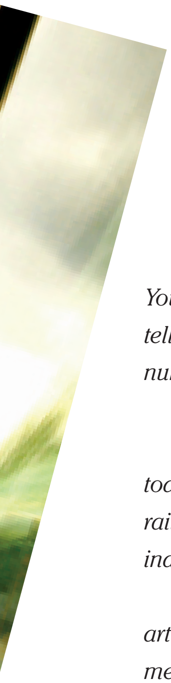
DESTINATION TOMORROW

TRANSPORTATION RESEARCH IN ONTARIO

ANNUAL
REPORT
2007–2008

Ontario
Innovation
Trust

You roll up the garage door, and there it is.
The new ride.



You hung onto that hybrid for a decade—and truth to tell, it was a great car. But compared to this sleek little number, it was just so…2008.

Time to start breaking it in.

Normally, you jack into the office from home. But today you're meeting at a client's. You could take the light rail downtown—but this is the perfect opportunity to inaugurate your new wheels.

Your eyes linger on the fine folds in the bodywork—art deco's big right now. Amazing what they can do with metal. *

Inside, you run your hand over the dash. Nice texture. Who'd believe it's mostly hemp? Good, um, alternative use. *

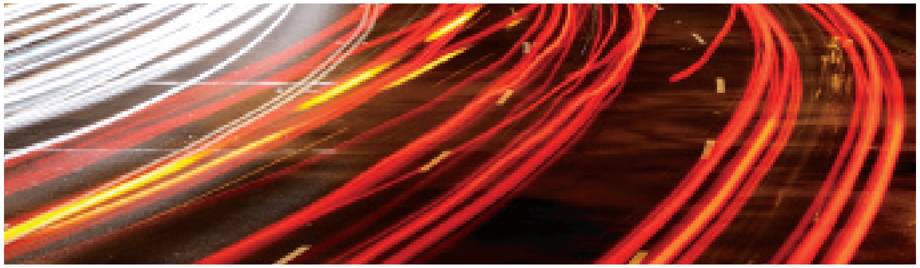
A punch code turns the status light green and with a whir, you slide out onto the street. You seriously considered one of those sweet little bio-diesels—lots of zip and amazingly clean. * But the new fuel cell cars are just so…with it. * And hydrogen pumps are popping up at service stations all over.

There's been a fender-bender at the corner. Pretty rare these days, with the new windshield displays and collision avoidance systems *—but hey, stuff happens. Anyway, it doesn't look like there's much damage. Those new composite plastics are not only lighter but stronger. *

The light at the on-ramp is red, but after a short wait, you're whizzing along the freeway. Rush hour ain't what it used to be... * The on-board guidance system takes you to the right exit, then coaches you turn by turn to your destination. Remember how your old GPS unit used to cut out in these high-rise canyons? Not any more! *

The thought of your previous car triggers a twinge of guilt. Well, at least the ol' hybrid won't end up as a toxic, rusting wreck. And who knows? Some part of it might even make its way into your next ride. * Call it…car-ma.

You park it, lock it and walk away. Time to get to work—and to look forward to the drive home.



* Look for the coloured asterisks on the following pages for the research that will help make it happen.

DRIVE TO INNOVATE TO DRIVE

Is that what a commute in 2018 will really be like? Who knows. Predicting tomorrow's technology is a very uncertain business. Just ask any long-time reader of *Mechanics Illustrated* or *Popular Science*.

But whatever the morning drive will bring a decade from now, some aspects of the trip will very likely be influenced by the many Ontario scientists and engineers working in automotive research.

From parts made of hemp and wood pulp to traffic lights that learn, here's a look at how researchers across the province are driving innovation in driving. And how the Ontario Innovation Trust is paving the way.

* *

It can happen so fast. You sneak a second look at that fetching model on the billboard. You check that incoming number on your cell. You squint at the GPS for that next turn. You…

And bam. It's over. All that's left to say is: "Honestly officer, I just didn't see it!"

