

INNOVATION HAS AN ADDRESS.

Research & Development (R&D)
Technology Transfer

Summary
and Highlights
2011-2012



ÉTS

Engineering for Industry





*« Genius is one percent inspiration and
ninety-nine percent perspiration. »*

Thomas A. Edison

GOOD NEWS FROM ÉTS...

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FREQUENTLY USED ACRONYMS

ADRIQ Association pour le développement de la recherche et de l'innovation du Québec

CRIAQ Consortium for Research and Innovation in Aerospace in Quebec

NSERC Natural Sciences and Engineering Research Council of Canada

FRQNT Fonds de recherche du Québec – Nature et technologies

IRSST Institut de recherche en santé et en sécurité du travail

WATER-SUPPLY SYSTEMS

April 13, 2011 – In the wake of being awarded the “Distinction Arnold Drapeau” for the thoroughness and excellence of his article published in *Vecteur environnement*, Professor **Saad Bennis** has published in the American Water Works Association’s *Journal AWWA*, THE leading publication worldwide on water management.

AEROSPACE ENGINEERING

July 7, 2011 – ÉTS officially inaugurates the NSERC-P&WC Industrial Research Chair on Propulsion System Integration and Optimization with a hundred guests and colleagues of the new executive Chairholder, Professor **Hany Moustapha**, in attendance.

GREEN INTERNET

September 14, 2011 – Concurrently with the Quebec Premier’s trade mission to China, Professor **Mohamed Cheriet**, Director of the GreenStar network, inaugurates the first Asian node as part of the first carbon-neutral worldwide telecommunications network in collaboration with the Shanghai Research Center for Wireless Communications (WICO).

SOFTWARE ENGINEERING

October 3, 2011 – As an active and internationally regarded player in the field of software engineering, ÉTS garners the ISO Award for Higher Education in Standardization during the 34th general assembly of the International Organization for Standardization (ISO).

BIOMEDICAL ENGINEERING

November 28, 2011 – According to the highly regarded *Better World Report*¹, KneeKG, the knee function assessment device created by Professor **Jacques A. de Guise**’s team, ranks among the best university-developed technologies to be marketed in 2010. This year, only 23 projects worldwide appear on the list.

¹ *Better World Report* was created in 2005 by the Association of University Technology Managers (AUTM). This annual publication is designed to publicize the tangible benefits of university research and technology transfer around the world.

OVERVIEW: KEY FIGURES...

Figure 1:

MAIN RESEARCH FUNDING CATEGORIES

Scholarships for graduate studies are included in total funding.

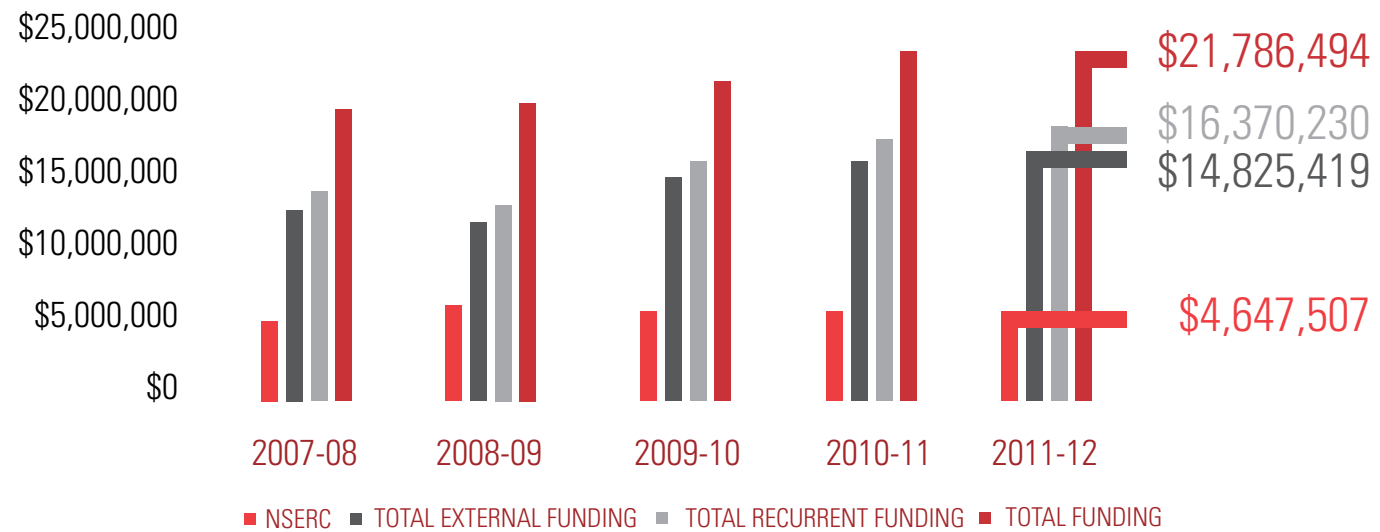


Figure 2:

EXTERNAL CONTRACTS AND GRANTS

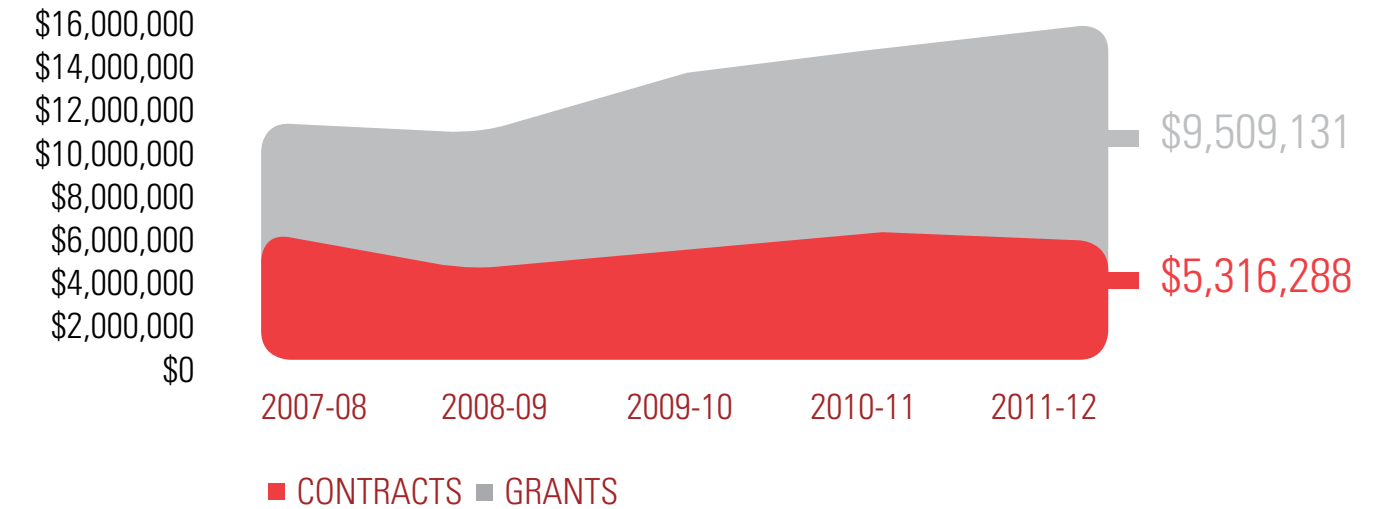


Figure 3:

RESEARCH INTENSITY (\$ / PROF)

Average funding per professor is above the Canadian university average.



...AND

KEY MESSAGES

Dear Readers,

ÉTS was founded in 1974 and created its first graduate studies program in 1991. Today, over 1,500 students are registered in our graduate studies programs, including 350 at the Ph.D. level. Together, they contribute to ÉTS growing reputation in the area of research, development and innovation (RD&I) and in graduate studies. Our institution enjoys steadily increasing standing both in the vast university-based research community and among our many local, national, and international RD&I partners.

In a nutshell, that is what our results for 2011-2012 reveal, as can be seen in the data and performance indicators presented on pages 4 and 5.

Among the most significant indicators are increases of 3.6% in recurrent funding and 8.8% in funding from NSERC (Figure 1), the federal granting council that represents ÉTS leading source of research funds. It is worth noting that NSERC funding is allocated on the basis of a national peer-review process. In the area of research intensity (Figure 3), ÉTS once again ranked among the 20 most research intensive universities in Canada, all study disciplines combined, and among the top 5 universities without a medical faculty. Another highlight of 2011-2012 was an increase of over 34% in funding obtained for international projects.

Moreover, NSERC's regional office paid special tribute to ÉTS, as the university establishment that garnered the greatest number of *Engage Grants* in Quebec during the "Célébrons le partenariat," the ADRIQ's gala in celebration of academic-industry partnerships. ÉTS in fact shared this award with McGill University, one of the most research active university in the country with 10 times as many professors as ÉTS and recognized as one of the world's leading universities.

In 2011, ETS innovated by creating its own research chair program, leading to the creation of 7 ÉTS chairs. This 3-year pilot project is designed to recognize excellence in research and enable participating chairholders to enhance their ability to obtain an externally funded research chair. We are proud to announce that this program has already contributed to funding a new industrial research chair and a new Canada Research Chair less than 2 years following its launch.

The rest of this annual review provides an overview of ÉTS major sectors of activity and expertise in RD&I with a presentation of 8 portraits of researchers that showcase their distinctive and wide-ranging talents. Each of the featured researchers represents one of the 8 major domains in our Strategic Research Plan, as shown on pages 8 and 9.

This year, in an attempt effort to convey our professors' growing efforts in developing a more comprehensive approach to research – one that is more attentive to the needs of people and society in general – we provide a glimpse into the passions that inspire our researchers' spirit, work, and life. Essentially, these portraits reveal in part the person behind the researcher.

For the sake of brevity, we present only one portrait per domain. For a more complete presentation of our researchers' vast expertise and their outstanding RD&I achievements, please visit www.etsmtl.ca (Research and Innovation tab).

Enjoy our latest issue!

Claude Bédard, Dean of Research



STRATEGIC RESEARCH PLAN

To provide an accurate representation of the scope and specificity of the research initiatives undertaken at ÉTS, we have created a matrix featuring our **eight major domains** of R&D. The first five domains (columns) correspond to **business sectors** recognized as key by the economic milieu, industrial clusters, and various levels of government. Active fields of research at ÉTS that belong to one or another of these major domains are listed within each column.

The three **enabling technologies** (rows) correspond to leading approaches in engineering R&D, ranging from the most theoretical (ideation and design) to the most tangible and/or practical (materials characterization, nanotechnologies). In turn, these three domains, which are of competitive interest to all business sectors, encompass various categories of activity.

The table clearly reveals the interdependence among sectors and technologies, enabling the positioning of each professor and each research project at a point where a business sector and an enabling technology meet.

