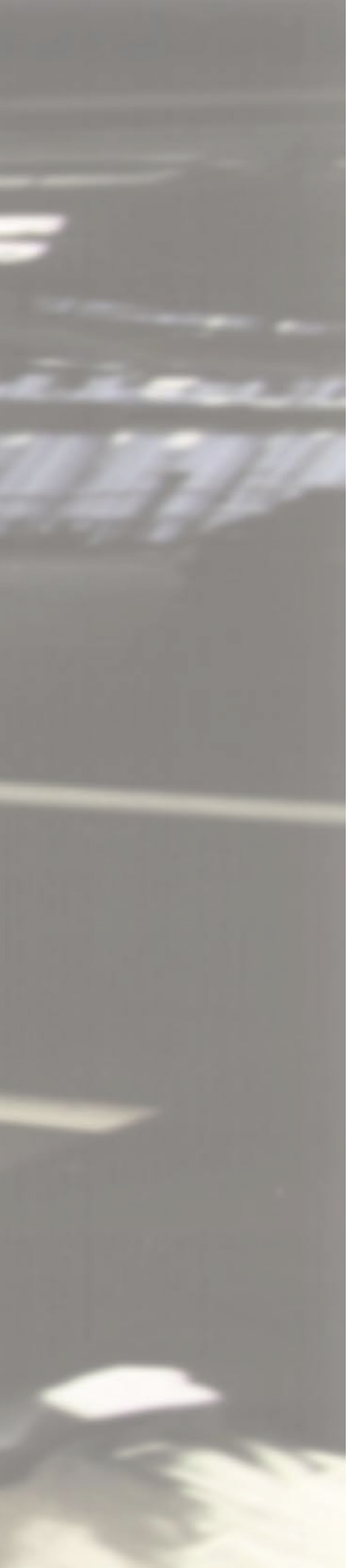
ADVANCED TECHNOLOGY INFORMATION PROCESSING SYSTEMS



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The ATIPS (Advanced Technology Information Processing Systems) Laboratory at the University of Calgary (U of C) leverages the use of highly advanced and emerging computing technologies to conduct research into the development and implementation of a variety of information processing systems, including high performance digital signal processors, machine vision systems, information security systems, streaming video processors, bio-engineering devices, arithmetic intensive processors, wireless networking components, opto-electronic sensors and processors.

EXECUTIVE SUMMARY

The ATIPS research group is primarily concerned with the exploitation of microstructure techniques, including microelectronics, System-on-Chip (SoC), microelectro mechanical systems, microfluidics, and sensors, to the benefit of Canadian industry, Canadian health, Alberta high technology diversification, and the training of highly qualified personnel.

The year 2003, our third year of operation, has proven to be exceptionally exciting. Most importantly we have achieved our original goal of assembling a world-class team representing the broad areas of sensor technology, system-on-chip, microsystems, and mathematical techniques.

Based on the strengths of this team the ATIPS research focus and capacity has broadened to include the following application areas: embedded and fault tolerant systems for wireless networks, streaming video, secure communications and machine vision; custom integrated circuit architectures for hearing instruments, arithmetic intensive processors, video processors, image sensors for biomedical applications and bio-sensors; emerging fabrication technologies where we have established leadership in the production of CAD tools and new device design in the area of Quantum Cellular Automata.

Major new multidisciplinary research projects and programs have been initiated in the following areas:

- Image Sensors - advanced image sensors, image and capacitive sensing with dielectrophoretic techniques.
- Cryptography and hardware based security systems.

Continuing and new collaborative ties with key academic and industry groups include:

- DALSA Corp. (Waterloo): machine vision and camera systems
- Gennum Corp (Burlington): video processors and hearing instruments
- Micralyne Inc: Microfluidic drug delivery systems using microneedles
- Non-Elephant Encryption Systems: crypto systems
- SGI (Canada): crypto systems
- RCIM, University of Windsor: integrated circuit design
- CMC: System-on-Chip Research Network (interaction with 26 other universities)
- LIRMM, Montpellier University, France: number theoretic and crypto systems

Our research has resulted in a substantial contribution to the literature (85 publications in journals conferences and books) including publication or acceptance of 25 journal papers, 52 conference proceedings papers, 8 books or book chapters, 6 workshop presentations, 3 contributions to international standards and 3 tutorial and keynote talks and important Intellectual Property (IP). In 2003 ATIPS team members were issued two patents, submitted eight more, registered a key invention, registered two trademarks, and initiated the establishment of a spin-off company – Smart Camera Technology Inc.

