Electrical and Computer Engineering

Electrical and Computer Engineering is a core discipline that plays a pivotal role in many fields. That's why the department is the natural home for Canada's first stand-alone undergraduate degree in Biomedical Engineering.

Ever wonder what happens to the diseased hearts removed from heart transplant patients? Some are used by researchers in Ryerson's Department of Electrical and Computer Engineering to learn more about sudden cardiac death.

Sudden cardiac death is caused by abnormal electrical activity in the heart. After years of research there is still no reliable way to identify those at risk and then take preventive action. "The type of data produced by the heart is difficult to analyze and base predictions on," says Dr. Sri Krishnan, Chair of the department, who also holds a Canada Research Chair (CRC) in Signal Analysis. "I'm helping to build a mathematical model that will produce better predictions."

Krishnan's work has also been applied to other physiological signals, such as knee joint vibration for screening subjects with osteoarthritis, EEG signals for identifying sleep disorders, and arterial pulse signals for monitoring hypertension and stress.

The research of Krishnan, his fellow CRC Dr. Victor Yang (see page 20) and others is providing the foundation for a new program, the BEng in Biomedical Engineering. Launched in September 2008, it is Canada's only stand-alone undergraduate degree in Biomedical Engineering. It builds on Ryerson's inter-disciplinary strengths, involving the departments of Mechanical and Industrial Engineering, Chemical Engineering, Aerospace Engineering, Chemistry and Biology, Physics, Mathematics and Computer Science. "We have always promoted electrical engineering as a core discipline, from which our students can go anywhere," says Krishnan. "The program in Biomedical Engineering is proof of that."

The department also offers undergraduate programs in Electrical Engineering and Computer Engineering, and graduate programs at the master's and doctoral levels. There are 41 faculty members, four of whom hold federally-funded research chairs.

Faculty members are also involved in a wide range of other research fields. The teams of Dr. Xavier Fernando and Xijia Gu, for example, have received significant funding for their work in communications with underground mines and tunnels, using hybrid wireless and fibre optics technologies.

Several investigators are working on problems involving microsystems. The challenge in this field is to ensure that small devices such as implantable retinal prosthetics and swallowable encapsulated endoscopes deliver the same performance as larger devices. Issues include inefficient power harvesting, poor data security, signal interference from nearby devices and poor readability. Dr. Fei Yuan and his research group are looking for new ways to address these issues.

The department has several productive partnerships with industry. Among them, Dr. Bala Venkatesh is working with Hydro One on research related to transmission systems, Dr. Muhammad Jaseemuddin is designing automated routing failure detection tools with Solana Network, and Dr. Nagi Mekhiel is partnering with MOSAID Technologies.

The department celebrated an important milestone in 2008 with the graduation of its first PhD candidate, Yifeng He. "This symbolizes that we are truly a comprehensive department," says Krishnan. "Yifeng was an excellent research student and we are delighted he has now become one of Ryerson's first post-doctoral fellows."
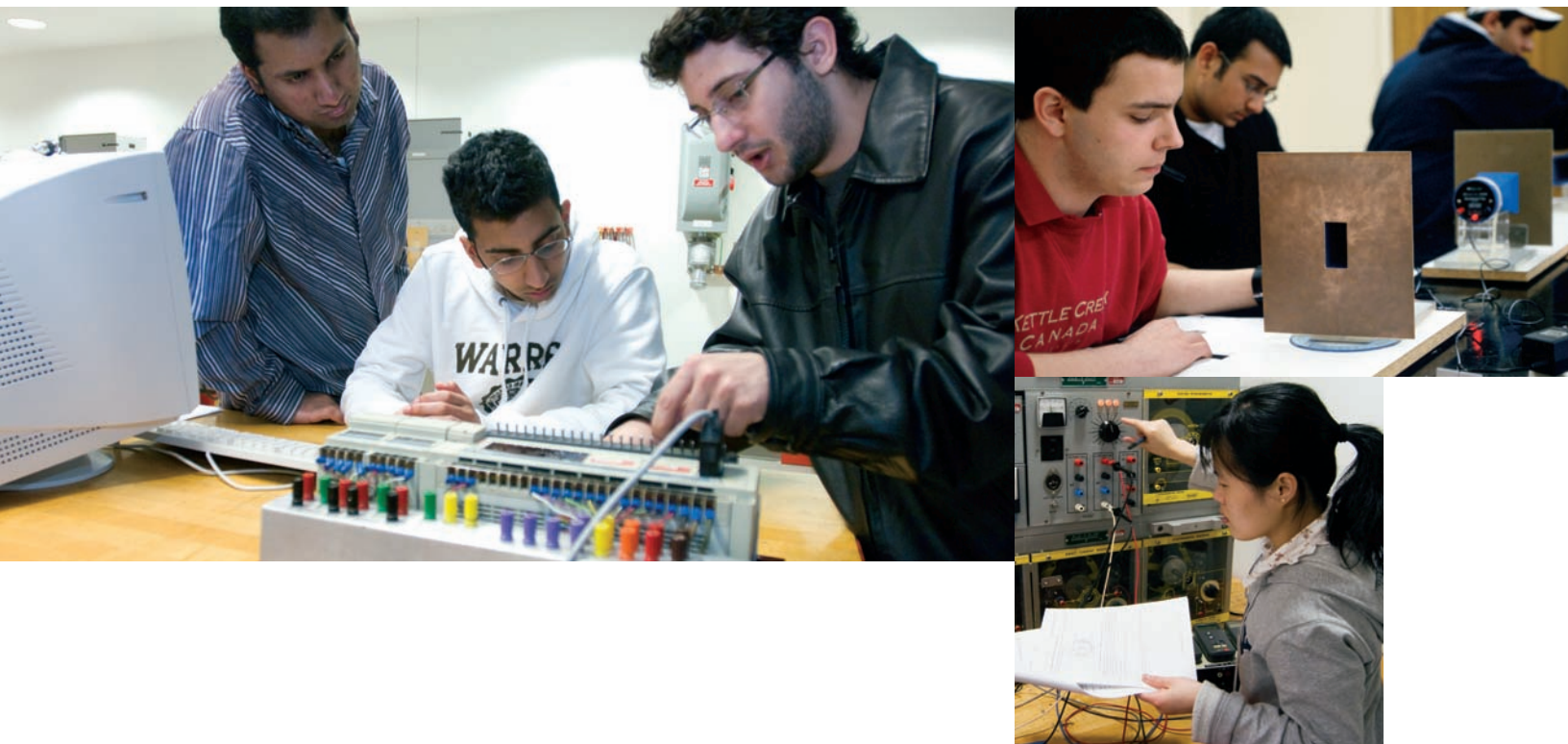
Krishnan says the department is well positioned for future growth. "We have all the tools we need, and we have the right faculty members and the right programs."