BUSINESS SECTORS

HEALTH TECHNOLOGIES

- Biomechanics and biomaterials
- Medical imaging and devices
- Occupational health and safety
- Telehealth, electronic patient records

INFORMATION AND COMMUNICATIONS TECHNOLOGIES (ICT)

- Electro-optical and RF devices, microsystems, sensors, MEMS, RFID
- Microelectronics, LTCC microfabrication
- Telecoms

ENVIRONMENT AND CONSTRUCTION

- Climate change
- Construction, urban infrastructures, rehabilitation
- Roads, bituminous materials
- Soil decontamination, water treatment, recycling

AEROSPACE AND LAND TRANSPORTATION

- Aerodynamics, aeroservoelasticity
- Manufacturing processes, in-service performance, avionics
- Public transportation, cyber-transportation
- Propulsion and gas turbine engines

ENERGY

- Electric power generation, transportation and distribution
- Power electronics, energy efficiency
- Renewable energies
- Thermal energy, energy conversion, biofuels

ENGINEERING SCIENCES

Ideation and design

Modelling, simulation, analysis, optimization

Operations management, production management, supply chain management

Project management, life cycle analysis, certification

Innovation management

SOFTWARE AND COMPUTER APPLICATIONS

Software engineering, security, biometry, surveillance

Multimedia: AI, computer graphics, interfaces, video, vision, voice, digital documents

Maintenance, quality, embedded systems

MATERIALS AND FABRICATION

Product development and prototyping, manufacturing process optimization

Manufacturing systems, robotics, automation

Machine dynamics and vibration

Machine components: pressure tanks, seals, tribology and gears

Fabrication; clean, high-speed and high-performance machining

Characterization of materials and *in situ* testing; development of advanced materials

Nanotechnologies

ENERGY:

Canada Research Chair in Electrical Energy Conversion and in Power Electronics
Industrial Research Chair in Technologies of Energy and Energy Efficiency – t3e
ÉTS Research Chair in Biofuel Combustion for Transport

Power Electronics and Industrial Control Research Group – GREPCI
Research Laboratory on the Nordic Environment Aerodynamics of Wind Turbines – NEAT
Thermal Technology Centre – CTT

ENVIRONMENT AND CONSTRUCTION:

Canada Research Chair in Characterization of Contaminated Sites
Pomerleau Industrial Research Chair in the Integration of Construction Practices and Technologies

Experimental Station of Pilot Processes in Environment – STEPPE
Geotechnical and Geoenvironmental Engineering Laboratory – LG2
Integration and Sustainable Development in Built Environment – GRIDD
Pavement and bituminous materials laboratory – LCBM
Research Group on Digital Applications in Engineering and Technology – GRANIT
Research group specialized in Development and Applied Research in Environmental Modeling – DRAME
Research team specialized in Development and Research on Structures and Rehabilitation – DRSR

HEALTH TECHNOLOGIES:

Canada Research Chair in Precision Robotics
Canada Research Chair in Biomaterials and Endovascular Implants
Canada Research Chair on 3D Imaging and Biomedical Engineering
Chaire de recherche en orthopédie Marie-Lou et Yves Cotrel de l'Université de Montréal et de l'ÉTS
Industrial Research Chair in In-Ear Technologies – CRITIAS
Research Chair on Materials used in Protective Clothing and Equipment in Occupational Health and Safety
ÉTS Research Chair in Vertebral Medullary Traumatology

Biomedical Information Processing Laboratory – LATIS
Control and Robotics Laboratory – CoRo
Laboratoire d'imagerie et d'orthopédie – LIO
Occupational Safety Research Team – ÉREST

INFORMATION AND COMMUNICATIONS TECHNOLOGIES (ICT):

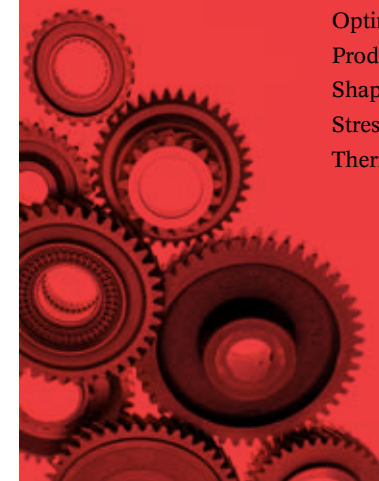
NSERC-Ultra Electronics Chair on Wireless Emergency and Tactical Communications
Canada Research Chair in Hybrid Optoelectronic Materials and Devices
Vantrix Industrial Research Chair in Video Optimization
ÉTS Research Chair on Shared Cloud Computing and Intelligent Applications
ÉTS Research Chair on Adaptive and Evolutive Surveillance Systems in Dynamic Environments
ÉTS Research Chair in Design Methodology for Highly Integrated and Reliable Hybrid Systems

Advanced Research in Telecommunications – COMunity
Communications and Microelectronic Integration Laboratory – LACIME
Imaging, Vision and Artificial Intelligence Laboratory – LIVIA
Multimedia Communication in Telepresence – Synchromedia
Multimedia Research Laboratory – LABMULTIMÉDIA
Organizational Engineering Research Laboratory for the Digital Enterprise – NUMÉRIX
Production Technologies Integration Laboratory – LITP
Software Engineering Research Laboratory – GÉLOG
Telecommunications and Computer Networks Management Laboratory – LAGRIT

AEROSPACE AND LAND TRANSPORTATION:

NSERC/P&WC Industrial Research Chair on Propulsion System Integration and Optimization
Canada Research Chair for Aircraft Modelling and Simulation Technologies
Industrial Research Chair in Forming Technologies of High-Strength Alloys (CM2P)

Aeronautical Research Laboratory in Active Control, Avionics and Aeroservoelasticity – LARCASE
Composite Materials Manufacturing and Characterization Laboratory – LFCMC
Laboratory of specialized embedded system, navigation and avionics – LASSENA
Machine Dynamics, Structures and Processes Team – DYNAMO
Optimization of Aerospace Manufacturing Processes Laboratory – LOPFA
Products, Processes, and Systems Engineering Laboratory – LIPPS
Shape Memory Alloys and Intelligent Systems Laboratory – LAMSI
Stress Analysis by Finite Element and Testing Laboratory – ACEFE
Thermo-Fluids for Transport Laboratory – TFT





PROFESSOR **NICOLA HAGEMEISTER**

PREVENTING AND OVERCOMING CHRONIC SHOULDER PAIN

Past the age of 55, one out of two people suffers from shoulder pain; half of these cases become chronic. Why chronic shoulder pain develops is unclear, which is a worrisome situation for physicians.

