

SUMMARY AND HIGHLIGHTS

2018 ▶ Research & Development (R&D)
2019 ▶ Innovation



ÉCOLE DE
TECHNOLOGIE
SUPÉRIEURE
Université du Québec

TABLE OF CONTENTS

ACRONYMS AND SHORTCUTS USED

CARIC	Consortium for Aerospace Research and Innovation in Canada
CRC	Canada Research Chairs
CRIAQ	Consortium for Research and Innovation in Aerospace in Québec
CRIQ	Centre de recherche industrielle du Québec
CRITM	Metal Transformation Research and Innovation Consortium
NSERC	Natural Sciences and Engineering Research Council of Canada
CFI	Canada Foundation for Innovation
CIHR	Canadian Institutes of Health Research
FRQNT	Fonds de recherche du Québec – Nature et technologies
MEI	Ministère de l'Économie et de l'Innovation
MITACS	Mathematics of Information Technology and Complex Systems
PRIMA	Advanced Materials Research and Innovation Hub

A Pivotal
Time for Research

4

Major
Projects

6

Overview:
Key Figures

8

Our Major Gains

10

Using Artificial Intelligence to Better
Manage Energy Consumption
KAMAL AL-HADDAD

12

Using Waves to Analyse the
Condition of a Structure
PIERRE BÉLANGER

14

Improving Productivity in the Construction
Industry Through Digital Technology
CONRAD BOTON

16

Incorporating Renewable Energy into
the Hydroelectric Power Grid
AMBRISH CHANDRA

19

Using ICTs to Help Achieve
Sustainable Development Targets
MOHAMED CHERIET

21

Knee Kinesiology: Spectacular Progress for
Treating Knee Osteoarthritis
NICOLA HAGEMEISTER

22

Reducing Pollutant Emissions Through
Fuels and Technology
PATRICE SEERS

25

Securing Data Through
Blockchain Technology
KAIWEN ZHANG

27

Major
Research Events

28

ÉTS Research
Chairs and Units

30

A PIVOTAL TIME FOR RESEARCH

This last fiscal year marks a turning point for research at ÉTS. First off, support from funding agencies reached an all-time high. Then, ÉTS received major international recognition when it was ranked 6th out of all Canadian institutions and 1st in Québec for its work in computer vision. On top of that, this year, ÉTS welcomed the first-ever strategic cluster in its history and received funding for six new research chairs, two of which are Canada Research Chairs. Here are this year's highlights in a nutshell.

NSERC – Discovery Grants: a resounding success

Our team of research professors can take pride in having received one of the largest amounts ever allocated to ÉTS through NSERC's Discovery Grants Program. Thirty-one researchers will share a budget envelope totalling close to \$1 million that is renewable annually for a period of five years. Moreover, 74% of those who submitted grant applications received positive responses, which represents an 8% increase in the success rate compared to last year.

This level of success confirms the excellent quality of our professors' research, but also the exceptional level of expertise of people we have hired over the past few years: six of the eight researchers at ÉTS whose careers are on the rise and who submitted applications under this program received Discovery Grants.

CIRODD: funding beyond traditional sources

We took over from Polytechnique Montréal as the managing institution for the Centre interdisciplinaire de recherche en opérationnalisation du développement durable (CIRODD – Centre for interdisciplinary research into the operationalization of sustainable development). And we are delighted to take on this new responsibility! This important strategic cluster, which includes 93 researchers from 13 universities and five CEGEPs and colleges, will bring many networking opportunities both with research professors and our industrial partners. What's more, CIRODD received the maximum amount of funding that can be granted to a strategic cluster by the Fonds de recherche du Québec. CIRODD will be headed by Mohamed Cheriet until 2025.



Research Chairs: promising partnerships

And what a year this has been for research chairs! We are thrilled to announce that ÉTS was awarded six new research chairs, including four Industrial Research Chairs and two Canada Research Chairs, in addition to the renewal of two others.

The creation of these new research bodies speaks to the relevance and quality of research done by our team in cutting-edge fields such as computer vision, green aeronautics, collaborative robotics, ultrasonic testing, shape analysis and telecommunications networks.

I would also like to thank the holders of these chairs for the excellence of their research: Professors Bélanger, Kaddoum, Lombaert, Garnier, Duchaine and Ben Ayed. And I would be remiss if I didn't thank our industrial partners, Orthogone, Robotiq, Olympus and Safran, for their confidence in funding our research and renewing their agreements. Sincere thanks as well to the Canada Research Chairs Program and NSERC for their support, which is critical to ensuring the continuation of collaborative research in groundbreaking fields.

Computer Vision: ÉTS ranks first in Québec!

According to CSRankings, which ranks top computer-science institutions around the world, ÉTS came 1st in Québec and 6th in Canada in the Computer Vision category, based on the high quality of its scientific publications over the last five years! This distinction inspires us to continue producing outstanding work. Special thanks to Professors Ismail Ben Ayed, Christian Desrosiers, José Dolz, Éric Granger, Hervé Lombaert, Marco Pedersoli and Matthew Toews for allowing ÉTS to shine on the world stage.

5G: ÉTS is one of five Canadian innovation hubs

In summer 2018, ÉTS was chosen as one of five innovation hubs in Canada for the 5G ENCQOR (Evolution of Networked Services through a Corridor in Québec and Ontario for Research and Innovation) initiative. This project led to the development of a fifth-generation pre-commercial wireless telecommunications network where digital applications can be tested. This major undertaking is supported by five private-sector partners, including Ciena, as well as the Québec, Canadian and Ontario governments. Centech, the ÉTS tech enterprise accelerator, is home to the Montréal innovation hub.