Electrical & Computer Engineering

AREAS OF SPECIALIZATION
- Biomedical signal analysis
- Medical image processing
- Pattern recognition and classification
- Computer vision and artificial neural networks

SELECTED ARTICLES/PUBLICATIONS
S. Z. Mahmoodabadi, J. Alireazie, P. Babyn, A. Kassner, E. Widjaja, *"Spectroscopy Analysis in Pediatric Metabolic Brain Diseases,"* Int. J. Computer Assisted Radiology and Surgery, Vol. 3, pp.17-21, June 2008.

E. Helm, O. Talakoub, F. Grasso, D. Engelberts, J. Alierzaie, B. Kavanagh, P. Babyn, *"Use of Dynamic CT in Acute Respiratory Distress Syndrome (ARDS) with Comparison of Positive and Negative-Pressure Ventilation,"* European Radiology, Feb-2008-004824.

O. Talakoub, E. Helm, J. Alierzaie, P. Babyn, B. Kavanagh, F. Grasso, D. Engelberts, *"An Automatic Approach for Lung Segmentation and Density Analysis in Dynamic Computed Tomography for Acute Respiratory Distress Syndrome,"* Int. J. Computer Assisted Radiology and Surgery, pp. 87-89, Vol 2. June 2007.

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AREAS OF SPECIALIZATION
- Image, video and multimedia processing
- Digital cinema
- Multimedia retrieval
- Object identification and tracking
- Image and video compression

SELECTED ARTICLES/PUBLICATIONS
P. Androutsos, D. Androutsos, A. N. Venetsanopoulos, *"A Distributed Fault-Tolerant MPEG-7 Retrieval Scheme based on Small World Theory,"* IEEE Trans. Multimedia, Vol. 8, No. 2, April 2006.

P. Androutsos, D. Androutsos, A. N. Venetsanopoulos, *"Small World Distributed Access to Multimedia Data,"* IEEE Signal Processing Magazine, Vol. 23, No. 2, pp. 142-153, Mar. 2006.

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RESEARCH AIMS
Improving diagnostic accuracy of radiographic imaging techniques. Current projects include automated computerized detection of lung nodules in helical CT scans, classification of clustered microcalcifications on mammograms and measuring and monitoring temperature using digital images in ultrasound thermometry during clinical hyperthermia therapy.

D. Androutsos, L. Guan, A. N. Venetsanopoulos, *"Semantic Retrieval of Multimedia,"* IEEE Signal Processing Magazine, Vol. 23, No. 2, pp. 14-16, Mar. 2006.

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RESEARCH AIMS
Enhancing the wireless system capacity and related performance measures by innovating novel radio resource management paradigm with associated techniques that intelligently allocate and control the radio resources, thus enabling wireless multimedia access, communication and networking.

AREAS OF SPECIALIZATION
- Multicarrier spread spectrum systems
- Wireless cross layer optimization
- Hybrid multiple access technologies
- Radio resource management
- QoS-aware packet scheduling

SELECTED ARTICLES/PUBLICATIONS
L. Khalid, A. Anpalagan, *"Performance analysis of a threshold-based adaptive modulation scheme with adaptive subcarrier allocation in OFCDM systems,"* IEEE Trans. Wireless Communications, Vol. 7, No. 4, pp. 2463-2467, July 2008.

R. Caldwell, A. Anpalagan, *"Adaptive subcarrier allocation in synchronous reverse links of a multicarrier CDMA system with time and frequency spreading,"* IEEE Trans. Vehicular Technology, Vol. 57, No. 3, pp. 1494-1501, May 2008.

K. Hazaveh, A. Anpalagan, *"A proof toward optimality of a combined rate, power and cell-control algorithm employed in a cellular CDMA network,"* IEEE Trans. Vehicular Technology, Vol. 56, No. 6, pp. 3924-3927, Nov. 2007.

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RESEARCH AIMS
Using statistical signal processing and information theory for system modeling, data compression, and information extraction.

SELECTED ARTICLES/PUBLICATIONS
S. Beheshti, *"Kullback-Leibler Distance in Linear Parametric Modeling,"* Proc. IEEE Inter. Symp. on Information Theory, 2008.

S. Beheshti, N. Nikvand, X. Fernando, *"Soft thresholding by noise invalidation,"* Proc. 24th Queen's Biennial Symp. on Communications, 2008.

S. Beheshti, M.A. Dahleh, *"A new information theoretic approach to signal denoising and best basis selection,"* IEEE Trans. Signal Processing, Oct. 2005.

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RESEARCH AIMS
Using optimization techniques to solve control problems.

AREAS OF SPECIALIZATION
- Real-time control systems
- Control of robotic manipulators
- Numerical optimization

SELECTED ARTICLES/PUBLICATIONS
Y. C. Chen, J. Naughton, *"An Undergraduate Laboratory Platform for Control System Design, Simulation, and Implementation,"* IEEE Control Systems Magazine, Vol. 20, No. 3, pp. 12-20, June 2000.

Y. C. Chen, *"Solving Robot Trajectory Planning Problems with Uniform Cubic B-Splines,"* Optimal Control Applications and Methods, Vol. 12, No. 4, pp. 247-262, 1991.

Y. C. Chen, M. Vidyasagar, *"Optimal Control of Robotic Manipulators in the Presence of Obstacles,"* J. of Robotic Systems, Vol. 7, No. 5, pp. 721-740, 1990.