ATIPS team members have graduated 10 students, and attracted some of the best graduate students interested in our research, to the ATIPS environment health, Alberta high technology diversification, and the training of highly qualified personnel.

RESEARCH PROGRAM OVERVIEW

Our Team

The ATIPS Laboratory now has a core personnel group of over 50 researchers and students, and the ATIPS laboratory workstations host more than 70 users performing research on all aspects of integrated circuit design. We represent the U of C's portal to the services of CMC, and many tens of integrated circuit designs are fabricated every year using design tools running on our server. Several national awards were won in 2003-2004 by researchers using the ATIPS Laboratory facilities. A key recruitment, Dr Orly Yadid-Pecht, took up her new position in July 2003, providing us with invaluable, and internationally recognized skills in sensor and CMOS imager technologies. These skills represent a vital component in our established research thrust into microsystem components for health sciences applications.

Our Partners

Our research is conducted with the support of major Canadian industries, and we are partnering with small and large local, national and international firms to develop valuable new tools and technologies. We are a member and lead client in the CMC System-on-Chip Research Network, funded by a $40 million CFI grant, that is being used to bring the technology of System-on-Chip design to all interested Canadian Universities.

Our Focus

In the short term we will continue to work in the implementation areas of high performance signal, image and video processing with application areas in machine vision, bio-engineering devices, and communication systems. Our recent expansion into the implementation of crypto systems will also be expanded with stronger ties to our new industrial partners. Our longer term goals are focused on the microconvergence of the different microstructure technologies with which we are already familiar, and the further exploration of nano-technologies based on the tools we have already developed for Quantum Cellular Automata. The application areas for these technologies are enormous, and many groups are starting to explore these avenues. We need to make sure that the ATIPS Laboratory is at the leading edge of this research.

RESEARCH PROJECTS

The following lists the key areas being targeted by ATIPS, and the key goals within each for the coming year and beyond. These goals are aligned with the original ATIPS research program and the opportunities this research program has presented to our team over the past three years.

WIRELESS NETWORKS

Development of digital signal processors for wireless base-stations

The goal is to produce single-chip high performance solutions for the very high data rate signal processing required for next generation Gbps wireless networks.

System-on-Chip low-power wireless platforms

The research goals are to develop low-power platforms for a variety of applications, including micro-location devices, remote bio-analysis, and multi-media compression systems. Our work this year has included the interaction with NE2, a Calgary based corporation in the area of key establishment algorithms for secure transmission over wireless and other networks.

EMBEDDED SYSTEMS/FAULT TOLERANT SYSTEMS

These systems are broadly defined as those that contain full custom, field programmable or processor-based integrated circuits.

Machine Vision

Our goals and objectives for machine vision are to develop new algorithms and implementation techniques for in-camera processing of moving images obtained from targeted industrial inspection processes. In 2003-2004 we were able to demonstrate the TDI self-synch algorithm and several defect detection algorithms for heavily textured backgrounds, running in an industrial camera provided by DALSA Corp., one of our industrial sponsors.

Hearing Instruments

Our medium-term research goal is to develop next generation embedded systems for completely in-the-canal (CIC) hearing instruments. This research is being conducted with one of our industrial sponsors (Gennum Corp.) As of 2003-2004 we have demonstrated the advantages of a new number representation in implementing very low power digital signal processing algorithms for hearing loss correction. We have also explored the concept of acoustic beam steering for enhancing the effectiveness of hearing instruments. A chip was fabricated and successfully tested in 2003.

Arithmetic Techniques

Our research goals are to be able to fit special number representations and arithmetic both to the algorithms to be implemented and to the advanced and emerging fabrication processes from which processing devices will be built, such that performance is optimized. Applications for this research encompass many of our other research projects including work on the implementation of arithmetic for cryptography applications. In 2003-2004 we have discovered new conversion properties and techniques for our novel multi-dimensional logarithmic number system. The conversion technique has been implemented in a digital hearing aid processor in collaboration with Gennum Corp. and Micronet.