Nicola Hagemeister is a Professor of Automated Production Engineering at ÉTS, associated with the Imaging and Orthopaedics Research Laboratory (LIO), and researcher at the research centre of Centre hospitalier de l'Université de Montréal (CHUM). She is a specialist in shoulder kinematics and the development of tools that evaluate the functions of natural joints, especially the shoulder.

Her work consists in building models to predict the development of chronic pain to enable physicians to determine the most effective treatment for patients. In her work, she uses EOS imaging, a highly effective, low-dose X-ray technology.

The study, which has received 3-year funding of \$200,000 from IRSST, is of particular interest also for its large sample size of 90 subjects (60 ill and 30 healthy), which provides a solid foundation, from a scientific standpoint.

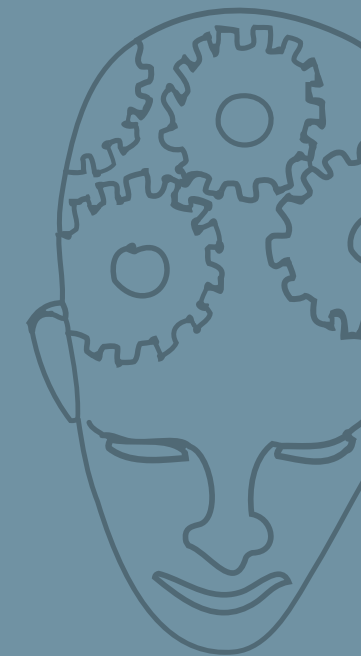
The study targets 3 objectives, namely to develop: (1) better predictors of chronic pain; (2) improved treatment options; and (3) effective preventive strategies. The first preliminary results, based on an innovative 3D head-and-socket movement-detection method, were recently made public, drawing considerable interest from the international community.

THE MIND-BODY RELATIONSHIP

In her work, Professor Hagemeister must take into account one extremely subjective parameter: the experience of pain, which varies from person to person. This attention to psychology is hardly incidental, as people are very important to Nicola Hagemeister. It is an essential feature of her work that it should make a contribution to people's lives. She would like to develop a detection method that can one day be used in primary care.

Nicola Hagemeister is a passionate teacher, an avid runner, and a fan of the emerging theatre scene. For this professional who was initially attracted to a career in psychology, research takes on its full meaning in clinical applications – and in life, in diverse forms.

**“ENHANCING PEOPLE'S
QUALITY OF LIFE IS WHAT
MAKES MY WORK TRULY
MEANINGFUL.”**



PROFESSOR AMMAR KOUKI



TOWARD LINEAR, EFFICIENT, AND INTELLIGENT CIRCUITS

Electromagnetics and electromagnetic waves have multiple practical applications ranging from electric motors and washing machines to cell phones and X-ray technology. However, systems and devices that make use of electromagnetic waves can be more intelligent and much more energy efficient.

That is the challenge that Ammar Kouki – Professor of Electrical Engineering and Director of the Communications and Microelectronic Integration Laboratory (LACIME) at ÉTS – has set for himself. Among other objectives, his work is designed to enhance the quality of signals transmitted by waves and to develop linear, efficient, and intelligent circuits that are both high-performance and environmentally friendly.

CONCRETE, ECO-FRIENDLY, AND HIGH-PERFORMANCE APPLICATIONS

“WE’RE IMMERSSED IN WAVES WITHOUT REALIZING IT.”

While Professor Kouki’s work is based on fundamental concepts, it generally leads to concrete applications such as the following examples.

To travel great distances, waves must be amplified, a process that causes distortion and loss of signal quality. Ammar Kouki came up with the idea of applying inverse “pre-distortion” to waves to restore the signal’s integrity, linearity, and quality.

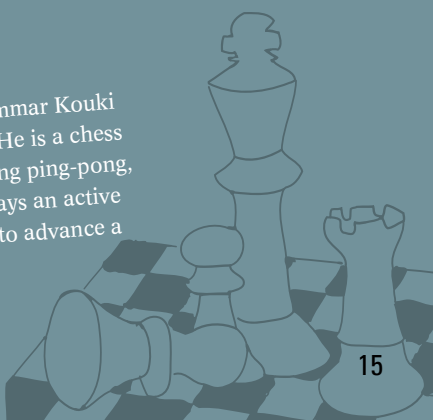
A cell phone contains 3 or 4 circuits, each of which is optimized for a single frequency. Ammar Kouki and his team are striving to develop circuits that can be reconfigured for multiple frequencies by changing certain specific properties – thereby making phones really smart!

Thanks to a \$600,000 strategic project grant from NSERC, Professor Kouki has also developed techniques designed to maximize wave power while minimizing energy consumption using gallium nitride-based semi-conductor chips. These techniques are of great interest to the Canadian Space Agency for use on its satellites. They are also of interest to many radio equipment suppliers.

Professor Kouki’s research team is also involved in CRIAQ’s AVIO-404 project, in partnership with Bombardier, MacDonald Dettwiler and Associates (MDA), École Polytechnique, and Concordia University (funding of \$300,000). Their work consists in developing airplane antennas that hug the contour of the fuselage and feature denser and lighter electronics.

Professor Kouki is also carrying pioneering work on multi-layer circuits using thin and extremely light ceramic tiles. These circuits are designed and fabricated in the Low-Temperature Cofired Ceramics (LTCC) Laboratory at ÉTS which he founded.

All of these activities may suggest that Ammar Kouki never leaves his lab. Quite the contrary! He is a chess champion who also loves sports, including ping-pong, basketball and soccer. In addition, he plays an active role in various civic initiatives designed to advance a more equitable society.