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AREAS OF SPECIALIZATION
- Power electronics
- Power systems
- Alternative energy
- Power quality
- Control

SELECTED ARTICLES/PUBLICATIONS
H. Cheung, L. Wang, A. Hamlyn, F. Chen, C. Yang, R. Cheung, *"Two-Level Network Architecture for Open-Access Power Systems with Distributed Generations,"* IEEE Power and Energy Society (PES) General Meeting, Pittsburgh, Pennsylvania, USA, July 20-24, 2008.

H. Cheung, A. Hamlyn, L. Wang, G. Allen, C. Yang, R. Cheung, *"Network-Integrated Adaptive Protection for Feeders with Distributed Generations,"* IEEE Power and Energy Society (PES) General Meeting, Pittsburgh, Pennsylvania, USA, July 20-24, 2008.

H. Cheung, L. Wang, A. Hamlyn, R. Cheung, *"Network-Assisted Corrective Actions against Short-Term and Long-Term Voltage Instability in Power System with DGs,"* IEEE Power and Energy Society (PES) General Meeting, Pittsburgh, Pennsylvania, USA, July 20-24, 2008.

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AREAS OF SPECIALIZATION
- Digital systems
- Microprocessors
- Embedded systems
- Software engineering

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RESEARCH AIMS
Researching dependability and performance evaluation of distributed systems. Using knowledge of functional layering to identify failure dependencies in complex systems, and create a scalable analysis.

AREAS OF SPECIALIZATION
- Development of stochastic models for evaluating dependability and performance of distributed systems.
- Fault-tolerant computing

SELECTED ARTICLES/PUBLICATIONS
G. Franks, T. Al-Omari, M. Woodside, O. Das, S. Derisavi, *"Enhanced modeling and solution of layered queueing networks,"* IEEE Trans. Software Engineering, 2008.

O. Das, A. Das, *"Performability Evaluation of Mobile Client-Server Systems,"* 23rd ACM Symp. Applied Computing, Dependable and Adaptive Distributed Systems Track, Ceara, Brazil, March 2008, pp. 2197-2201.

O. Das, C. M. Woodside, *"Analyzing the Effectiveness of Fault-Management Architectures in Layered Distributed Systems,"* Performance Evaluation, 56, 2004, pp. 93-120.

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RESEARCH AIMS
Signal processing for reliable broadband multimedia delivery over optical, copper and wireless networks considering physical and higher layer issues; wireless access to special areas like mines and tunnels, information and communication technologies for energy saving

AREAS OF SPECIALIZATION
- Broadband access networks
- Cognitive radio
- Fiber-wireless systems
- RFID Systems

SELECTED ARTICLES/PUBLICATIONS
S. Z. Pinter, X. N. Fernando, *"Concatenated fibre-wireless channel identification in a multiuser CDMA environment,"* IET Proc. Communications, Vol. 1, No. 5, 2007, pp. 937-944.

H. Kosek, Y. He, X. Gu, X. N. Fernando, *"All-optical de-multiplexing of WLAN and cellular CDMA radio signals,"* J. of Lightwave Technology, Vol. 25, No. 6, June 2007, pp. 1401-1409.

R. Yuen and X. N. Fernando, *"Analysis of Sub-Carrier Multiplexed Radio over Fiber Link for the Simultaneous Support of WLAN and WCDMA Systems,"* Kluwer Wireless Personal Communications Journal, Vol. 33, No. 1, pp. 1-20, April 2005.

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RESEARCH AIMS
Developing at-speed testing and diagnosis procedures for digital and mixed-signal systems, with high probability of error detection/location and small hardware overhead.

AREAS OF SPECIALIZATION
- Built-in self-test and self-repair in reconfigurable computing systems
- Digital and mixed-signal systems testing and testable design
- Self-diagnosis in microprocessor based measurement instruments
- Error-control codes

SELECTED ARTICLES/PUBLICATIONS
V. Geurkov, *"Testing Digital Systems by Error-Locating Codes,"* Proc. Inter. Conf. Embedded Systems and Applications (ESA'08), 2008 World Congress in Computer Science, Computer Eng. and Applied Computing, Las Vegas, USA, 2008, pp. 233-238.

V. Kirischian, V. Geurkov, P. Chun, L. Kirischian, *"Macro-Programmable Reconfigurable Stream Processor for Collaborative Manufacturing Systems,"* J. Intelligent Manufacturing (JIM), 2007.

L. Kirischian, V. Geurkov, I. Terterian, V. Kirischian, J. Kleiman, *"Multilevel Radiation Protection of Partially Reconfigurable Field Programmable Gate Array Devices,"* J. Spacecraft and Rockets, American Institute of Aeronautics & Astronautics, USA, 2006, Vol. 43, No. 3, pp. 523-529.

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RESEARCH AIMS
Developing novel optical devices; recent work includes the development of fiber grating sensors and laser beam shaping with long-period grating.

AREAS OF SPECIALIZATION
- Fibre optic devices and modules for communication and sensing
- Fibre lasers and their applications in material processing

SELECTED ARTICLES/PUBLICATIONS
H. Lu, R. Hussain, M. Zhou, X. Gu, *"Fiber Bragg Grating Sensors for Failure Detection of Flip Chip Ball Grid Array in Four-point Bend Tests,"* to appear in IEEE Sensors Journal, 2008.

X. Gu, W. Mohammed, L. Qian, P. W. E. Smith, *"All-Fiber Laser Beam Shaping Using a Long-period Grating,"* IEEE, Photonics Technology Letter, Vol. 20, No. 13, pp. 1130, July 2008.

S. S.-H. Yam, X. Gu, W. Mohammed, P. W. E. Smith, *"Multimode Fiber Bragg Grating Wavelength Filter in a 10 Gb/s System,"* IEEE Photonics Technology Letter, Vol. 20, No. 8, pp. 584-586, Apr. 2008.

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RESEARCH AIMS
Investigating solutions for the search, management, transmission and delivery of digital media over the Internet and wireless networks.

AREAS OF SPECIALIZATION
- Multimedia processing and communications
- Human centered computing
- Image and video processing
- Biometrics and biomedical engineering
- Bioinformatics

SELECTED ARTICLES/PUBLICATIONS
Y. Wang, L. Guan, *"Combining speech and facial expression for recognition of human emotional state,"* IEEE Trans. Multimedia, Vol. 10, No. 5, pp. 936-946, Aug. 2008.