Video Processors

The goals and objectives of this research are to increase the efficiency of implementing the compression standards determined by international bodies, and to take part in the process of defining new standards.

Circuit techniques

Often our investigations into architectures and arithmetic lead us to examine special circuit (transis-

Graham Jullien and some of his research team members at the 2004 Banff Informatics Summit

tor-level) techniques for their implementation. Our research objectives are to explore such implementations in order to improve system performance. In 2003-2004 we have developed new structures for ultra low noise digital arithmetic circuitry, including the first three-state CNN implementation of signed-digit redundant adders.

Fault-Tolerant Systems

Our research goals are to produce low-overhead fault tolerant computational systems that take advantage of special number representation properties. In 2003-2004 we have used this technique for the TRLabs wireless LAN adaptive filter chip currently under development in the ATIPS Laboratory.

ADVANCED TECHNOLOGIES AND COMPUTING WITH NANOTECHNOLOGY

Advanced CMOS System-on-Chip Platforms

Our objectives here are to bring the advantages of system-on-chip design to research projects that require advanced system-level implementation techniques. Our goal is to develop several platforms (basic chip architectures that can be custom modified) targeting different facets of our research. These include low-power bio-platforms and high throughput rate signal processing platforms. In 2003-2004 we fabricated and successfully tested a LEXEL array chip for implementing dielectrophoretic bio-cell manipulation with non-uniform electric fields.

Graham Jullien

Advanced Image Sensors

Our goals here are to develop imagers with additional functionality for aiding in different applications. We have the knowledge of the imager physics, the architecture and possible circuitry to be added to the imager array. We aim to capitalize on this knowledge and find solutions to best meet the needs of the biomedical research community. In parallel we aim to continue to develop our basis of knowledge in Integrated Sensors.

Microconvergence

This refers to the integration of advanced micro-structure technologies such as micro-electronics, micro-electro-mechanical systems (MEMS), microfluidics, RF-wireless, opto-electronics and photonics. Our current research goals and objectives lie in the integration of the first three technologies with applications to bio-technology and the health sciences. In 2003 we finished the construction of a class-100 clean room (a common facility within the CCIT laboratory cluster) within which we will establish a microconvergent integration laboratory. We have already started to produce some early microconvergent devices, including an "intelligent pill (The iPill)", and prototype bio-analysis devices with the potential to manipulate and interrogate bio-cells using electric fields. The iPill device was heralded in the CMC *Impact* publication (Volume 1, No. 2).

Nanotechnologies

Our research goal is to explore the potential of several of the emerging nanotechnologies for future computing needs. In general, our research interests in nanotechnologies are in those that have the potential to provide a reasonably smooth transition from the design techniques that have driven microelectronic systems design over the past five decades. We have targeted Quantum Cellular Automata (QCA) for our initial investigations. In particular, quantum-dot cellular automata (QCA) devices can be arranged to represent classical deterministic states of '0' and '1', and so may possibly be used to build systems that have familiar architectures. As engineers we are interested in exploring the design capabilities of the technology even before commercial level fabrication techniques have been established. To do this we have explored a new concept of providing Computer Aided Design (CAD) tools for technologies that are yet to be proven in terms of fabrication. This concept appears to have been well-accepted by the international research community, based on international interactions. Both CAD tool downloads and major publications have resulted from this work.

RESEARCH TEAM MEMBERS

PARTNERSHIPS AND COLLABORATIONS

Establishment of new and continued key partnerships with academic and industry groups including Gennum Corp, Dalsa Inc, SGI Canada, NE2, and Micralyne Inc. These partnerships have resulted in substantial funding, productive research initiatives, and IP.

Our partnership with SGI Canada and NE2 resulted in the development of a cryptography based Strategic Grant, partnered with the iCORE funded Centre for Information Security and Cryptography (CiSAC), targeted to address software and hardware security applications.