Equity, diversity and inclusion: getting stronger!

It is well known that increasing equity, diversity and inclusion (EDI) fosters excellence. With this in mind, ÉTS launched its EDI action plan last November. We are committed to implementing policies and practices based on EDI principles outlined in the plan, which will apply not only to the teaching and research sectors, but also to the entire ÉTS community.

A number of initiatives were undertaken as part of this plan, including consulting widely with staff to get their feedback on inclusion at ÉTS, creating sub-committees, training, reviewing the hiring process for teaching staff and endorsing the Charter of the Dimensions Program. We will certainly be able to present results of these actions in our next edition of Summary and Highlights. Stay tuned!

Going even further in 2020

The success we experienced in 2019 makes us very optimistic about 2020. We are continuing to work hard to raise the ÉTS profile in its many fields of research. Our goal? To make talented students and researchers want to come to ÉTS. Why? Because they know they will find a stimulating research setting where they can reconsider, adapt and invent what will be key for tomorrow's world. François Gagnon, our new Director General, entrusted the entire ÉTS community with this responsibility when he presented the 2019-2022 Strategic Plan. Just like the rest of the ÉTS community, the Office of the Dean of Research is pleased to take on this new assignment.

In closing, let's not forget that discovery is at the heart of every researcher's work. It's possible that some of our discoveries will lead to innovations that will boost economic growth. Some may transform a whole field of research, while others may help colleagues – at ÉTS or elsewhere in the world – solve problems that have been puzzling researchers for many years.



Charles Despins,
Director of Research and Partnerships
Interim Dean of Research

MAJOR PROJECTS

Over the course of the last year, several external research funds and private partners have contributed to the launch of new projects, the hiring of students for research work or the acquisition of strategic equipment for the various laboratories at ÉTS.

Here are some of the promising projects that were launched in 2018-2019.

**CFI - John R.-Evans
Leaders Fund**

—

**Claudiane
Ouellet-Plamondon**
Additive Manufacturing
and Automation in Civil and
Construction Engineering

RDC - MEDTEQ

—

Ghyslain Gagnon
Nouveaux circuits de
traitement de signal
et matériaux pour une
électrocardiographie robuste
et abordable

RDC - Thales Canada Inc.

—

Yves Blaquière
Configurable Integrated
Power Input/Output Systems
for Avionic Applications

RDC - Rio Tinto Alcan

—

Richard Arsenault
Value Chain Optimization
of Hydroelectric Power
Generation Systems

**CARIQ - CRIAQ - MEI
and 9 international
partners**

—

Olivier Doutres
New Acoustic Insulation
Meta-Material Technology for
Aerospace

CRITM - NSERC - SAFRAN

—

Mohammad Jahazi
Simulation numérique de
la trempe des composants
aéronautiques en acier

Conception Génik Inc.

—

Martine Dubé
Mass Production of Induction
Welded Thermoplastic
Composites
MANU-1709_ TRL4+-

**RDC - Acme
Engineering Products Ltd.**

—

Abdelouahed Gherbi
Specification, Deployment and
Management of Large-scale
and Dependable IoT Systems
using Model-based Engineering
Techniques

CRC

—

Hervé Lombaert
Canada Research Chair in
Shape Analysis in Medical
Imaging
(Tier 2)

CRC

—

Yvan Petit
Canada Research Chair in
Engineering Innovations in
Spinal Trauma
(Tier 2 – renewal)

Siemens – AGT - ÉTS

—

Hany Moustapha
Siemens Research Chair on
Industry 4.0 Technology
Integration

OVERVIEW: KEY FIGURES

After a record 25% increase in 2017-2018, research funding went up by a sizeable 19% in 2018-2019.

Total research funding in this last fiscal year went from \$36.1M to \$42.8M.

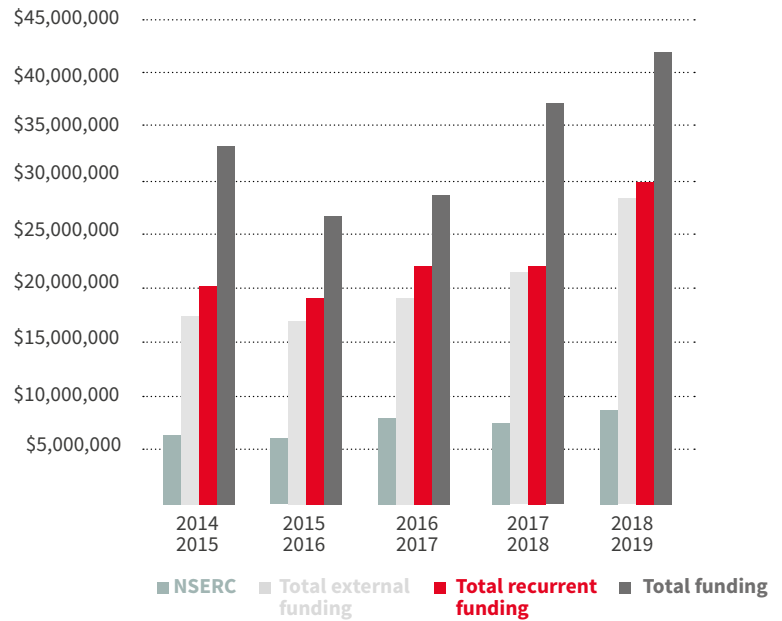
These figures are calculated as follows

Total funding =
total recurrent funding + major infrastructures (CFI, FEI and CED) + indirect research costs + donations + graduate scholarships