J. Randall, L. Guan, W. Li, X. Zhang, *"The HCM for perceptual image processing,"* NeuroComputing, Vol. 71, Nos. 10-12, pp. 1966-1979, June 2008.

T. Amin, M. Zeytinoglu, L. Guan, *"Application of Laplacian mixture model for image and video retrieval,"* IEEE Trans. Multimedia, Vol. 9, No, 7, pp. 1416-1429, Nov. 2007.

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RESEARCH AIMS
Modelling the lightning return stroke at elevated objects and evaluating the performance characteristics of the North American Lightning Detection Network based on CN Tower lightning.

AREAS OF SPECIALIZATION
- Applied electromagnetics
- Measurement, characterization and modelling of fast transients
- De-noising techniques (Fourier and wavelets transforms)

SELECTED ARTICLES/PUBLICATIONS
A. Lafkovici, A. M. Hussein, W. Janischewskyj, K. Cummins, *"Evaluation of the Performance Characteristics of the North American Lightning Detection Network Based on Tall-Structure Lightning,"* IEEE Trans. Electromagnetic Compatibility, Vol. 5, No. 3, pp. 630-641, Aug. 2008.

A. M. Hussein, M. Milewski, W. Janischewskyj, *"Correlating the characteristics of the CN Tower lightning return-strokes current with those of its generated electromagnetic pulse,"* IEEE Trans. Electromagnetic Compatibility, Vol. 5, No. 3, pp. 642-650, Aug. 2008.

A. M. Hussein, M. Milewski, W. Janischewskyj, F. Noor, F. Jabbar, *"Characteristics of lightning flashes striking the CN Tower below its tip,"* J. Electrostatics, Vol. 56, No. 5-6, pp. 307-315, May 2007.

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RESEARCH AIMS
Focus on three problem areas in heterogeneous wireless networks: routing, mobility management, and network middleware.

AREAS OF SPECIALIZATION
* Routing fault detection
* Failure recovery in multicast routing
* Co-operative wireless networks
* Network protocols, routing and MAC for multi-hop wireless networks with smart antennas
* Middle-layer software for ad hoc and ubiquitous network applications

SELECTED ARTICLES/PUBLICATIONS
O. Bazan, M. Jaseemuddin, *"An Opportunistic Directional MAC Protocol for Multihop Wireless Networks with Switched Beam Directional Antennas,"* Proc. IEEE Inter. Conf. on Communications (ICC), Beijing, China, 2008.

M. Jafarian, M. Jaseemuddin, *"Routing of Emergency Data in a Wireless Sensor Network for Mines,"* Proc. IEEE Inter. Conf. on Communications (ICC), Beijing, China, 2008.

A. Helmy, M. Jaseemuddin, G. Bhaskara, *"Multicast-based Mobility: A Novel Architecture for Efficient Micro-Mobility,"* IEEE J. Selected Areas in Communication, Special Issue on All-IP Wireless Networks, February 2004.

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RESEARCH AIMS
Developing reusability-driven IP block design flow that supports migration between nano-CMOS processes.

AREAS OF SPECIALIZATION
* Digital CMOS design
* Noise modelling in deep-submicron (SDM) CMOS systems
* Virtual library generation and performance driven transistor sizing
* Design for reusability
* Timing and power consumption modelling in digital DSM CMOS circuits

SELECTED ARTICLES/PUBLICATIONS
A. Kabbani, D. Al-Khalili, A. J. Al-Khalili, *"Delay Analysis of CMOS Gates using Modified Logical Effort Model,"* IEEE Trans. Computer-Aided Design on Integrated Circuits and Systems, Vol. 24, No. 6, pp. 937-947, June 2005.

A. Kabbani, D. Al-Khalili, A. J. Al-Khalili, *"Technology-portable Analytical Model for DSM CMOS Transition Time Estimation,"* IEEE Trans. Computer-Aided Design on Integrated Circuits and Systems, Vol. 22, No. 9, pp. 1177-1187, Sept. 2003.

A. Kabbani, A. J. Al-Khalili, *"Technique for Dynamic CMOS Noise Immunity Evaluation,"* IEEE Trans. Circuits and Systems - I, Vol. 50, No. 1, pp. 74-87, Jan. 2003.

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AREAS OF SPECIALIZATION
* Photonics
* Electromagnetics
* Field theory
* General relativity

SELECTED ARTICLES/PUBLICATIONS
P. Kantorek, *"Interpretation of the Concept of Time,"* Centre for Theoretical Study, Czech Academy of Sciences and Charles University, Prague, Nov. 2002.

P. Kantorek, *"The Theory of Microwave Detection by a Discharge,"* Czech J. Physics, Vol. B17, pp. 1021-1037, 1967.

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AREAS OF SPECIALIZATION
* Power systems planning
* Motor control
* Power electronics

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AREAS OF SPECIALIZATION
* Biomedical instrumentation
* Real-time digital signal processing and embedded systems
* Advanced analog/digital circuit designs

SELECTED ARTICLES/PUBLICATIONS
A. P. Blaber, R. L. Bondar, M. Kassam, *"Automatic Control of Heart Rate Pre- and Post-spaceflight as Assessed by Heart Rate Variability Analysis: Relationship to Post Flight Orthostatic Intolerance,"* 14th IAA Humans in Space Symp., May 18-22, 2003, Banff, Canada.

J. M. Serrador, J. K. Shoemaker, S. J. Wood, P. A. Picot, F. Stein, M. S. Kassam, R. Bondar, T. T. Schlegel, *"Effect of Acute Exposure to (Gx vs Gz) on Dynamic Cerebral Autoregulation,"* J. Applied Physiology, Nov. 2001.

J. M. Serrador, J. K. Shoemaker, T. E. Brown, M. S. Kassam, R. L. Bondar, T. T. Schlegel, *"Cerebral Vasoconstriction Precedes Presyncope Post Parabolic Fight,"* Brain Research Bulletin, UK, 53(1):113-120, Sept. 1, 2000.

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RESEARCH AIMS
Development of CAD tools for embedded system and multiprocessor systems on chip (MPSoC) design.