Partnership with Micralyne Inc., in the fabrication of a novel design for microneedle arrays. This fabrication is to be supported by a $30,000 grant from Micralyne.

Team Leader and ATIPS Faculty

NAME AND ROLE	RESEARCH INTERESTS OR TOPIC	OTHER INFORMATION
G. A. Jullien: ATIPS Lab. Director and Team Leader	Integrated Circuits, SoC, Computer Arithmetic, Signal and Video Processing, Machine Vision, Neural Networks, MEMS, QCA, Fault Tolerance	Received the IEEE Fellow Award at the banquet of the 2003 IEEE Symposium on Circuits and Systems, Bangkok, May 27th, 2003.
		Named Director of the Centre for Microsystems Engineering. Author, best paper award (Systems) in the 2003 Micronet Workshop
V.S. Dimitrov: iCORE Research Associate	Number Representations, Digital Signal Processing, Cryptography, Large-scale Optimization, Parallel Algorithms.	Named to the management board of the Centre for Information Security and Cryptography.
W. Badawy: iCORE Research Associate	VLSI Architectures, SoC, Video Processing, Image Recognition, Low-power Design, VLSI prototyping.	Strategic Microelectronics Council Industrial Collaboration Award at CMC MR&DCAN Research Excellent Award, The Department of Electrical and Computer Engineering
		Outstanding Chapter Award, Chair of the Computer Chapter, IEEE - Southern Alberta Section. Outstanding Research Contribution, MTC
O. Yadid-Pecht: iCORE Research Associate	CMOS Image sensors, Integrated Sensors, Smart Sensors, Image Processing algorithms hardware implementation, Micro-systems.	Dr Yadid-Pecht has been nominated as an IEEE Distinguished Lecturer for 2004.

Postdoctoral Fellows

NAME AND ROLE	RESEARCH INTERESTS OR TOPIC	OTHER INFORMATION
S. Amer	MEMS Modeling and its manufacturability	Fully funded from the MTC
M. El Zewidi	Secure Data Mining	Fully funded from the MTC
A. Fahmy	Security protocols for streaming data	Fully funded from the MTC
P. Zhang (MEMS)	Bio MEMS, Optical MEMS, MEMS Processes, Clean Room procedures.	$30K Micralyne fabrication grant
W. Zhang (SoC)	Data Stream SoC Architectures, VLSI Design, Integrated Circuit Test, Neural Networks	

PhD Students

NAME AND ROLE	RESEARCH INTERESTS OR TOPIC	OTHER INFORMATION
M. Ahmadi	Plexel Arrays for bio-sensors	eMPOWR (NSERC) Scholarship
I. Amer	New standards for high performance streaming video processor architectures (H.264)	ICORE Scholarship
Ali Entershari	Flexible on chip DEP Arrays for bio-sensors	eMPOWR (NSERC) Scholarship
I.C. Baykal	Defect detection using in-Camera Video Stream Processing: Self-Synchronized TDI, Machine Vision, Line-scan CCD, FPGAs, Video Processing.	Provisional patent for a novel TDI self-synchronization technique for CCD cameras
J. Eskritt, (Part-time)	Applications of MDLNS with complex bases for quadrature signal processing: computer arithmetic, logarithmic number systems, digital signal processing, integrated circuit design	Also ATIPS Lab Manager
H. Fahim	Radar Signal Processing	Fully funded with scholarship from MTC
M. Fu	Applications of Algebraic Integers in New Architectures for Video Codecs: multi-dimensional algebraic integers, DCT, VLSI design.	Research Centre for Integrated Microsystems: University of Windsor
Y. Ghallab	Sensors for electrical fields in micro-channels	
Y. Ibrahim	Very low-noise Arithmetic Processing Unit using Non-Linear Analog Arrays: CNNs, computer arithmetic, analog circuit design.	Research Centre for Integrated Microsystems: University of Windsor
A. Makki	Beam-Steered Hearing Instruments: hearing instrument processors, beam-steering algorithms, MEMS microphone arrays.	Research Centre for Integrated Microsystems: University of Windsor
T. Mohamed	Streaming video compression standards and algorithms (MPEG-4)	iCORE Scholarship
R. Muscedere	Difficult Operations in Double-Base Number Systems: multi-dimensional logarithms, conversion and arithmetic algorithms, integrated circuit implementation.	Defended Successfully 2003. Currently a PDF in the RCIM Lab, University of Windsor
B. Prasad	Cell tracking algorithms for bio-sensors	
C. Rahman	Advanced Video Architectures	eMPOWR (NSERC) Scholarship