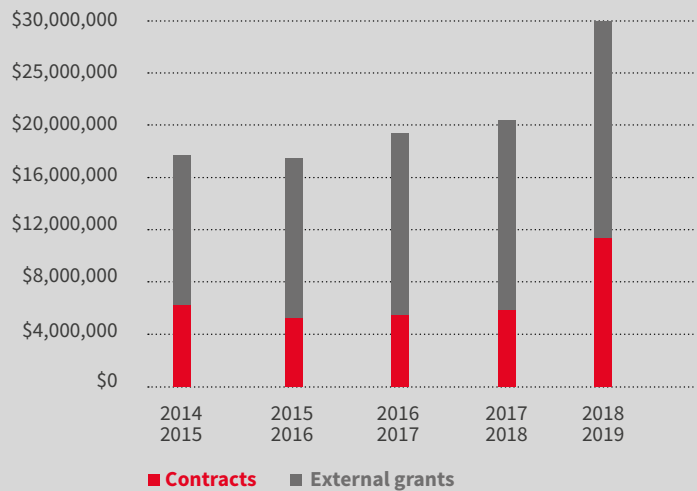
Recurrent funding =
total external funding + total internal funding

MAIN RESEARCH FUNDING CATEGORIES

Scholarships for graduate studies are included in total funding.



EXTERNAL CONTRACTS AND GRANTS



RESEARCH INTENSITY (\$ / PROF)

The average funding per professor is higher than the Canadian university average.



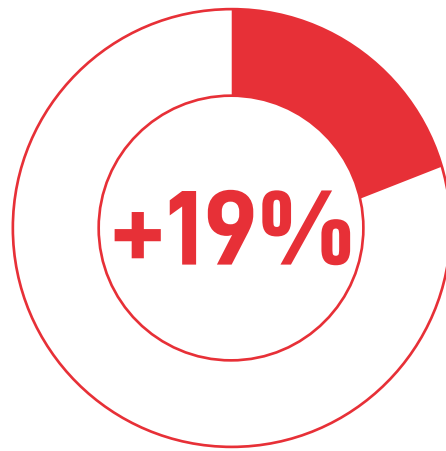
**OUR
MAJOR
GAINS
2018-2019**

42.8 MILLION

Total research funding



The positive response rate for applications for NSERC Discovery Grants went from 66% to 74%.



Total research funding went from \$36.1M to \$42.8M.

+6

Research Chairs

ÉTS was awarded 4 new Industrial Research Chairs and 2 new Canada Research Chairs, which brings the total number of active chairs to 24.

+1

Strategic Cluster

L'ÉTS welcomed its first-ever strategic cluster: the Centre interdisciplinaire de recherche en opérationnalisation du développement durable (CIRODD – Centre for interdisciplinary research into the operationalization of sustainable development).

+10

Professors

Ten new professors joined the ÉTS faculty.

USING ARTIFICIAL INTELLIGENCE TO BETTER MANAGE ENERGY CONSUMPTION

Kamal Al-Haddad

Professor in the Electrical Engineering Department

Our electricity needs will reach unprecedented levels within 10 years. These days our electricity supply largely comes from polluting resources, the cheapest and most abundant being coal. Are we ready to live in an increasingly energy-hungry world?

According to research professor Kamal Al-Haddad, we have no choice but to develop techniques and means to use energy as judiciously as possible and to find new sources of renewable energy in order to meet all our industrial, commercial and residential needs.

Tomorrow's smart energy

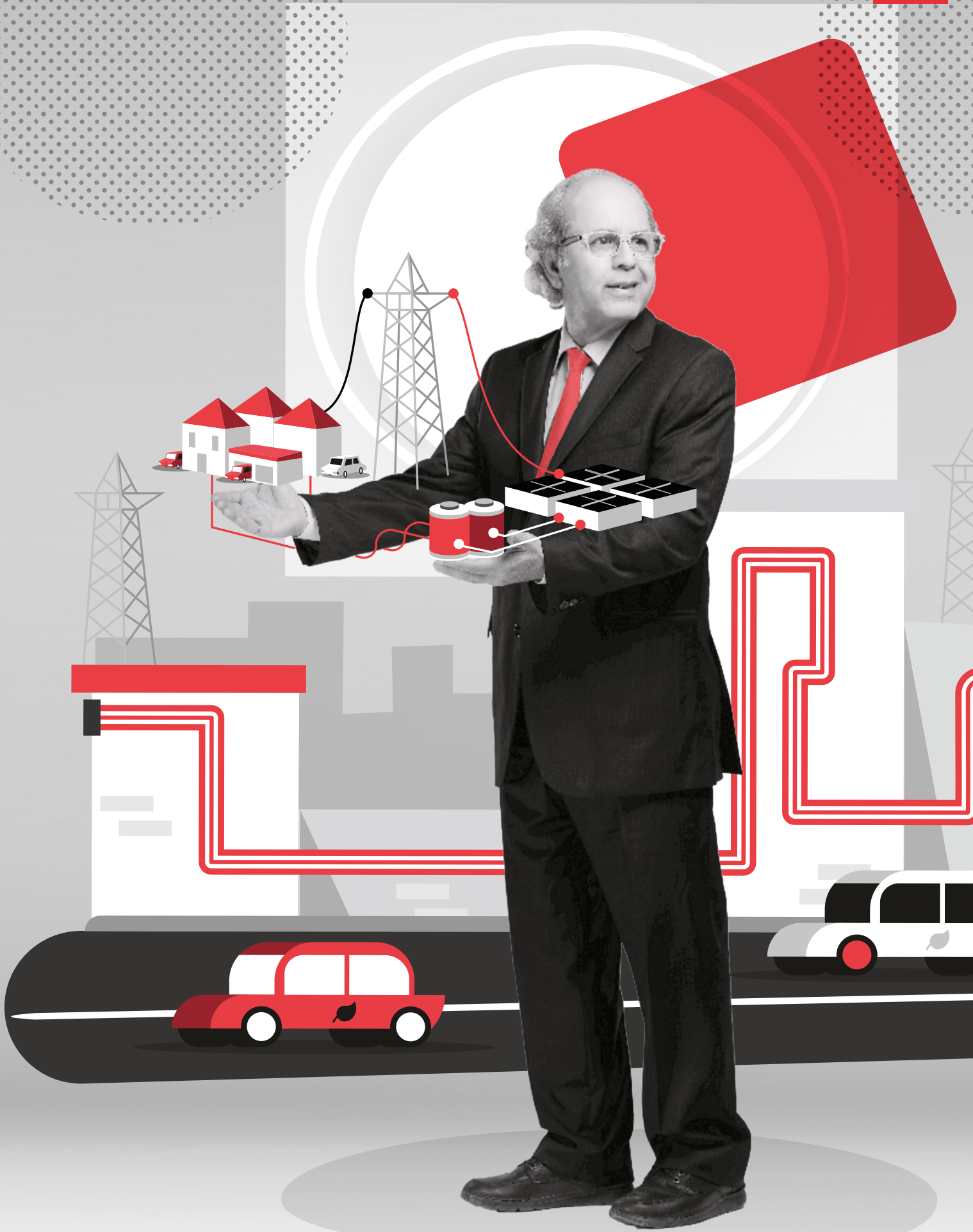
A pioneer in the field of power electronics and energy conversion systems, Dr. Al-Haddad is now among the world's finest researchers in this field. For over 30 years he has been interested in electronic power converters, electric power quality, harmonic currents and green energies.