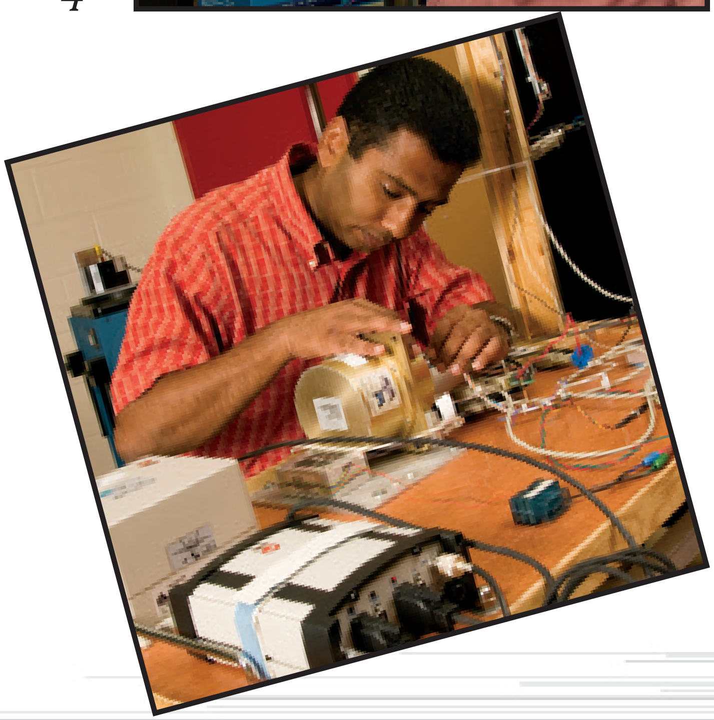
Lana Trick knows better than most how distraction can lead to car accidents. But it's not because she's a bad driver. Dr. Trick is a psychologist at the University of Guelph, and she's exploring ways to reduce the risk of collision by improving the driving environment inside tomorrow's cars.

Using a sophisticated simulator built around the body of a Saturn sedan, Dr. Trick and her colleagues can duplicate a wide range of distracting conditions both inside and outside the car. And what she's learning could very well shape the way you interact with your next ride.

Her findings challenge, for example, the commonly accepted design rule that any secondary task in a car—tuning the radio, checking the GPS—should take no longer than a total of 15 seconds. "We found that while time-on-task predicted some aspects of collision risk, it

THE DRIVE FACILITY (DRIVING RESEARCH IN VIRTUAL ENVIRONMENTS) IS A COLLABORATIVE EFFORT. LANA TRICK (SECOND FROM LEFT) CO-DIRECTS THE LAB WITH DR. BLAIR NONNECKE (LEFT) FROM THE UNIVERSITY OF GUELPH'S COMPUTING AND INFORMATION SCIENCE DEPARTMENT.

ABOELMAGD NOURELDIN



didn't predict others like hazard response. This highlights the need for those involved in the design of controls to use several criteria rather than relying only on the 15-second rule."

Looking ahead to new collision-avoidance technologies, Dr. Trick and her team are also experimenting with warning systems—auditory and visual—for alerting drivers to upcoming obstacles. In true Canadian fashion, the researchers have dubbed the project the "moose detector."

Infrastructure support from the Ontario Innovation Trust has been crucial to Dr. Trick's research. "There's no way I could investigate any of these things without a driving simulator. For one thing," she adds wryly, "it's tricky to get a moose to volunteer. And it's very hard on the drivers—and the moose—when an experiment doesn't work out."

✻

Thanks to scientists like Dr. Trick, your next car is going to be better at helping you avoid things. But it's also going to be better at helping you find them.

These days, many road warriors depend on global positioning system—GPS—technology for directions. But this automotive Achilles has an exposed heel. Urban obstacles like bridges and tall buildings can scramble the satellite signals the system depends on, or block them out altogether. And that outage can mean you end up a long way from your intended destination.

Dr. Aboelmagd Noureldin wants to put electronic navigation back on track in the city. He and his team at Royal Military College are working on a system that

PRECISION TOOLS LIKE THIS ROTATING TEST PLATFORM LET THE RMC TEAM CALIBRATE THEIR TEST SYSTEMS.

combines GPS satellite data with information from an "inertial navigation system"—a package of tiny instruments that can sense every change in a vehicle's direction and speed. The instruments are similar to the devices that track movement in some console game systems and high-end cell phones.

The RMC approach combines the strengths of both technologies. When a car is receiving GPS data, Dr. Noureldin's hybrid system uses artificial intelligence routines to compare satellite information with what the inertial devices are saying. By continually noting any discrepancies, the system "learns" how much the inertial system is tending to drift. Whenever the GPS signal is lost, the system applies that knowledge to correct the drift until the satellite connection is restored.

Just how practical is it? "We should have a finished prototype in a year," says Dr. Noureldin. And a major car maker is already calling.

✻

All the good directions in the world, however, won't be much use if your state-of-the-art ride is stuck in traffic. And Baher Abdulhai is in a position to know just how bad things can get out there.