NAME AND ROLE	RESEARCH INTERESTS OR TOPIC	OTHER INFORMATION
A. Razavi	Hybrid CMOS Imagers, plenoptic camera systems	EMPOWR (NSERC) Scholarship
M. Sayed	Embedded memory solutions for video applications	iCORE International Scholarship Strategic Microelectronics Council Industrial Collaboration Award at CMC MR&DCAN (co-authored)
Khan Arif Wahid	Compression transforms, algebraic integers, VLSI architectures	Uof C's Graduate Faculty Council Scholarship April, 2003 eMPOWR (NSERC) Scholarship
K. Walus	Quantum Cellular Automata: modeling and simulation of quantum dot arrays, design tool development, split-current QCA.	NSERC Postgraduate scholarship. eMPOWR (NSERC) Scholarship
		Finalist: ASTECH "Leaders of Tomorrow" award, 2003. Best paper award (Systems) in the 2003 Micronet Workshop
Y. Wei	Zoom invariant motion tracking algorithm	This research work is a major contribution to the Smart Cameras start-up.

MSc Students

NAME AND ROLE	RESEARCH INTERESTS OR TOPIC	OTHER INFORMATION
P. Aggrawa	Bio-medical smapling techniques using MEMS devices	
M. Alam	SoC Implementation of Video Codecs: DCT and DWT architectures, MPEG-4 IP Cores.	Strategic Microelectronics Council Industrial Collaboration Award at CMC MR&DCAN Defended successfully in 2003
M. Amtoun	Depth Analysis using a Plenoptic Camera System	Successfully defended 2003, Research Centre for Integrated Microsystems, University of Windsor
L. Chaoji	Digital Video Processing	
R. Choudhury	Ridgelet Transforms for image compression	Defended successfully in 2003
J. Doherty	Transcutaneous Powering of an Implantable Stimulator for Re-creation of Impaired Gastrointestinal Motility: transcutaneous power transfer, circuit modeling, data coding, integrated circuit design.	AIF Scholarship and travel award. Co-supervised by Dr K.I.V.S. Kaler, Director of the Biosystems Research and Applications Group

NAME AND ROLE	RESEARCH INTERESTS OR TOPIC	OTHER INFORMATION
L. Fleshel	CMOS wide dynamic range sensors	Transferred from Ben-Gurion University
R. Glabb	Low-power System-on-Chip Platforms: IP blocks, design reuse, wrappers, System-on-Chip design	SoC Lab. Manager. Major contributor to Strategic Grant application with NE1, SGI and CiSAC
P. Horbal (Part-time)	Adiabatic logic for ROM-Based Architectures: adiabatic circuits, minimized dual-rail switching trees, applications to DBNS and MRRNS processors	ATIPS Webmaster and publicity director
J. Keilman	Lexel Arrays for Cell Manipulation using Dielectrophoresis: non-uniform electric field generation, microfluidics, integrated processors	NSERC Postgraduate Scholarship. Co-supervised by Dr K.I.V.S. Kaler, Director of the Biosystems Research and Applications Group
S. E. Jalilian	Implantable micro-stimulators, trans-cutaneous power and data transfer, applications of SoC bio-platform	Co-supervised by collaborator, Dr Mintchev, Director Bio-Instrumentation Lab
P. Mokrian	Multiplier Design in Deep Sub-micron Technologies: multiplier architectures, column compressors, interconnect modeling, integrated circuit layout	RCIM, University of Windsor. Defended successfully in 2003.
G. Nelson	CMOS Imager watermarking	NSERC Postgraduate Scholarship
D. Onen	Digital Video Processing	
B. Prasad	Imagers for tracking bio-cells using DEP	Defended successfully in 2003
M. Sayed	Embedded Memory Architectures for MPEG-4 Motion Estimation: mesh-based motion estimation, motion compensation, MPEG-4	CMC annual TEXPO. Mohammed Sayed and Mehboob Alam won the prestigious Strategic Microelectronics Council Industrial Collaboration Award. (Poster with Badawy, Alam)
G. Schulhoff	Modeling Quantum Dots on a Computer Cluster: quantum dots, quantum mechanics, QCA, simulation tools, computer clusters	
A. Shaohui	Digital Video Processing	
J. Tracey	Optimized Arithmetic Cells for SoC IP Blocks: digital transistor circuits, deep sub-micron technologies, SoC design, design tools	
Y. Wei	Zoom Invariant Motion Tracking Algorithms	Defended successfully in 2003. Currently a PhD candidate
J. Wu	Asynchronous Hearing Instrument MDLNS Processors: asynchronous circuit and system design, MDLNS, integrated circuit design	
X. Liu	Low bit-rate video streaming	Defended successfully in 2003
J. Yeboah	CNN Analog Arrays for Low-Noise Digital Adder Design: cellular neural networks, transistor circuit design, computer arithmetic, integrated circuit design	