“Artificial intelligence can be widely used to solve complex problems related to power electronics and its applications in a variety of fields, particularly renewable energy,” explains the professor. As he sees it, companies such as Hydro-Québec will need to radically transform themselves, including by providing residents with individual smart micro-grids. These would be centralized in places where people live, and electricity distribution would be managed by control systems based on artificial intelligence. Moreover, these networks would no longer have to be connected to cables several hundred kilometres long.

He goes on to say, “Each individual will be expected to manage their energy as if it were a portfolio. Electricity will be deregulated and will be billed according to consumption. Because transportation accounts for one third of overall energy expenditures, electrified transport using non-polluting resources is a hot topic around the world, on both collective and individual levels. Judicious electricity management will be part of a global effort, like recycling.”

An IEEE Fellow since 2007, Professor Al-Haddad is also a Fellow of the Academy of Sciences and a Fellow of the Royal Society of Canada (FRSC) – the highest honour in Canada bestowed on people working in the arts, social sciences or sciences. He has held the Canada Research Chair in Electrical Energy Conversion and Power Electronics at ÉTS since its inception in 2002 and he heads GRÉPCI, the Power Electronics and Industrial Control Research Group.





USING WAVES TO ANALYSE THE CONDITION OF A STRUCTURE

Pierre Bélanger

Professor in the Mechanical Engineering Department

Aging public infrastructures are a worldwide and increasingly critical problem. Our dams and bridges, for example, are reaching the end of their useful life. The cost of replacing them is so high that countries are seeking ways to extend their use over several decades. Ultrasonic nondestructive testing is one of the best ways to accomplish this. It involves using waves and a range of techniques to analyze the condition of a structure or a material without damaging it.

Pierre Bélanger has been a professor in the Mechanical Engineering Department at ÉTS since 2013. His research is focused on examining ultrasonic wave propagation and looking at ways in which these waves can be used in different industrial and biomedical applications. After earning a Ph.D. at the world-renowned Imperial College London in England, Dr. Bélanger worked as a simulator test and development engineer with the Vodafone McLaren Mercedes Formula 1 racing team before joining ÉTS, where he now combines his instrumentation expertise with his knowledge of the propagation of ultrasonic waves.

The Olympus Chair

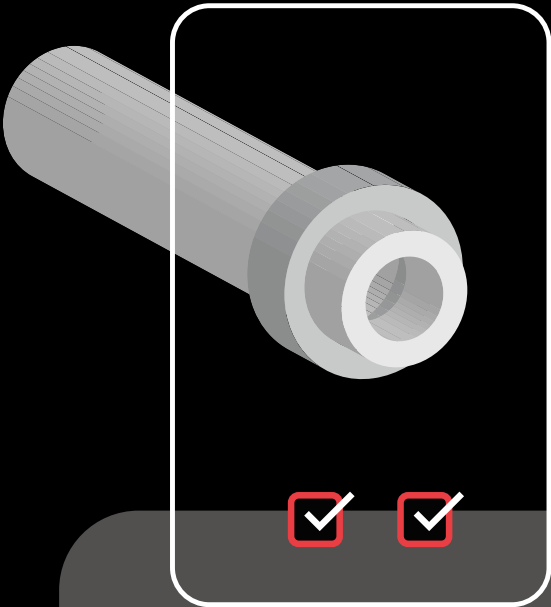
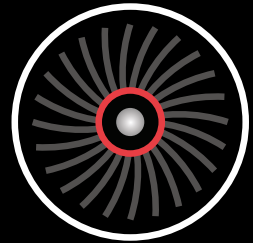
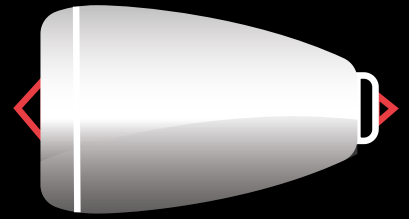
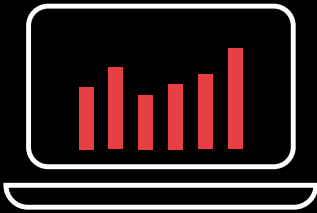
Pierre Bélanger's work attracted the attention of Olympus, a global technology leader in precision technologies. Their Industrial Solutions Division works to develop and manufacture very high-precision inspection tools. Dr. Bélanger began a collaboration with this Japanese company, which led to the launch of the Olympus Industrial Research Chair on Ultrasonic Nondestructive Testing, of which he is chairholder.