PROFESSOR FRÉDÉRIC MONETTE

FROM WASTEWATER TREATMENT TO SUSTAINABLE CITIES

Increasingly, cities in industrialized countries consume more energy and resources and produce more waste matter and wastewater. Given the growing scarcity of water worldwide, urban wastewater treatment has become a critical environmental issue.

No one knows more about this situation than Frédéric Monette, Professor in the Construction Engineering Department at ÉTS. As a researcher, he specializes in wastewater treatment, particularly water contaminated with phosphorus and nitrogen nutrients, and in development and validation protocols for new technology. As an internationally renowned expert, he takes part in numerous projects and conducts his own experimental and fundamental research initiatives.

ISOLATION: THE KEY TO EFFECTIVE TREATMENT

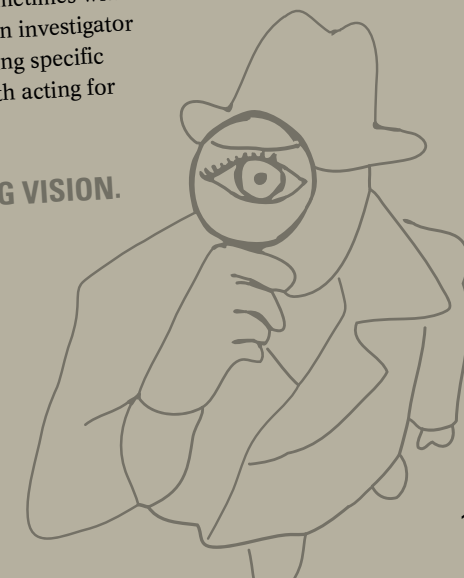
All regions and all cities around the world face specific challenges with respect to wastewater treatment. For instance, due to the difference in climate, nitrogen treatment methods employed in Canada are not exactly the same as the ones used in Europe. Faced with this problem, Professor Monette found an original solution: isolate nitrogen and treat it separately. This idea contains the kernel of a new approach that changes the way we regard wastewater treatment: rather than treating it as a whole, we isolate components and treat them separately. With funding from NSERC, he hopes that his work will lead to concrete applications in the medium term.

REDESIGNING CITIES THROUGH PRE-EMPTIVE ACTION

Professor Monette considers that the problems of wastewater treatment require that we take earlier action, that is, prior to the treatment process itself. His belief, which challenges conventional thinking, is that water management should be viewed from a much broader perspective that encompasses our urban way of life. Simply put, we need to rethink cities: analyze systems, find out where pollutants come from, work on a human scale, and prioritize action rather than reaction.

Along with his scientific pursuits, Frédéric Monette is also devoted to civic concerns and how they affect people. For this researcher who has worked in Africa (and dreams of going back), who runs half-marathons, and who sometimes wishes he had pursued a career as an investigator (medical or criminal), studying specific problems is synonymous with acting for the greater good.

THIS IS AN INSPIRING VISION.





PROFESSOR PATRICE SEERS

REINVENTING THE ENGINE IN THE ERA OF BIOFUELS

To make cars “greener,” you need to do more than fill them up with biofuel. You also have to look under the hood, create new settings, and rethink certain parts. In other words, reinvent the engine!

For Patrice Seers, Professor of Mechanical Engineering at ÉTS and holder of the ÉTS Research Chair in Biofuel Combustion for Transport, engine efficiency is an obsession. And what is efficiency? It’s all about getting optimal performance using the smallest quantity of fuel and generating the least amount of polluting emissions.

This magical equation is played out on a chess board featuring two central pieces: the fuel and the injector.

CHARACTERIZING BIOFUELS

Patrice Seers analyzes fuel sprays emitted by the injector. This avid golf player examines the sprays as carefully as he studies the quality of the putting green. He assesses their trajectory, gauges their speed, evaluates their viscosity, and examines their size. His objective? To enhance performance.

His characterization efforts are part of the Canadian government’s AUTO21 project and are carried out in partnership with the University of Toronto and the University of Windsor as well as the Industrial Research Chair in Technologies of Energy and Energy Efficiency (t3e) at ÉTS. The project has received nearly \$300,000 in funding, including \$100,000 from Ford.

“ENGINES DON’T MAKE
NOISE – THEY SING!”

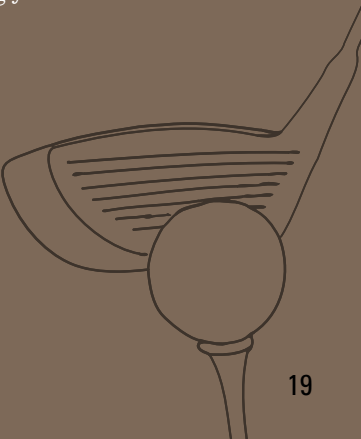
THE INJECTOR: THE KEY PART

Performance, however, is not solely a matter of fuel – the injector also plays a major role. Accordingly, Patrice Seers examines the injector from all angles in order to find the perfect injector-biofuel equation. His work on the injector has received funding of \$175,000 over a 3-year period mainly from Fonds de recherche du Québec – Nature et technologies (FRQNT).

IMPROVED BIOFUELS

Patrice Seers toggles constantly between experiments and numerical models. In fact, Professor Seers’ results might help biofuel producers by defining the properties biofuels must have to ensure optimal use.

Patrice Seers is a fan of historical novels, and today he is writing a new chapter in the story of energy-related challenges at a time when natural resources are growing increasingly scarce. His professional golf career will have to wait.





**PROFESSOR
DANIEL ROUSSE**

ENERGY: A CORE ISSUE IN OUR LIVES

Each Canadian uses over 8 tons of oil equivalent per year; clearly, the time has come to act and make a change.