COLLABORATIONS

Over the past year we have developed numerous important collaborations. Some represent existing work, and some will enable our research growth and technology transfer activities in the coming years. Some collaborations represent financial support, some involve the organization of international conferences and workshops, and some enable our access to confidential IP and knowledge that we would otherwise not have access to.

Examples are:

UNIVERSITIES AND INSTITUTES
PROVINCIAL
Centre for Information Security and Cryptography (CISaC) (U of C)
Centre for Biomedical Research Engineering (U of C)
Centre for Microsystems Engineering - U of C Faculty of Engineering Researchers
NATIONAL
Canadian Arthritis Network
Canadian Microelectronics Corporation (CMC)
Micronet R&D (NCE)
RCIM Laboratory faculty, University of Windsor
ECE Dept. University of Western Ontario
RESMIQ (PQ)
INTERNATIONAL
Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier, France
Ben-Gurion University, Isreal
Graduate School in Electronics, Telecommunication and Automation (GETA)
John Hopkins University, USA
University of Maryland, USA
Centre for Advanced Computer Studies, University of Louisiana at Lafayette, USA
University of Texas, Austin, USA
The University of Wisconsin, Madison, Usa
INDUSTRY
INTERNATIONAL
SGI, Alberta and international
NATIONAL
DALSA Corp., (Ontario – head office)
Gennum Corporation
PROVINCIAL
Non Elephant Encryption Systems (NE2)
TRLabs, Calgary
Micralyne Inc.

INTELLECTUAL PROPERTY

TYPE OF IP AND ATIPS MEMBER	TITLE/NAME	STATUS
PATENTS		
Yadid-Pecht	Yadid-Pecht, O., Fossum, E.R., and Mead, C., "Active Pixel Image Sensor with a Winner-Take-All Mode of Operation"	U.S. Patent No: 6,515,702, issued February 4, 2003
Yadid-Pecht	Yadid-Pecht, O., Mansoorian, B., and Pain, B, "Circuitry for determining Median of Image Portions"	US Patent No. 6,546,148, issued April 8, 2003
INVENTIONS		
Dimitrov and Jullien	Efficient technique for Elliptic Curve Cryptography computations using a special form of the Double Base Numbering System	Filing date December 17, 2003, Serial # 60/481,806, discussions with Certicom Inc
LICENSES		
Badawy	"Tracking and streaming technique"	New
TRADEMARKS		
Badawy	GrApp and WebConcorde	Registered with UTI
Jullien, Kaler	For Lexel and Plexel - DEP based biosensors	Registered as Trade-Marks
SPIN-OFFS		
Badawy	Smart Camera Technology Inc.	New, registered with InnoCentre to attract venture funding

Graham Jullien and research team members during construction of the new Calgary Centre For Innovative Technology building on the University of Calgary campus

AWARDS AND ACHIEVEMENTS

ATIPS is a key component of the U of C's Wireless, Location and Micro-electronics pillar of research excellence.