AREAS OF SPECIALIZATION
- Real-time and embedded systems
- Hardware software codesign
- Networks-on-Chip (MPSoC)
- Computer vision and intelligent systems

SELECTED ARTICLES/PUBLICATIONS
G. N. Khan, U. Ahmed, *"Hardware-Software Cosynthesis of Multiprocessor Embedded Architectures,"* Proc. 4th IEEE Inter. Symp. Embedded Computing (AINA-Workshops). Niagara Falls, Canada, pp. 804-810, May 2007.

Y. Yang, A. Guergachi, G. N. Khan, *"Support Vector Machines for Environmental Informatics: Application to Modeling the Nitrogen Removal Processes in Wastewater Treatment Systems,"* J. Environmental Informatics, Vol. 7 No.1, pp. 14-25, March 2006.

G. N. Khan, G. Wei, *"Fault-tolerant Wormhole Routing using a Variation of Distributed Recovery Block Approach,"* IEEE Proc. Computers and Digital Techniques, Vol. 147, No. 6, pp. 397-402, Nov. 2000.

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AREAS OF SPECIALIZATION
- Reconfigurable computing systems
- Embedded parallel computing architectures
- Automated high-level (architectural) synthesis of digital systems
- Automated architecture-to-algorithm optimization
- Built-in-self-restoration (BISR) of FPGA based systems

SELECTED ARTICLES/PUBLICATIONS
Valeri Kirischian, Vadim Geurkov, Pill Woo Chun, Lev Kirischian, *"Macro-Programmable Reconfigurable Stream Processor for Collaborative Manufacturing Systems"*, Journal of Intelligent Manufacturing (JIM), Vol. 19, No. 6, pp. 723-734, 2008

Lev Kirischian, Vadim Geurkov, Valeri Kirischian and Irina Terterian, *"Multi-parametric Optimization of the Modular Computer Architecture,"* International Journal of Technology, Policy and Management (IJTPM), Vol. 3, Issue 6, pp. 327-346, 2006

Lev Kirischian, Vadim Geurkov, Irina Terterian, Valeri Kirischian and Jacob Kleiman, *"Multilevel Radiation Protection of Partially Reconfigurable Field Programmable Gate Array Devices,"* Journal of Spacecrafts and Rockets (JSR), Vol. 43, No. 3, pp. 523-529, 2006

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RESEARCH AIMS
Development of signal processing and pattern recognition techniques for non-stationary signal analysis, applied to knee joint vibration signals for screening subjects with osteoarthritis, ultrasound backscattered signals for screening apoptotic (cancer) cells, electroencephalogram (EEG) signals for screening alcoholics, and arterial pulse signal analysis for monitoring hypertension and stress.

AREAS OF SPECIALIZATION
- Biomedical signal and image analysis
- Assistive technologies
- Biometrics
- Multimedia information security
- Audio signal processing

SELECTED ARTICLES/PUBLICATIONS
K. Umapathy, S. Masse, E. Sevaptsidis, J. Asta, S. Krishnan, K. Nanthakumar, *"Spatio-temporal Frequency Analysis of Ventricular Fibrillation in Explanted Human Hearts,"* IEEE Trans. on Biomedical Engineering, 2008.

D. Hosseinzadeh, S. Krishnan, *"Keystroke Patterns As a Biometric,"* IEEE Trans. Systems, Man and Cybernetics: Part C, 2008.

K. Momen, S. Krishnan, T. Chau, *"Real-time classification of forearm electromyographic signals corresponding to user-selected intentional movements for multifunction prosthesis control,"* IEEE Trans. Neural Systems and Rehabilitation Engineering, Vol. 15, No. 4, pp. 535-542, Dec. 2007.

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RESEARCH AIMS
Multimedia information mining: the extraction, analysis and linkage of useful information being generated across media, applied to the summarization, navigation and consumption of news, sports, TV and film, meetings, personal lifelogs, surveillance, biomedical images and biometrics.

AREAS OF SPECIALIZATION
- Interactive multimedia information mining
- Unsupervised learning and pattern recognition
- Machine learning in computer graphics, data visualisation and virtual reality
- Microbiological image/signal analysis, archiving and retrieval
- Biometrics, bioinformatics

SELECTED ARTICLES/PUBLICATIONS
M. Kyan, K. Jarrah and L. Guan, *"Unsupervised Learning via Self-Organization – A Dynamic Approach,"* IEEE Press, 2008.

M. T. Ibrahim, M. Kyan and L. Guan, *"On-Line Signature Verification Using Most Discriminating Features and Fisher Linear Discriminant Analysis (FLD),"* IEEE Int. Symp. Multimedia (ISM), Dec. 15-17, 2008, Berkeley, California, USA.

M. Kyan, L. Guan, S. Liss, *"Refining competition in the self-organizing tree map for unsupervised biofilm image segmentation,"* J. of Neural Networks, Vol. 18, pp. 850-860, 2005.

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RESEARCH AIMS
Design and development of different types of networking hardware, systems, and protocols for wireline and wireless communications.

AREAS OF SPECIALIZATION
- Networking and protocol design
- Ubiquitous computing
- RF circuit design for communications
- Optical MEMS switch fabric designs

SELECTED ARTICLES/PUBLICATIONS
K. L. E. Law, W.-C. Hung, *"Channel Control for Multi-radio Multi-channel Wireless Mesh Networks,"* 11th ACM Inter. Conf. Modeling, Analysis and Simulation of Wireless and Mobile Systems, Oct. 27-31, 2008, Vancouver.

A. Tang, F. Yuan, E. Law, *"A New CMOS Active Transformer QPSK Modulator with Optimal Bandwidth Control,"* IEEE Trans. Circuits and Systems II - Express Briefs, Vol. 55, No. 1, pp. 11-15, Jan. 2008.

T.-W. Yeow, K. L. E. Law, A. Goldenberg, *"SOI-based 2D MEMS L-Switching Matrix for Optical Networking,"* IEEE J. Selected Topics in Quantum Electronics, Vol. 9, Issue 2, pp. 603-613, March-April 2003.

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RESEARCH AIMS

Security in peer-to-peer networks, including secure transaction mechanisms and fingerprinting.