It is no longer only a matter of reducing the world's increasing energy consumption rate. Quite simply, we need to consume less than we do now. That is the only possible basis for developing a sustainable world.

This is the sort of consideration that occupies Daniel Rousse, Professor of Mechanical Engineering at ÉTS and head of the Industrial Research Chair in Technologies of Energy and Energy Efficiency (t3e). It is his view that energy should be at the heart of all public debates as it has an impact on most aspects of our civilisation.

THE T3E RESEARCH CHAIR

Daniel Rousse's t3e Research Chair, inaugurated in 2010, is a nexus of research and discussion on matters relating to energy. His work focuses on 3 orientations: (1) radiation; (2) energy storage; and (3) bio-energy. Within these 3 orientations, numerous, diverse, and complementary topics are studied.

Research on radiation allows us, for example, to assess the actual efficiency of solar panels and to store this energy. Through energy conversion and recovery from wastes, the goal is to minimize the volume of disposable waste and to produce energy for on-site use. In addition, generating bio-energy using waste matter or agricultural and forest residues represents a clever solution for Quebec.

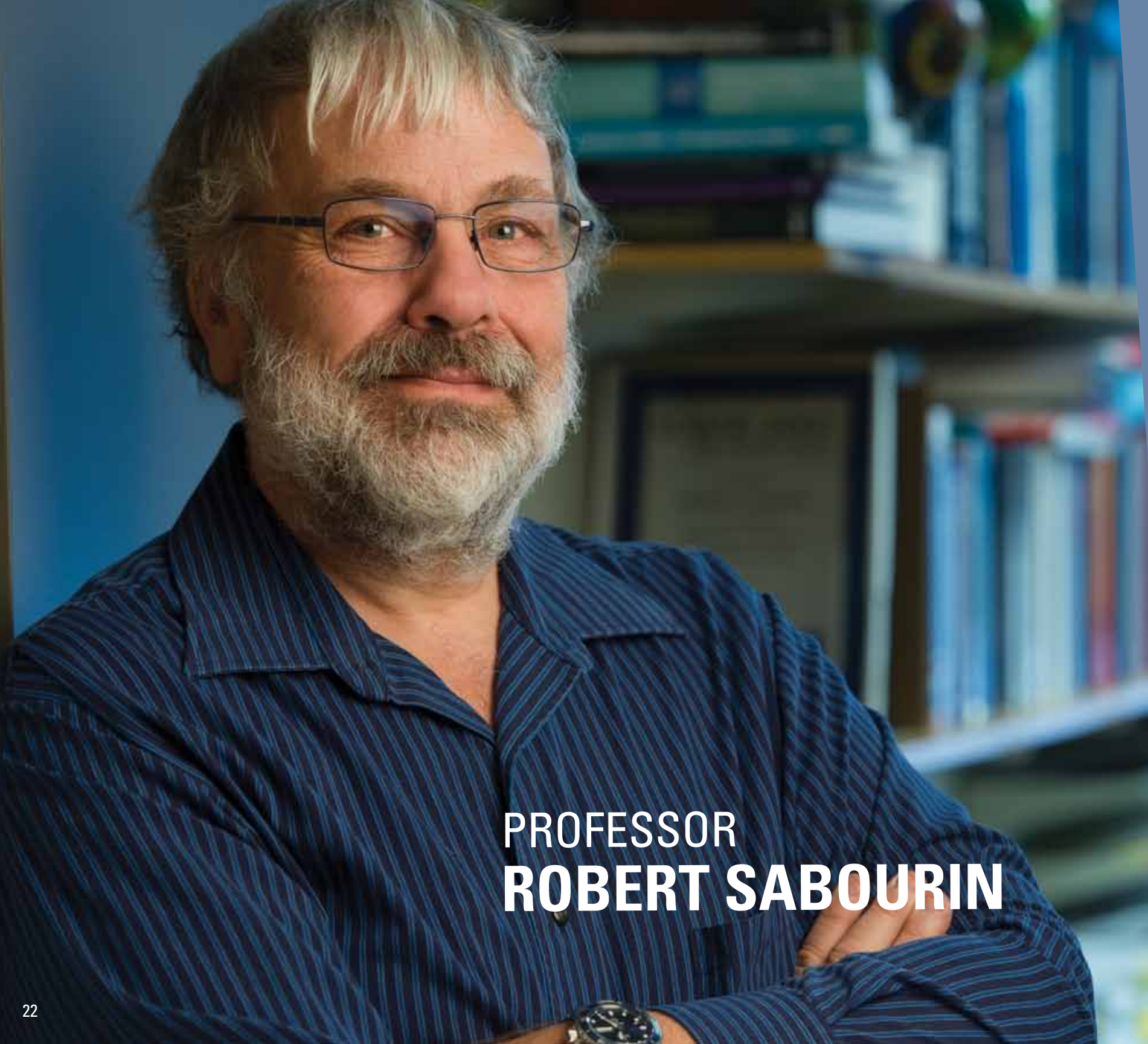
"INEVITABLY, AS WE KEEP INCREASING CONSUMPTION FASTER THAN WE IMPLEMENT RENEWABLE ENERGY SOURCES AND ENERGY EFFICIENCY MEASURES, WE'LL REACH THE 'BOTTOM OF THE BARREL'. THAT'S THE REALITY. AND IT'S GOING TO HURT."

A HUMANIST VISION OF ENERGY

Daniel Rousse strongly believes that his work should make a socio-economic contribution. His research and related efforts and the bonds he builds with public and private organizations are designed to contribute to economic, cultural, social, and intellectual development in Quebec and other parts of the world. In fact, his Research Chair will pursue a philanthropic mission through initiatives in Senegal, Cuba, and Ecuador.

