, "Temporal coding in a network of silicon integrate-and-fire neurons", *IEEE Transactions on Neural Networks*, Special Issue on Temporal Coding for Neural Information Processing, Vol. 15, Issue 05, pp. 1305-1314, 2004.

## Appendix C

### *Regular Refereed Conference Publications:*

1. S. Hamami, L. Fleshel and O. Yadid-Pecht, "CMOS APS Imager employing 3.3V 12 bit 6.3 MS/s pipelined ADC", Proc. IEEE ISCAS'04, vol. IV, pp. 960-963, Vancouver, Canada, May, 2004.
2. A. Fish, V. Milrud and O. Yadid-Pecht, "High speed and high resolution current winner-take-all circuit in conjunction with adaptive thresholding", Proc. IEEE ISCAS'04, vol. IV, pp. 852-855, Vancouver, Canada, May, 2004.
3. A. Belenky, A. Fish, S. Hamami, V. Milrud and O. Yadid-Pecht, "Widening the dynamic range of the readout integration circuit for uncooled micro-bolometer infrared sensors", Proc. IEEE ISCAS'04, vol. V, pp. 600-603, Vancouver, Canada, May, 2004.
4. E. Artyomov, O. Yadid-Pecht, "Adaptive Multiple Resolution CMOS Active Pixel Sensor", Proc. IEEE ISCAS'04, vol. IV, pp. 836-839, Vancouver, Canada, May, 2004.
5. E. Artyomov, O. Yadid-Pecht, "Practical, computation efficient High-Order Neural Network for rotation and shift invariant pattern recognition", Proceedings of the International Conference on Information and Communication Technologies and Programming, Varna, Bulgaria, pp. 37-44, June 2004.
6. E. Artyomov, Y. Rivenson, G. Levi, O. Yadid-Pecht, "Morton (Z) scan based real time variable resolution CMOS image sensor", IEEE ICECS, December 2004, CD ROM.
7. A. Fish, V. Mosheyev, V. Linkovsky and O. Yadid-Pecht, "Ultra Low-Power DFF based Shift Registers Design for CMOS Image Sensors Applications", IEEE ICECS, Tel-Aviv, Israel, December 2004, CD ROM.
8. A. Fish, A. Spivakovsky, A. Golberg and O. Yadid-Pecht, "VLSI Sensor for multiple targets detection and tracking", IEEE ICECS, December 2004, CD ROM.
9. A. Fish, V. Milrud and O. Yadid-Pecht, "High speed and high resolution current Loser-take-all circuit of  $o(N)$  complexity", IEEE ICECS, December 2004, CD ROM.
10. I. Shcherback and O. Yadid-Pecht, "CMOS APS Photoresponse and Crosstalk optimization analysis for Scalable CMOS Technologies", IEEE ICECS, December 2004, CD ROM.
11. A. Fish, A. Belenky and O. Yadid-Pecht, "Low Power Global Shutter CMOS Active Pixel Image Sensor with Ultra-High Dynamic Range", IEEE ICECS, December 2004, CD ROM.
12. T. Danov, I. Shcherback, O. Yadid-Pecht, "Ring-Shaped N+/P-Well Photodiode: study of responsivity enhancement", IEEE ICECS, December 2004, CD ROM.
13. J. L. Gonzalez, O. Yadid-Pecht, D. Sadowski, K. V. I. S. Kaler, M. P. Mintchev, "Integrated Esophageal Pressure, pH and Bolus Transit Sensor", IEEE Sensors, 2004, CD ROM.
14. I. Shcherback, A. Belenky, O. Yadid-Pecht, "CMOS APS Crosstalk; Modeling, Technology and Design Trends", IEEE Sensors, 2004, CD ROM.
15. I. Shcherback, B. Lichterov, A. Belenky, O. Yadid-Pecht, "The Unique Sub-micron Scanning System: Further development and new applications", Proc of the SPIE, January 2005.
16. U. Mallik, E. Choi, M. Clapp, G. Cauwenberghs and R. Etienne-Cummings, "Temporal Change Threshold Detection Imager," accepted for *ISSCC'05 Digest of Technical Papers*, Vol. 48, Feb 2005.
17. R. J. Vogelstein, U. Mallik, G. Cauwenberghs, E. Culurciello and R. Etienne-Cummings, "Saliency-Driven Image Acuity Modulation on a Reconfigurable Silicon Array of Spiking Neurons," accepted for *Proc. of Neural Information Processing Systems*, Vancouver, Canada, December 2004.
18. F. Tenore, R. Etienne-Cummings and M. A. Lewis, "Entrainment of Silicon Central Pattern Generators for Legged Locomotory Control," *Proc. of Neural Information Processing Systems 16*, S. Thrun, L. Saul and B. Scholkopf (Eds.), MIT Press, Cambridge, MA, 2004.

19. J. Vogelstein, U. Mallik, E. Culurciello, R. Etienne-Cummings and G. Cauwenbergs, "Spatial Acuity Modulation of an Address-Event Imager," *IEEE ICECS 2005*, Tel Aviv, Israel, December 2004.
20. V. Gruev and R. Etienne-Cummings, "Active Pixel Sensor with On-Chip Normal Flow Computation on the Read-Out," *IEEE ICECS 2005*, Tel Aviv, Israel, December 2004.
21. V. Gruev, T. Horiuchi and R. Etienne-Cummings, "Linear Current Mode Imager with Low Fix Pattern Noise" *IEEE ISCAS'04*, May 2004.
22. S. Mehta and R. Etienne-Cummings, "Normal Optical Flow Measurement on a CMOS APS Imager" *IEEE ISCAS'04*, Vancouver, Canada, May 2004.
23. M. Clapp and R. Etienne-Cummings, "Bearing Angle Estimation For Sonar Micro-Array Using Analog VLSI Spatiotemporal Processing" *IEEE ISCAS'04*, Vancouver, Canada, May 2004.
24. E. Culurciello and R. Etienne-Cummings, "Second Generation of High Dynamic Range, Arbitrated Digital Imager" *IEEE ISCAS'04*, Vancouver, Canada, May 2004.
25. R. Philipp and R. Etienne-Cummings, "Low Power Current Rectifiers for Large-Scale Current-Mode Signal Processing" *IEEE ISCAS'04*, Vancouver, Canada, May 2004.
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