AREAS OF SPECIALIZATION
- Peer-to-peer networks
- Security

SELECTED ARTICLES/PUBLICATIONS

Y. Jia, L. Zhao, N.W. Ma, *"Energy-Efficient Algorithm and Protocol Design in Sensor,"* IJSNet.

X. Chen, B. N. W. Ma, C. Yang, *"A Modified Cliques Key Management Algorithm for Secure Multicast,"* Computers & Security, Vol. 26, No. 3, pp. 238-245, May 2007, Elsevier.

X. Li, S. Krishnan, N. W. Ma, *"Application of grammar-based codes for lossless compression of digital mammograms,"* J. Electronic Imaging (SPIE), Vol. 15, No.1, Jan. 2006.

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RESEARCH AIMS

Inventing new computer models to solve fundamental problems that prevent improved performance and scalability of current and future parallel computers.

AREAS OF SPECIALIZATION
- Computer architecture
- Parallel processing
- High performance memory systems
- VLSI
- Performance evaluation and modeling

SELECTED ARTICLES/PUBLICATIONS

N. Mekhiel, Data Processing with Time Based Memory Access, Patent Application 1267-01 US-000-95, October 2007.

N. Mekhiel, *"Understanding the Behavior of Simultaneous Multithreaded, Multiprocessor and Multiprocessor with Simultaneous Multithreaded Architectures,"* ISCA 21st Inter. Conf. on Computers and Their Applications (CATA-2006), Mar. 23-25, 2006, Seattle.

N. Mekhiel, Method and Apparatus for Accelerating Retrieval of Data from a Memory System with Cache by Reducing Latency, Patent No: US 6,892,279 B2 May 10, 2005.

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RESEARCH AIMS

Advanced electrothermal computer simulation and transient temperature-related experiments of integrated circuits.

AREAS OF SPECIALIZATION
- Advanced electro-thermal computer simulation (virtual prototyping) of integrated circuits incorporating heat sources
- Development of electro-thermal test set-up for transient temperature-related experiments of electronic products
- Measurement of thermal conductivity, emissivity, and other parameters

SELECTED ARTICLES/PUBLICATIONS

F. A. Mohammadi, S. S. Attar, *"Development of an Electro-thermal Simulation Tool for Integrated Circuits,"* Canadian J. Electrical and Computer Engineering (CJECE), Vol. 33, Issue 3, 2008.

F. A. Mohammadi, M. Marami, *"Creation and Verification of Dynamic Compact Thermal Model of a BGA Package,"* Microelectronics Inter. J., Vol. 25, Issue 3, pp. 3-13, 2008.

F. A. Mohammadi, M. Marami, *"Dynamic Compact Thermal Model of a Package,"* Proc. IEEE International Symp., Circuits and Systems (ISCAS2008), pp. 2869-2872, Seattle, USA, May 2008.

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AREAS OF SPECIALIZATION
- Simulation
- Applied optimization
- Testing of VLSI circuits

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AREAS OF SPECIALIZATION
- VLSI design test
- Combinatorial optimization problems
- Layout synthesis
- Real-time fault injection
- Fault modelling

SELECTED ARTICLES/PUBLICATIONS

P. Lee, R. Sedaghat, *"FPGA-based Switch-level Fault Emulation using Module-based Dynamic Partial Reconfiguration,"* Inter. J. of Microelectronics Reliability, Science Direct, Elsevier, Vol. 48, Issue 11, 2008, pp. 2032-2040.

M. Kunchwar, R. Sedaghat, V. Geurkov, *"Dynamic Behavior of Resistive Faults in Nanometer Technology,"* Inter. J. of Microelectronics Reliability, Science Direct, Elsevier, Vol. 47, Issue 12, 2007, pp. 2141-2146.

R. Javaheri, R. Sedaghat, J. Zalev, *"Verification and Fault Synthesis Algorithm at Switch-Level,"* Microprocessors and Microsystems, Science Direct, Elsevier, Vol. 30, Issue 4, pp. 199-208, June 2006.

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RESEARCH AIMS

Study of legged locomotion dynamics through the use of autonomous robotic surrogates, targeting specific gaits or gait pathologies such as bounding, galloping and toe-walking. Applications include space exploration robots, variable-compliance lower-limb orthoses, and upper-limb walking aids.

AREAS OF SPECIALIZATION
- Biomedical engineering
- Biomechanics
- Legged locomotion
- Rehabilitation
- Mechatronics and robotics
- Embedded systems

SELECTED ARTICLES/PUBLICATIONS

J. A. Smith, A. Seyfarth, *"Patient-Adaptable Biomedical Devices: Benefits and Barriers for Granting Patients More Control,"* Proc. Inter. Conf. Biomedical Electronics and Devices (BIODEVICES), Madeira, Portugal, Jan. 2008.

J. A. Smith, A. Seyfarth, *"Elastic leg function in a bipedal walking robot,"* J. Biomech., 40(S2):S306, 2007.

I. Poulakakis, J. A. Smith, M. Buehler, *"Modeling and experiments of untethered quadrupedal running with a bounding gait: The Scout II Robot,"* Inter. J. of Robotics Research, 24:239–256, Apr. 2005.

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RESEARCH AIMS

Studying human balance control mechanisms and rehabilitation protocols to assist the elderly and the disabled through virtual reality systems and training programs.

AREAS OF SPECIALIZATION
- Biomedical engineering
- Human-computer interaction
- Human adaptation mechanisms and learning
- Sensation of self motion in multimedia displays
- Multimedia information processing

SELECTED ARTICLES/PUBLICATIONS

S. Virk, K. M. Valter McConville, *"Virtual Reality: Applications in Minimizing Occupational Falls,"* Association for Canadian Ergonomists 27th Annual Conf., Oct. 22-25, 2006, Banff.

S. Virk, K. M. Valter McConville, *"Virtual Reality Applications in Improving Postural Control and Minimizing Falls,"* IEEE Engineering in Medicine and Biology Conf., Aug. 29-Sept. 3, 2006, New York.

R. Karkoklil, K. M. Valter McConville, *"Design and Development of a Cost Effective Plantar Pressure Analysis System for Clinical Podiatry,"* IEEE Engineering in Medicine and Biology Conf., Aug. 29-Sept. 3, 2006, New York.

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RESEARCH AIMS
Developing new methods of analyzing operation of transmission and distribution systems, while modeling the uncertainty posed through the inclusion of wind electric generators. Research also includes development of models to operate electricity markets.