Technology transfer to other fields

Promising research is currently underway to adapt the method used by Pierre Bélanger to map corrosion in infrastructures to the biomedical field, including bone characterization. This technology transfer could be used to diagnose osteoporosis and assess the elasticity of the spinal cord in cases of spinal cord injuries.

Advantages of ultrasonic waves and artificial intelligence

A small environmental footprint and low cost make it very attractive to use ultrasonic waves. But this technology is complex and requires modelling and simulation. Luckily, Dr. Bélanger and his team have considerable expertise in this area. Through recent advances, they have been able to collect enough ultrasonic testing data to be able to use artificial intelligence, which improves data interpretation. Research in this field has a bright future.



IMPROVING PRODUCTIVITY IN THE CONSTRUCTION INDUSTRY THROUGH DIGITAL TECHNOLOGY

Conrad Boton

Professor in the Construction Engineering Department

Since the advent of digital technologies, the construction industry has faced significant changes on a global scale. Building Information Modeling (BIM), a digital modeling approach to building design, construction and operation, is now an inescapable reality.

Conrad Boton is a professor in the Construction Engineering Department at ÉTS and a BIM specialist. He joined Professor Daniel Forgues and his team in 2015, to be part of the Research Group in Integration and Sustainable Development in Built Environment (GRIDD). He comes to ÉTS with significant professional and research experience gained in various institutions, including as a researcher at the Luxembourg Institute of Science and Technology (LIST), at the Centre de Recherche en Architecture et Ingénierie (CRAI) at the École Nationale Supérieure d'Architecture de Nancy, in France, as well as in Egypt and Bénin.

Better collaboration through ICT

Dr. Boton is interested in the development of BIM-related technologies, aimed at improving collaboration and productivity in the construction industry through better integration of information and communication technologies (ICTs). He recently received support from ÉTS to set up the Research Laboratory on Information Technologies in Construction (LaRTIC), whose mission will be to develop technological tools more suited to real needs within the industry.

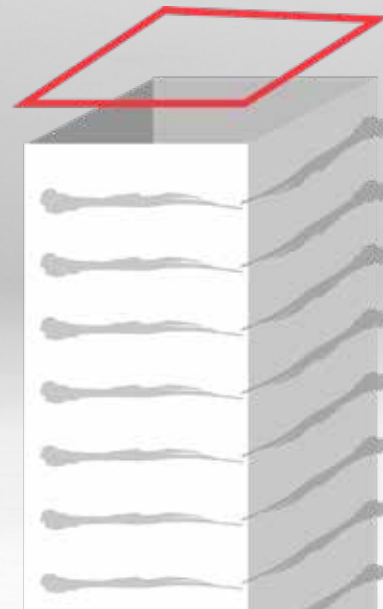
Professor Boton studies organizational and technological issues related to implementing the BIM approach and, more broadly, to new technological approaches that can be used in Québec architectural and engineering firms as well as in the province's construction companies. He adds a temporal dimension to BIM (4D) to simulate the construction process visually and in a collaborative way. His systemic approach aims to develop more appropriate models that would allow stakeholders not only to work better together, but also to develop a shared perspective.

International recognition

ÉTS's expertise in this area of engineering is recognized around the world. Among other things, Professor Boton was asked to join the advisory board for DigiPLACE, a major project funded by the European Union and bringing together key players in Europe's construction industry.

Sharing, a fundamental value

Dr. Boton believes sharing knowledge is an important part of his work aimed at bringing the construction industry into the 4th Industrial Revolution. After moving to Québec a few years ago, he devotes a significant amount of his time to international cooperation. As a result, he jumps at the chance to spend several weeks a year as a volunteer expert on assignments in developing countries.







INCORPORATING RENEWABLE ENERGY INTO THE HYDROELECTRIC POWER GRID

Amrish Chandra

Professor in the Electrical Engineering Department at ÉTS

Amrish Chandra is a professor in the Electrical Engineering Department who has been interested in the quality of electrical energy for over 25 years. Electric power networks constantly experience different types of disturbances, including harmonic currents generated by nonlinear loads. Mitigating them is critically important to sustain power quality.

Renewable energy, including wind power and solar photovoltaic energy, also cause disturbances to the electric power grid. For example, winds are unpredictable so the energy they produce is uneven. We need to take these risks into account as we integrate renewable energy sources into the hydroelectric grid.

Power grid pollution generally occurs because of converters which are used to supply power to non-linear loads, when alternating currents are transformed into direct currents. Dr. Chandra has developed many mitigation techniques to improve the quality of electrical energy. His focus is on improving existing technologies and he is particularly interested in both the production and integration of renewable energy into existing systems, as well as the conversion and optimization of converters.

Amrish Chandra completely endorses the United Nations framework of action aimed at speeding up transition to a sustainable society, adopted by Canada. Fundamentally, his research aims are the same as the sustainable development goals outlined in this framework.

The excellence and innovation of Dr. Chandra's research are unanimously recognized around the world. He has contributed to the development of new theory and control algorithms related to the integration of renewable energy sources into electric distribution systems. Improving power quality in distribution systems has also been a focus of his research.