This man of a thousand projects – who speaks with humour and, when dealing with serious subjects, scientific rigour – plans to pursue doctoral studies in philosophy focusing on the manner in which energy has changed humankind over time.





**PROFESSOR
ROBERT SABOURIN**

TOWARD SMART AND EVOLVING MACHINES

Can machines learn from experience, adapt to their environment, and evolve? The answer is yes.

Robert Sabourin is a Professor in the Automated Production Engineering Department and Director of the Laboratory for Imagery, Vision, and Artificial Intelligence (LIVIA). In his work, he develops algorithms whose function is to optimize biometric (including face, signature, and voice) classification and recognition applications. Currently, biometrics is a booming sector. In 2012, ÉTS inaugurated its Research Chair on Adaptive and Evolutive Surveillance Systems in Dynamic Environments, with Robert Sabourin as Chairholder.

A SMART SURVEILLANCE SYSTEM

Robert Sabourin and his team are working to create face-recognition systems. Recognition conditions are often adversely affected by changing conditions in dynamic environments: change of angle, lighting, rain, poor visibility, crowds, and so on. Given these demanding conditions, conventional surveillance systems are quickly overwhelmed.

In efforts to improve recognition, classification, and authentication technology, systems must be able to improve and learn from past experience. The systems created by Professor Sabourin are adaptive (they are able to learn) and evolving (they continue to function even if the context changes). Contrary to surveillance systems designed for static environments with controlled parameters, these smart machines continue to perform well in complex and dynamic settings.

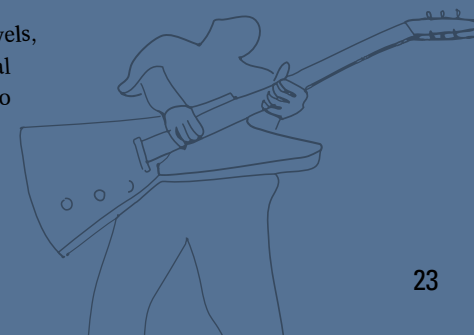
“IN MY VIEW, CONDUCTING RESEARCH IS A CREATIVE PROCESS.”

For the most difficult cases, Professor Sabourin uses an “expert committee”: he merges several machines and pools their respective specialties (fingerprints, voice, image, and so on) to achieve results that are beyond the reach of a single machine. This expert committee must also evolve, that is, it must learn from past experience in order to keep improving its performance.

INTERNATIONAL DISSEMINATION

The international impact of Robert Sabourin’s work is evident from his publishing record: over 350 publications and 4,000 citations, making him one of the most cited professors at ÉTS. He is a world-renowned researcher who is also the Director of the Ph.D. program at ÉTS. Currently, he is supervising about 10 graduate students.

Long ago, this former rock guitarist registered for a semester of study at École Polytechnique “just to try it out.” As a result, he caught the science bug! For Robert Sabourin, also a fan of spy novels, research provides the same intellectual and artistic stimulation that he used to find in music.





PROFESSOR ALAIN APRIL

FROM BIG DATA TO OPEN-SOURCE SOFTWARE: THE FUTURE OF IT

“Big Data” is a term that refers to one of the biggest IT-related challenges of the decade ahead.

When conventional database management systems are no longer adequate, innovative solutions must be found. That is what Google has done by creating a revolutionary technology that enables rapid processing of very large amounts of data. The result is astounding and now that we have mastered this technology, it can be used for business applications.

Alain April is one of the leading big data specialists in the country. As a Professor of Software Engineering at ÉTS and Director of the Software Engineering Research Laboratory (GÉLOG), he uses this technology extremely effectively in various fields, including healthcare.

He has contributed to efforts to accelerate the processing of human genome sequencing and query/analysis of blood-test results for the Jewish General Hospital. Using big data and open-source software, his research teams have developed high-performance and low-cost solutions to rapidly process massive quantities of medical data.

A BIG DATA SPECIALIST

THE TRANSITION TO OPEN-SOURCE SOFTWARE

Open-source software is another field for which Alain April is a recognized specialist. Mandates from major companies include analysis of the feasibility of migrating to open-source software, taking into account related costs (other than licensing fees), including those associated with conversion, support, and training, as well as related risks and benefits. He also integrates cloud computing technology in his research, analyses and solutions.

Though he deals with technologies that will become IT standards in the future, Alain April also has a certain attachment to tradition. He is a classical and folk guitarist, plays an active role in his community and in local politics. His most surprising passion, perhaps, are the works of Romain Gary, aka Émile Ajar, a major French writer whose first editions he collects. Perhaps one day he will need his technology clusters to store it all.

“WITH BIG DATA, WE’RE NOT CREATING NEW TECHNOLOGY. WE ARE IDENTIFYING THE MOST PROMISING TECHNOLOGY, APPLYING IT RAPIDLY AND IN A STRUCTURED MANNER TO INDUSTRIAL PROBLEMS.”



PROFESSOR MARC THOMAS

EVERYTHING VIBRATES!

Vibration is a natural phenomenon. Everything vibrates – there are no exceptions – from solid and stiff structures to the finest-tuned devices, and even the human body. Although natural, the vibrations can generate their batch of problems.

Marc Thomas is a Professor of Mechanical Engineering at ÉTS and mentor for the Quebec division of the Canadian Machinery Vibration Association. He is a specialist in vibration analysis and predictive machine maintenance.

But what is vibration? It is a periodic oscillation in mechanical systems that can be measured in various ways, including amplitude, phase, and frequency. All structures subjected to excitation vibrate.

VIBRATION AS AN INDICATION OF DETERIORATION

Marc Thomas main area of application is machine maintenance. His work consists in detecting all defects at a very early stage. He discerns defects through their vibro-acoustic expression by detecting signals within a broad frequency range. Using sensors, he digitally decrypts noise signals and analyzes data with precision.