AREAS OF SPECIALIZATION
- Power systems analysis and optimization
- Intelligent systems

SELECTED ARTICLES/PUBLICATIONS
B. Venkatesh, P. Yu, H. B. Gooi, D. Choling, *"Fuzzy MILP Unit Commitment Incorporating Wind Generators,"* IEEE Trans. Power Systems, Vol. 23, No. 4, pp. 1738-1746, Nov. 2008.

B. Venkatesh, T. Jamstho, H. B. Gooi, *"Unit Commitment - a Fuzzy Mixed Integer LP Solution,"* IET Proc. Generation, Transmission and Distribution,*"* Vol. 1, No. 5, pp. 836-846, Sept. 2007.

B. Venkatesh, A. Rost, L. Chang, *"Dynamic Voltage Collapse Index – Wind Generator Application,"* IEEE Trans. Power Delivery, Vol. 22, No. 1, pp. 90-94, Jan. 2007.

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RESEARCH AIMS
Developing power converters and advanced controls for electric drive and renewable energy systems.

AREAS OF SPECIALIZATION
- Power electronics
- Renewable energy systems
- Adjustable-speed drives
- Flexible ac transmission systems
- Advanced controls

SELECTED ARTICLES/PUBLICATIONS
L. Y. Li, B. Wu, *"A Novel DC Voltage Detection Technique in the CHB Inverter-Based STATCOM,"* IEEE Trans. on Power Delivery, Vol. 23, No. 3, pp. 1613-1619, July 2008.

B. Wu, J. Pontt, J. Rodriguez, S. Bernett, S. Kouro, *"Current Source Converter and Cycloconverter Topologies for Industrial Medium Voltage Drives,"* IEEE Trans. Industrial Electronics, Vol. 55, No. 7, pp. 2786-2797, July 2008.

R. Li, B. Wu, D. Xu, N. Zargari, *"Space Vector Sequence Investigation and Synchronization Methods for Active Front End Rectifiers in High Power Current Source Drives,"* IEEE Trans. Industrial Electronics, Vol. 55, No. 3, pp. 1022-1034, March 2008.
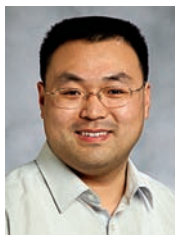
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RESEARCH AIMS
Power electronics applications for renewable energy, electric drives, and electric machinery. Recent research topics cover different areas in wind energy conversion systems, including control of wind turbines and power converters, generator design, wind farm optimization and grid integration.
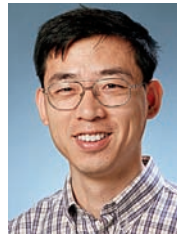
AREAS OF SPECIALIZATION
- Renewable energy
- Electric drives
- Electric machinery
- Power converter and digital control

SELECTED ARTICLES/PUBLICATIONS
J. Dai, D. Xu, B. Wu, et al., *"Dynamic Performance Analysis and Improvement of A CSC PMSM Wind Energy System,"* IEEE PESC'08 Conf., 2008, pp. 99-105.

B. Gong, D. Xu, *"Real-time Wind Turbine Simulator for Wind Energy Conversion System,"* IEEE PESC'08 Conf., 2008, pp. 1110-1114.

K. Protsenko, D. Xu, *"Modeling and Control of Brushless Doubly-fed Induction Generators in Wind Energy Applications,"* IEEE Trans. Power Electronics, Vol. 23, No. 3, pp. 1191-1197, 2008.

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AREAS OF SPECIALIZATION
- Data security
- Role-based access control modelling
- Information flow analysis
- Security of wireless sensor networks
- Web security

SELECTED ARTICLES/PUBLICATIONS
C. Yang, C. Li, *"Access Control in a Hierarchy Using One-Way Hash Functions,"* Computers & Security, Vol. 23, No. 8, pp. 659-664, 2004, Elsevier.

C. N. Zhang, C. Yang, *"Information Flow Analysis on Role-Based Access Control,"* Information Management and Computer Security, Vol. 10, No. 5, pp. 225-236, 2002.

C. Yang, *"Designing secure e-commerce with role-based access control,"* Inter. J. Web Engineering and Technology. Vol. 3, No.1, pp. 73-95, Jan. 2007.

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RESEARCH AIMS
Developing Doppler optical coherence tomography (DOCT) that employs mature Doppler ultrasound signal processing techniques for imaging applications such as embryonic cardiovascular development, angiogenesis, and therapeutic monitoring of treatment directed at neovasculature.
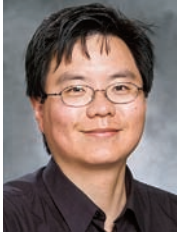
AREAS OF SPECIALIZATION
- Optical coherence tomography
- Intra-operative fluorescence imaging
- Photodynamic therapy
- Micro-machined electro-mechanical probes/catheters

SELECTED ARTICLES/PUBLICATIONS
B. A. Standish, K. Lee, X. Jin, A. Mariampillai, N. R. Munce, M. Wood, B. C. Wilson, I. A. Vitkin, V. X. D. Yang, *"Interstitial Doppler Optical Coherence Tomography as a Local Tumor Necrosis Predictor in Photodynamic Therapy: An in vivo study,"* Cancer Research, Dec, 2008.

A. Mariampillai, B. A. Standish, E. H. Moriyama, M. Khurana, N. R. Munce, M. K. K. Leung, J. Jiang, A. Cable, B. C. Wilson, I. A. Vitkin, V. X. D. Yang, *"Speckle Variance Detection of Microvasculature Using Swept-source Optical Coherence Tomography,"* Optics Letters, 33:1530-1532, 2008.

H. A. Collins, M. Khurana, E. H. Moriyama, A. Mariampillai, E. Dahlstedt, M. Balaz, M. K. Kuimova, M. Drobizhev, V. X. D. Yang, D. Phillips, A. Rebane, B. C. Wilson, H. L. Anderson, *"Blood-vessel closure using photosensitizers engineered for two-photon excitation,"* Nature Photonics, 2:420-424, 2008.