The numerous awards and distinctions Dr. Chandra has received speak to the huge impact of his work. These include the Phoivos Ziogas Electric Power Award from the Institute of Electrical and Electronics Engineers Canada (IEEE Canada). He has also been named a Fellow of the IEEE and a member of the Distinguished Lecturers program for the Power and Energy Society, as well as the Industry Application Society of the IEEE. He is also a Fellow of the Engineering Institute of Canada and a Fellow of the Canadian Academy of Engineering.





USING ICTS TO HELP ACHIEVE SUSTAINABLE DEVELOPMENT TARGETS

Mohamed Cheriet

Professor in the Systems Engineering Department

In 2015, the UN General Assembly adopted a framework for action to accelerate the transition to a globally sustainable society, entitled Transforming Our World: The 2030 Agenda for Sustainable Development. Canada is committed to implementing the 17 UN Sustainable Development Goals (SDGs), which include 169 targets. Of these, 103 involve information and communications technologies (ICTs).

“The implementation of the UN agenda requires not only that ICTs be “greened and sustainable” but also that we make society greener and sustainable through ICTs,” says Mohamed Cheriet, a professor in the Systems Engineering Department at ÉTS and Director of the Synchromedia Laboratory for multimedia communication in telepresence. Dr. Cheriet is also Canada Research Chair holder in Smart Sustainable Eco-Cloud, which is dedicated to developing knowledge acquisition and artificial intelligence for sustainability built on a smart, sustainable eco-cloud.

A standard for measuring the ICT footprint

No matter which hat he wears, Dr. Cheriet has always sought to reduce the GHGs emitted by ICTs. He recently led a working group as part of IEEE’s Sustainable ICT initiative, which introduced a new standard to measure ICT infrastructure emissions in real time – an important step towards making ICTs more sustainable.

The strength of cross-disciplinary research: CIRODD

Professor Cheriet is also the General Director of the Centre interdisciplinaire de recherche en opérationnalisation du développement durable (CIRODD – Centre for interdisciplinary research into the operationalization of sustainable development), an FRQNT strategic research cluster located at ÉTS since spring 2019. Now in its second mandate, this centre brings together close to 100 leading researchers from 13 universities and five CEGEPs and colleges working in a broad range of research fields whose aim is to implement sustainable innovation practices using a transdisciplinary approach.

Inducted as a Fellow into the Canadian Academy of Engineering, the Engineering Institute of Canada and the International Association for Pattern Recognition, Dr. Cheriet has received the Queen Elizabeth II Diamond Jubilee Medal and many IEEE awards. These honours are a testament to the importance of this eminent researcher’s work for society. Mohamed Cheriet has a single goal: the well-being and transformation of society.

KNEE KINESIOGRAPHY: SPECTACULAR PROGRESS FOR TREATING KNEE OSTEOARTHRITIS

Nicola Hagemeister

Professor in the Systems Engineering Department

Although there is still no cure for knee osteoarthritis, there is now a way to dramatically improve the quality of life for hundreds of thousands of Canadians living with this condition.

Many years of work at the ÉTS Imaging and Orthopædics Research Laboratory (LIO) have resulted in the development of a diagnostic tool called knee kinesiography, which objectively assesses full movement of the knee during gait. A recent study of 449 patients confirmed researchers' hypotheses that this tool would be useful in treating patients suffering from knee osteoarthritis. The study showed that this breakthrough technology reduced patients' knee pain as well as their symptoms and made daily activities easier.

Nicola Hagemeister, professor in the Systems Engineering Department at ÉTS and researcher at the CHUM Research Centre (CRCHUM), has long been interested in the biomechanics and functional analysis of the knee. As co-inventor of this tool – marketed under the name KneeKG by a Québec company called EMOVI – she headed the clinical study.

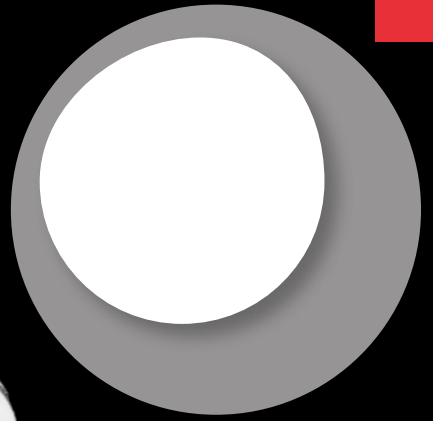
The knee is one of the body's most complex joints. While x-rays and magnetic resonance can be used to verify structural integrity, sometimes the pain people feel is not linked to how damaged the joint is. So the patient may be experiencing acute pain or have very limited movement, but imaging may not provide enough information. The opposite may also be true.

“The knee kinesiography exam is performed using a harness equipped with sensors and positioned on certain strategic areas of the leg where the skin doesn't move very much. As the patient walks on a treadmill, we can more accurately measure small rotations of the knee which are invisible to the naked eye,” explains Professor Hagemeister. The recorded image isn't static so tiny movements involved in rotations of the knee can be seen, which helps to determine more precisely what is happening when the knee is in motion.

Knee kinesiography enables doctors to understand what is causing the patient's pain and to recommend an individualized exercise program aimed at correcting biomechanical deficiencies.

The study led by Dr. Hagemeister found that patients who did the exercises prescribed by their doctor regularly had less pain and improved movement in their knee.







REDUCING POLLUTANT EMISSIONS THROUGH FUELS AND TECHNOLOGY

Patrice Seers

Professor in the Mechanical Engineering Department

Patrice Seers, research professor in the Mechanical Engineering Department at ÉTS, has always been fascinated with combustion. His areas of research include energy in ground transportation and the aerospace industry.