Part of the ATIPS research program is being conducted by students at our collaborative institutions, the University of Windsor and the University of Western Ontario. These students are funded from Micronet and NSERC grants and allow the ATIPS team to leverage resources to add additional value to the work of the ATIPS Laboratory.

- The modular class 100 clean room for the Integration Laboratory has been installed (June 2003).
- ATIPS Secure System-on-Chip Laboratory becomes operational.
- QCADesigner, our emerging technologies CAD tool, had over 500 international downloads in 2003-2004.
- Dr Orly Yadid-Pecht was successfully recruited by ATIPS from Ben Gurion University, Israel. She takes up her position in July, 2003.
- Dr Laurent Imbert (France) takes up his position as Visiting Scientist, January 2004.
- K. Walus, and G. Jullien invited to write the first graduate text book on QCA for Springer.
- Dr Badawy achieves international recognition with his iPILL drug delivery system.
- Drs Peiyu Zhang and Graham Jullien have been invited to write a review article on drug delivery techniques using microneedle arrays; this is evidence of success in reaching out to other disciplines (part of the ATIPS vision).
- Dr Graham Jullien accepts an Adjunct research position with the University of Western Ontario.
- Dr Jullien accepted the position of Director of the Centre for Microsystem Engineering at U of C.
- Dr Jullien invited to join the Canadian Arthritis Network to enhance the application of bio-engineering microsystems in the study of arthritis.

FUNDING

The Graham Jullien team receives funding from NSERC, CFI and the University (~$1M) to acquire and support software and equipment for microchip design and fabrication. They are also supported by over $400K/year from industry (DALSA, Gennum) and industry-government consortiums (CMC, Micronet) with iCORE Industry Chair Jim Haslett.

PUBLICATIONS

REFEREED JOURNAL PUBLICATIONS

V.S. Dimitrov and G.A. Jullien, "Multidimensional Algebraic-Integer Encoding for High Performance Implementation of the DCT and IDCT," *IEEE Electronics Letters,* vol. 39, no. 7, Apr. 2003, pp. 602–603.

L. Imbert, V.S. Dimitrov, G.A. Jullien, "Fault-Tolerant Computations over Finite Rings with Applications in Digital Signal Processing," *IEEE Trans. Circuits and Systems I: Fundamental Theory and Applications,* vol. 50, no. 7, July 2003, pp. 858–864.

M. Alam, W. Badawy, and G. Jullien, "An Optimal Call Admission and Bandwidth Reservation Scheme for Future Wireless Networks," *J. Internet Technology,* vol. 4, no. 3, 2003, pp. 163–169 (ISSN 1607–9264).

V.S. Dimitrov and G.A. Jullien, "Loading the Bases: A New Number Representation with Applications," *IEEE Circuits and Systems Magazine,* Oct. 2003, pp. 6–23 (invited article).

A. Belenky, E. Artyomov, A. Fish, and O. Yadid-Pecht, "Wide Dynamic Range Imaging," *The Neuromorphic Engineer,* vol. 1, no. 1, Jan 2004, p. 4.

I. Shcherback and O. Yadid-Pecht, "CMOS APS Pixel Photoresponse Prediction for Scalable CMOS Technologies," *IEEE Trans. Electron Devices,* vol. 51, no. 2, Feb. 2004, pp. 285–287.

I. Shcherback and O. Yadid-Pecht, "CMOS APS Crosstalk Characterization via Unique Sub-micron Scanning System Measurements," *IEEE Trans. Electron Devices,* vol. 50, no. 9, Sept. 2003, pp. 1994–1997.

O. Yadid-Pecht and A. Belenky, "In-Pixel Autoexposure CMOS APS," *IEEE J. Solid-State Circuits,* vol. 38, no. 8, Aug. 2003, pp. 1425–1428.

K. Walus, T. Dysart, G.A. Jullien, and R.A. Budiman, "QCADesigner: A Rapid Design and Simulation Tool for Quantum-Dot Cellular Automata," *IEEE Trans. Nanotechnology,* vol. 3, no. 1, Mar. 2004, pp. 26–31.