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AREAS OF SPECIALIZATION
- Field Programmable Gate Array (FPGA) architectures
- Computer-aided design (CAD) tools for FPGAs
- Logic synthesis
- Hardware implementation of computer graphics and digital communication algorithms
- Very large scale integrated circuit design

SELECTED ARTICLES/PUBLICATIONS
A. G. Ye, J. Rose, *"Measuring and Utilizing the Correlation between Signal Connectivity and Signal Positioning for FPGAs Containing Multi-bit Building Blocks,"* Proc. Inter. Conf. Field Programmable Logic and Applications, pp. 159-166, Aug. 2005, Tampere, Finland.

A. G. Ye, J. Rose, *"Using Bus-based Connections to Improve Field-programmable Gate Array Density for Implementing Datapath Circuits,"* Proc. ACM/SIGDA Inter. Symp. Field-Programmable Gate Arrays, pp. 3-13, Feb. 2005, Monterey, USA.

A. G. Ye, J. Rose, *"Using Multi-bit Logic Blocks and Automated Packing to Improve Field-programmable Gate Array Density for Implementing Datapath Circuits,"* Proc. Inter. Conf. Field Programmable Technology, pp. 129-136, Dec. 2004, Brisbane, Australia.

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RESEARCH AIMS
Exploring new topologies, algorithms, and silicon implementation of passive wireless micro-sensors, transponders, and readers.

SELECTED ARTICLES/PUBLICATIONS
F. Yuan, CMOS Active Inductors and Transformers – Principle, Implementation, and Applications, Springer, New York, ISBN: 978-0-387-76477-1, May 2008.

J. Li, F. Yuan, *"A new hybrid phase detector for reduced lock time and timing jitter of phase-locked loops,"* Analog Integrated Circuits and Signal Processing. Vol. 56, No. 3, Sept. 2008

A. Tang, F. Yuan, E. Law, *"A new CMOS active transformer QPSK modulator with optimal bandwidth control,"* IEEE Trans. Circuits and Systems II - Express Briefs, Vol. 55, No. 1, pp. 11-15, Jan. 2008.

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AREAS OF SPECIALIZATION
- Multimedia signal processing
- Audio coding

SELECTED ARTICLES/PUBLICATIONS
T. Amin, M. Zeytinoglu, L. Guan, *"Application of Laplacian Mixture Model to Image and Video Retrieval,"* IEEE Trans. Multimedia, Vol. 9, Issue 2, pp. 1416-1429, Nov. 2007.

S. Erkucuk, S. Krishnan, M. Zeytinoglu, *"A Robust Audio Watermark Representation Based on Chirps,"* IEEE Trans. Multimedia, Vol. 8, Issue 5, pp. 925-936, Oct. 2006.

M. Zeytinoglu, K. M. Wong, *"Detection of Harmonic Sets,"* IEEE Trans. Signal Processing, Vol. 43, No. 11, pp. 2618-2630, Nov. 1995.

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AREAS OF SPECIALIZATION
- Signal/information processing for finance, economics and marketing
- Multimedia signal processing and communications
- Wavelets, filterbanks and time-frequency/time-scale analysis
- Pattern classification and statistical signal processing
- Bioengineering and bioinformatics applications
- eCommerce applications

SELECTED ARTICLES/PUBLICATIONS
F. Wang, X.-P. Zhang, *"Reasons for market evolution and budgeting implications,"* J. of Marketing, Vol. 72, No. 5, Sept. 2008.

T. Tsui, X.-P. Zhang, D. Androutsos, *"Color image watermarking using multidimensional Fourier transforms,"* IEEE Trans. on Information Forensics and Security, pp. 13-28, Vol. 3, No. 1, March 2008.

X.-P. Zhang, K. Li, X. Wang, *"A novel look-up table design method for data hiding with near minimum distortion,"* IEEE Trans. on Circuit and Systems for Video Technology, pp. 769-776, Vol. 18, No. 6, June 2008.

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RESEARCH AIMS
Through R&D activities, provide solutions to problems experienced by the industry in the area of communication, instrumentation and control engineering.

AREAS OF SPECIALIZATION
- Wireless communications
- Intelligent transportation systems, vehicle-to-vehicle communications
- Positioning systems
- Power efficient wireless sensor networks
- Digital signal processing

SELECTED ARTICLES/PUBLICATIONS
L. Zhao, J. W. Mark, *"Joint Rate and Power Adaptation for Radio Resource Management in a Wideband CDMA System,"* IET on Communications, pp. 562-572, Vol. 2, No. 4, Apr. 2008.

J. Jia, L. Zhao, B. Ma, *"A Hierarchical Clustering-Based Routing Protocol Applied in Wireless Sensor Networks Supporting Multiple Data Aggregation Qualities,"* Inter. J. of Sensor Networks, pp. 79-91, Vol. 4, Nos. 1/2, 2008.

L. Zhao, J. W. Mark, J. Ding, *"Power Distribution/Allocation in Multirate Wideband CDMA Systems,"* IEEE Trans. Wireless Communications, pp. 2458-2467, Vol. 5, No. 9, Sept. 2006.

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RESEARCH AIMS
Research in Engineering Education:
studying student learning differences,
maturity levels and attitudes towards
learning to devise more effective strategies
for teaching engineering students and
increasing engagement and retention.

AREAS OF SPECIALIZATION
- System identification and control
- Engineering education research
- Faculty development (through Learning and Teaching Office)

SELECTED ARTICLES/PUBLICATIONS
M. S. Zywno, M. F. Stewart, *"A Summary Analysis of Engineering Students' Interactions with an Online Learning Object in the Context of their Learning Styles,"* Session 3430: New Models for Teaching and Learning, Proc. 2007 ASEE Annual Conference and Exposition, Honolulu, HI, June 24-27, 2007.

M. S. Zywno, *"Learning Styles of Engineering Students and their Implications for Successful Teaching with Instructional Technology,"* British J. of Engineering Education, UK, Vol. 5, No. 1, pp. 29-42, 2006.

M. S. Zywno, *"How to Survive, and Thrive, in a Large Class,"* In A. Fancy & M. Lerch (Eds.), Making a Difference / Toute la différence: A Celebration of the 3M Teaching Fellowship/Hommage au Prix d'enseignement 3M, Society for Teaching and Learning in Higher Education, Halifax, Canada, 2005.