His work focuses on phenomena linked to combustion, mainly internal combustion engines and porous burners, but his expertise extends far beyond that and includes such topics as direct-injection engines, liquid and gas alternative fuels (alcohol, biodiesel and biogas), numerical simulation of reacting flow, pollutant emissions, fuel spray, etc.

Internal combustion engines and porous burners

The way in which biofuels react in internal combustion engines and the study of new molecules with strong potential are at the heart of Dr. Seers' research interests. In fact, part of his research, done in collaboration with colleagues working in the materials field, is focused on porous burners. Using a sophisticated manufacturing technique, they have come up with a new design for burners, which would substantially reduce pollutant emissions – a promising avenue for further research.

His work has led him to develop innovative engine technologies, in particular a new approach to exhaust gas recirculation (EGR) using stratification, which should improve engine performance. An invention disclosure has been submitted for this technology. Using experiments and simulations, Professor Seers also studies complex phenomena linked to the formation of the fuel-air mixture and the combustion process in direct-injection spark ignition (DISI) engines. By identifying the physical properties of the injected fuel, it is possible to recommend injection strategies that have the potential to increase engine performance.

In this era when we are seeking ways to diversify energy sources, biofuels will undoubtedly play an important role. So Dr. Seers is working hard to better understand the influence of the properties of biofuels so we can adapt existing internal combustion engines and determine which biofuels have the desired properties. He underscores the importance of choosing plants that are not food sources – one of his ongoing concerns.

Training future researchers

Patience and an impeccable research methodology are key for any scientist who wishes to truly understand how things work. This is Patrice Seers' approach as he seeks to reduce the potential impacts of engines on the environment and to assess a range of potential fuels in order to find an alternative to conventional ones.





SECURING DATA THROUGH BLOCKCHAIN TECHNOLOGY

Kaiwen Zhang

Research professor in the Software and Information Technology Engineering Department at ÉTS

Human beings have always needed to store data in protected places. Blockchain technology – a specialized method of sharing and validating data – is revolutionizing an ancient model, the fortress resistant to invasion. It enables secure communication and authentication of data stored in blocks. As Kaiwen Zhang explains, “Ultimately, it’s essentially the same approach, a variation on the concept of the safe.”

Professor Zhang, who joined ÉTS almost three years ago as a research professor in the Software and IT Engineering Department, is a specialist in what is known as “distributed ledgers”. A ledger is said to be “distributed” (as opposed to a centralized ledger) when it is simultaneously recorded and synchronized on a network of computers managed by different stakeholders. This network evolves by adding new information, previously validated by the entire network, that will never be modified or deleted.

The blockchain forms the technological underpinning for distributed ledgers. It represents a revolution in terms of information storage, but also in terms of data security. It is virtually impossible to rebuild the chain for malicious purposes by hacking and tampering with information from existing blocks. Because the chain is completely transparent, all its users know how it works, as well as its limits.

Dr. Zhang is involved in several research projects led by the FUSEEE research group, which he founded at ÉTS. These include a project with Héma-Québec on traceability and compliance of blood products, a project with Bitfarms on modeling the Internet of Things and another with Ericsson on consenting to data collection for machine learning.

Now that data theft is a global scourge and protecting personal information has become a major international concern, especially with the imminent arrival of 5G connectivity – which will increase the data in circulation tenfold – and on the eve of the artificial intelligence revolution, blockchain technology is becoming a must.

MAJOR RESEARCH EVENTS

JUNE 2019

CIRODD – Centre for interdisciplinary research into the operationalization of sustainable development

ÉTS became the managing institution for CIRODD in June. This strategic cluster's mission is to contribute to accelerating the smart and sustainable transition of Québec society through the implementation of innovative sustainability mechanisms using an interdisciplinary approach. Toward this end, it plans to adopt collaborative approaches, tools and methods that will take full advantage of technological advances while also considering the needs, objectives and aspirations of stakeholders on the ground.

FEBRUARY 2019

Olympus Industrial Chair on Ultrasonics Nondestructive Testing

Professor Pierre Bélanger's chair has applications in many sectors, ranging from the marine and oil industries, to the nuclear, aeronautical and aerospace sectors, as well as countless others. Nondestructive testing involves using a range of techniques to analyze the condition of a structure or a material without damaging it. It can be used to determine whether a ship's hull, a pipeline, a storage tank, an airplane wing or an engine block are in good condition without having to disassemble them.

JUNE 2019

Frederick Jelinek Summer School

Only two non-American universities have ever had the honour of hosting the Frederick Jelinek Summer School, which is headed by Johns Hopkins University: Charles University in Prague and now École de technologie supérieure (ÉTS) in Montréal. The sixth edition of this annual event began mid-June and ended on August 2, 2019.

AUGUST 2019

Summer School Industry 4.0

The Innovation 4.0 Network's first event was held from August 26-28 at ÉTS. It was attended by over 100 people, including students, professionals and academics.

OCTOBER 2019

Unveiling of results of a wide-ranging clinical study

A team of scientists, headed by Nicola Hagemester, professor in the Systems Engineering Department at ÉTS and Researcher at CHUM, showed the relevance of having general practitioners incorporate knee kinesiography into their practice, especially when assessing biomechanical risk factors linked to the progression of osteoarthritis.

SEPTEMBER 2019

Robotiq Industrial Research Chair in Interactive Robotics

The labour shortage is adversely affecting many SMEs, especially those located outside of metropolitan regions. What if one solution to this problem lies in developing collaborative robots that are simple to program, easy to deploy and capable of accomplishing the majority of repetitive tasks required by SMEs? That is the question facing Vincent Duchaine, a Systems Engineering Professor and holder of the new Industrial Research Chair in Collaborative Robotics.