Marc Thomas detects operating defects in aviation turbine engines for Pratt & Whitney Canada. He also oversees pump maintenance for the City of Montreal and is working on robotic grinding control systems for Hydro-Québec (\$365,000 over a 3-year period).

**“EARLY DETECTION OF VIBRATIONS
ALLOWS US TO ACT EARLY. PREVENTING
IS BETTER THAN CURING.”**

WHEN THE HUMAN BODY VIBRATES

Marc Thomas also studies the effects of vibration on the human body. His work focuses on back pain in vehicle operators as well as segmental vibrations experienced by workers who use vibrating tools. He creates numerical models of the human body to study the effects of vibrations and the fatigue they generate in workers over the long term.

INTERNATIONAL COLLABORATIONS

As Director of the DYNAMO Research Team in Machine Dynamics, Structures, and Processes, Marc Thomas supervises between 6 and 13 graduate students, depending on the year, and collaborates with several laboratories in France.

Prior to studying structural vibrations, Marc Thomas liked to strum his guitar. He is a passionate musician, champion bridge player, and a gourmet cook. While his talents in the kitchen are appreciated by his friends, the industry is glad that he chose a career in machine maintenance rather than as a chef.



ÉTS AND ITS PROFESSORS

The hottest icicles on the big screen
November 21, 2011



Jonathan Gagnon, a student at ÉTS, and **Éric Paquette**, Professor in the Software Engineering and IT Department, were honoured as part of the Computer Graphics International (CGI) conference held in Ottawa in June 2011. Their article titled “Procedural and Interactive Icicle Modeling,” ranked first among the 220 science articles submitted for the occasion.

Constructo

ÉTS inaugurates the ICAR laboratory
April 5, 2011 (Émilie Laperrrière)

École de technologie supérieure (ÉTS) and Institut de recherche Robert-Sauvé en santé et sécurité du travail (IRSST) have joined forces to confront the issue of noise pollution in the workplace. The result is positively impressive: a one-of-a-kind laboratory in Quebec dedicated to research and testing of new acoustic products.



**Bioethanol at ÉTS:
filling up without stealing food from the poor**
January 30, 2012 (Denis Arcand)

One of the most frequent criticisms levelled at the biomass fuel industry is that it literally steals food from the poor to produce fuel to fill our tanks. [...] Finding a solution to this problem is one of Professor **Patrice Seers** mandates. Professor Seers is the Chairholder of the brand new Research Chair in Biomass Fuel Combustion at École de technologie supérieure (ÉTS) in Montreal.

IN THE NEWS IN QUEBEC



Toward a greener internet
December 8, 2011 (Martine Letarte)

“The information and telecommunications industry produces as much pollution as the aerospace industry. This corresponds to 2% of all greenhouse gas emissions, and is increasing by 6% a year. The GreenStar project aims to make IT and telecom greener,” asserts **Mohamed Cheriet**, Project Director and Professor at École de technologie supérieure (ÉTS).



A new bridge good for 150 years!
December 2011 (Jeanne Morazain)

Should we also agree to pay more in order to endow Montreal with a bridge that would become an iconic symbol of the province’s largest city? [...] “If we fail to do this, we’ll miss an opportunity to establish a major milestone,” states **Amar Khaled**. “Champlain Bridge is the main gateway into Montreal. It spans a great river and leads to the downtown core. That is why we need to design a visually appealing structure. Of course, engineers will have to work closely with architects while retaining project leadership.”



Research Chair in sustainable construction at ÉTS
January 31, 2012 (Voirvert.ca)

Montreal’s École de technologie supérieure will invest \$750,000 over 3 years in support of new institutional research chairs, including one dedicated to the integration of sustainable construction practices and technologies. The Chairholder will be **Daniel Forgues**, Professor in the Construction Engineering Department at ÉTS and member of the Board of Directors of the Quebec chapter of the Canada Green Building Council.



“We need to compete with countries like China.” Quebec industry benefits from research carried out by LIPPS
February 25, 2012 (Réginald Harvey)

Victor Songmene, Professor in the Mechanical Engineering Department at École de technologie supérieure (ÉTS), directs the Products, Processes, and Systems Engineering Laboratory (LIPPS) [...] For all activities, whether virtual or physical, a single objective applies: “We aim to train a new kind of engineer whose work is competitive while being environmentally friendly and ensuring occupational health and safety.”

les affaires

ÉTS recruits a major figure
September 3, 2011 (Pierre Théroux)

École de technologie supérieure (ÉTS) aims to become an even more important player in aerospace. [...] Two research chairs in aerospace have been launched since the beginning of the year. The Canada Research Chair in Aircraft Modelling and Simulation Technologies has been active since January 2011, under the guidance of Professor **Ruxandra Mihaela Botez**. As for the NSERC-P&WC Industrial Research Chair on Propulsion System Integration and Optimization, it is headed by **Hany Moustapha** himself.



35 inventions Made in Quebec
May 15, 2011 (Valérie Borde)

EOS, FOR DIAGNOSING SCOLIOSIS. The device, developed in the early 2000s by **Dr. Jacques de Guise**’s team at École de technologie supérieure, is different from other imaging technology in that it emits much less radiation.



Le génie pour l'industrie

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ÉTS, part of the Université du Québec network, educates professional engineers and researchers who are renowned for their practical and innovative approach. Among the 35 engineering schools and faculties in Canada, ÉTS ranks among the best, with over fifty chairs, research centres and laboratories, to which PhDs and graduate students are associated. This synergy of expertise and experience contributes to scientific progress, higher industrial productivity and quality, as well as the training of a highly qualified workforce.

For additional information on ÉTS chairs, laboratories and research groups, please refer to the Research and Innovation section of the ÉTS web site at www.etsmtl.ca