ACCEPTED PUBLICATIONS BY REFEREED JOURNALS

K.A. Wahid, V.S. Dimitrov, and G.A. Jullien, "VLSI Implementation of Daubechies Wavelet Transform Using Algebraic Integers," *J. Circuits, Systems and Computers* (special issue on VLSI Architectures for Multimedia Applications), accepted for publication.

M. Alam, W. Badawy, V.S. Dimitrov, and G.A. Jullien, "Efficient Direct 2-D Architectures for Lifted Biorthogonal DWT," *J. VLSI Signal Processing,* accepted Sept. 22, 2003.

K. Walus, R.A. Budiman, and G.A. Jullien, "Split Current Quantum Dot Cellular Automata: Modeling and Simulation," *IEEE Trans. Nanotechnology,* accepted Dec. 12, 2003.

I.C. Baykal and G.A. Jullien, "Self Synchronization of Time Delay and Integration (TDI) Cameras," *SPIE J. Electronic Imaging*, accepted Dec. 22, 2003.

E. Artyomov and O. Yadid-Pecht, "Modified High-Order Neural Network for Invariant Pattern Recognition," *Pattern Recognition Letters,* accepted for publication.

A. Fish and O. Yadid-Pecht, "Adaptive Thresholding for Current Mode Winner-Take-All Circuits," *Optical Engineering,* accepted for publication.

M. Herscovitz and 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,* accepted for publication.

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," *Optical Engineering,* accepted for publication.

S. Diller, A. Fish, and O. Yadid-Pecht, "Advanced Output Chains for CMOS Image Sensors Based on an Active Column Sensor Approach: A Detailed Comparison," *Sensors and Actuators,* accepted for publication.

E. Artyomov, Y. Rivenson, G. Levi, and O. Yadid-Pecht, " Morton (Z) Scan-Based Real-Time Variable Resolution CMOS Image Sensor," *IEEE Trans. Circuits and Systems for Video Technology,* accepted for publication.

M. Sayed and W. Badawy, "A Computational RAM (C-RAM) Architecture for Real-Time Mesh-Based Video Motion Tracking. Part I: Motion Estimation," *World Scientific J. Circuits, Systems and Computers,* accepted for publication.

M. Sayed and W. Badawy, "A Computational RAM (C-RAM) Architecture for Real-Time Mesh-Based Video Motion Tracking. Part II: Motion Compensation," *World Scientific J. Circuits, Systems and Computers,* accepted for publication.

A. Fish, D. Akselrod, and 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*, accepted for publication.

W. Badawy, "A VLSI Architecture for Video Object Motion Estimation Using a 2D Hierarchical Mesh Model," *Microprocessors and Microsystems,* (accepted for the April issue vol. 27, no. 3)

W. Badawy, M. Talley, G. Zhang, M. Weeks, and M. A. Bayoumi, "Low Power Very Large Scale Integration Prototype for Three-Dimensional Discrete Wavelet Transform Processor with Medical Applications," *SPIE J. Electronic Imaging,* (accepted for the April issue vol. 12, no. 2)

J.-C. Bajard and L. Imbert, "A Full RNS Implementation of RSA," IEEE Transactions on Computers, (accepted for the June 2004 issue, vol. 53, no. 6)

SUBMITTED JOURNAL PAPERS

B. Maliatski and O. Yadid-Pecht, "Hardware Driven Adaptive *k*-Means Clustering for Real-Time Video Imaging," *IEEE Trans. Circuits and Systems for Video Technology,* submitted June 2003.

B. Maliatski and O. Yadid-Pecht, "A VLSI Architecture for Active Pixel Sensor Video Compression," *IEEE Trans. VLSI,* submitted June 2003.

R. Muscedere, V.S. Dimitrov, G.A. Jullien, and W.C. Miller, "Efficient Conversion from Binary to Multi Digit Multi-Dimensional Logarithmic Number Systems Using Arrays of Range-Addressable Lookup Tables," *IEEE Trans. Computers* (Special Issue on Computer Arithmetic), submitted Nov. 2003.

E. Artyomov and O. Yadid-Pecht, "Adaptive Multiple Resolution CMOS Active Pixel Sensor," *IEEE Trans. Circuits and Systems I,* submitted Dec. 2003.

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