DECEMBER 2019

Safran Industrial Research Chair on the Development of Sustainable Aero-Propulsion Systems

World air traffic, which is growing by 4 to 5% each year, produces more than 2% of all human activity-related greenhouse gases. François Garnier, a research professor at the École de technologie supérieure (ÉTS), hopes to help resolve part of this problem by reducing fine and ultrafine particle emissions from aircraft engines at their source.

DECEMBER 2019

Orthogone Industrial Research Chair in Artificial Vision through Deep Learning

The rapid growth of autonomous transportation, industrial robotics and medical imaging is largely due to the ability of algorithms to interpret images. Although spectacular advances have been made in the fields of computer vision and machine learning, many technical challenges still need to be overcome before computer vision reaches its full potential. École de technologie supérieure (ÉTS) researcher professor Ismail Ben Ayed and Orthogone Technologies will meet these challenges using deep learning.

ÉTS
RESEARCH
CHAIRS AND
UNITS

Canada Research Chairs

Canada Research Chair in Electrical Energy Conversion and in Power Electronics
 Canada Research Chair in Engineering Innovations in Spinal Trauma
 Canada Research Chair on 3D Imaging and Biomedical Engineering
 Canada Research Chair for Aircraft Modeling and Simulation Technologies
 Canada Research Chair in Smart Sustainable Eco-Cloud
 Canada Research Chair in Printable Hybrid Optoelectronic Materials and Devices
 Canada Research Chair in Shape Analysis in Medical Imaging
 Canada Research Chair: Towards a Novel and Intelligent Framework for the Next Generations of IoT Networks

NSERC Chairs

NSERC-EERS Industrial Research Chair in In-Ear Technologies
 NSERC-Ultra Electronics Chair on Wireless Emergency and Tactical Communications

Industrial Chairs

Industrial Research Chair on the Integration of Digital Technologies in Construction
 ArianeGroup Research Chair on Emerging Materials in the Aeronautics and Space Sector
 Dr. Richard J. Marceau Chair on Wireless IP Technology for Developing Countries
 Siemens Research Chair on Industry 4.0 Technology Integration
 Olympus Industrial Chair on Ultrasonic Nondestructive Testing
 P&WC-ÉTS Industrial Chair on Propulsion System Integration and Optimization
 Finkl Steel Industrial Research Chair in Forming Technologies of High-Strength Alloys
 Robotiq Industrial Research Chair in Interactive Robotics
 Safran Industrial Research Chair on the Development of Sustainable Aero-Propulsion Systems
 Orthogone Industrial Research Chair in Artificial Vision through Deep Learning

Philanthropic Chair

Marie-Lou and Yves Cotrel Research Chair in Orthopædics at Université de Montréal and ÉTS

Strategic Cluster

Centre for interdisciplinary research into the operationalization of sustainable development

Certified Research Units

Power Electronics and Industrial Control Research Group – GREPCI
 Computer System Architecture Research Laboratory – LASI
 Hydrology, Climate and Climate Change Laboratory – H3C
 Polymer and Composite Engineering Laboratory – LIPEC
 Imaging, Vision and Artificial Intelligence Laboratory – LIVIA
 Products, Processes and Systems Engineering Laboratory – LIPPS
 Communications and Microelectronic Integration Laboratory – LACIME
 Laboratory for multimedia communication in telepresence – SYNCHROMEDIA
 Imaging and Orthopædics Research Laboratory – LIO
 Research Laboratory in Machine, Process and Structural Dynamics – DYNAMO



Recognized Research Units (18)

Research Team specialized in Development and Research on Structures and Rehabilitation – DRSR
 Research Team Specialized in Occupational Safety and Industrial Risk Analysis (EREST)
 Groupe de recherche en acoustique à Montréal – GRAM
 Research Group in Integration and Sustainable Development in Built Environment – GRIDD
 Multimedia Research Laboratory – LABMULTIMEDIA
 Interventional Imaging Laboratory – LIVE
 Control and Robotics Laboratory – CoRo
 Geotechnical and Geoenvironmental Engineering Laboratory – LG2
 Cognitive and Semantic Interpretation Engineering Laboratory – LINCS
 Aeronautical Research Laboratory in Active Control, Avionics and Aeroservoelasticity – LARCASE
 Organizational Engineering Research Laboratory for the Digital Enterprise – NUMÉRIX
 Thermo-Fluids for Transport Laboratory – TFT
 Biomedical Information Processing Laboratory – LATIS
 Laboratory of Space Technologies, Embedded Systems, Navigation and Avionic – LASSENA
 Engineering for Sustainable Development Laboratory – LIDD
 Optimization of Aerospace Manufacturing Processes Laboratory – LOPFA
 Shape Memory Alloys and Intelligent Systems Laboratory – LAMSI
 Pavements and Bituminous Material Laboratory – LCMB

École de technologie supérieure (ÉTS), a part of the Université du Québec network, educates professional engineers and researchers who are recognized for their practical and innovative approaches. Ranked among the five largest engineering schools and faculties in Canada, ÉTS is home to approximately 50 research chairs, centres and laboratories, with which numerous professors and graduate students are associated. This synergy of expertise and excellence contributes to scientific progress, increased industrial productivity and quality, and the training of a highly qualified workforce.

For more information on the research chairs, laboratories and groups at ÉTS, please consult the Research and Innovation section of the ÉTS website at www.etsmtl.ca



École de technologie supérieure
1100, Notre-Dame Street West
Montréal QC H3C 1K3

Office of the Dean of Research: 514 396-8829
Information and registration for graduate studies: 514 396-8888