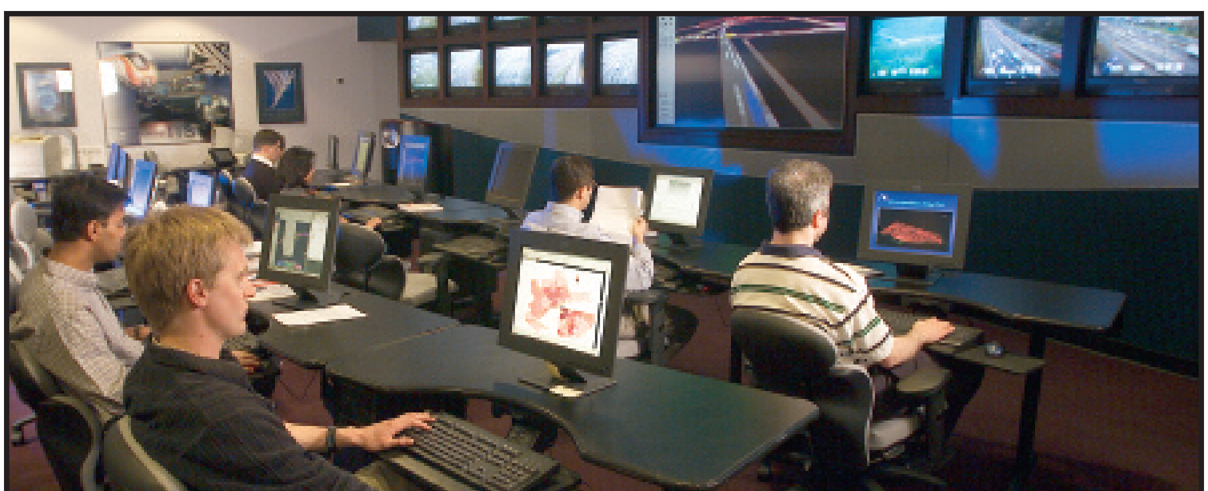
As Director of the Intelligent Transportation Systems Centre at the University of Toronto, Dr. Abdulhai has a ringside seat on Toronto's traffic circus. One entire wall of the Centre is covered with a bank of 20 video monitors displaying the view from hundreds of cameras along the city's dense web of roads and freeways. Other screens provide additional data from sensors buried in the pavement. All too often, that torrent of images and information paints a painful picture of congestion.

Perhaps surprisingly, Dr. Abdulhai maintains that there's plenty of capacity on Toronto's roads, even at rush hour. "The problem," he says, "is control." And some of the solutions to that problem may emerge from the futuristic traffic management systems he and his colleagues are exploring.

Theoretically, urban traffic could be managed by a centralized system of traffic lights and electronic message boards at intersections, freeway on-ramps, and key decision points. The lights could be operated to space out cars where there's congestion, and the signs could collaborate with the lights to guide drivers around accidents and construction. But co-ordinating such a system from a central point would take computing resources that simply aren't available today. And more importantly, big, centralized systems are vulnerable to big breakdowns.

Dr. Abdulhai is working on a startling alternative: autonomous traffic lights that learn. "Think of it as having a robocop standing at the intersection," he suggests, "getting more and more experience with what's happening, sensing the conditions and deciding what to do in order to optimize the flow through that intersection." A smart light would receive data about local traffic, and would be able to communicate with the lights around it, collaborating


BAHIR ABDULHAI



TRUST FUNDED EQUIPMENT AT QUEEN'S LETS RESEARCHERS CREATE AND TEST NEW HYBRIDS OF PLASTIC AND CLAY.

with them and with nearby message boards to smooth out the flow of vehicles. "If it does something and makes traffic conditions worse, then it's not going to repeat that. But if it improves conditions, then the action is stored as a 'good thing' and chances are it will be repeated again."

Dr. Abdulhai and his team are testing the idea with immense computer simulations that duplicate traffic patterns throughout Toronto—and they hope to begin real-world testing on the Gardiner Expressway in three or four years.

For commuters stuck in traffic, the new robocop can't arrive too soon.

* *

It's been 41 years since a friend gave Benjamin Braddock his famous one-word heads-up in *The Graduate*. Back in 1967, plastics were indeed the future—especially for cars. But today, Ben's would-be mentor might add a second word: clay.

"Imagine clay as a pack of cards," explains Queen's University materials scientist Dr. Marianna Kontopoulou. "The layers are very, very thin—a nanometre in thickness—but they have a large surface area." If those thin sheets could be dispersed evenly throughout a plastic part—a fender, say—they would add incredible strength, in much the same way that thin sheets of plywood and drywall brace and strengthen the framework of a house.

But you don't construct a house by mixing all the building materials in a vat: it has to be assembled—and it's the same with plastic/clay "nano-composites." To accomplish their magic, the sheets of clay need to be separated and evenly dispersed among the chains of molecules that make up a plastic. There's no simple way of doing this—and that's why the idea was only a gleam in the eye of a few scientists back in the days of *The Graduate*.

Now, however, researchers like Dr. Kontopoulou can "build" these materials by using chemical modification techniques to control the way substances like clay and plastic interact when the two are mixed.

The implications are huge for the automotive industry. Plastic/clay nano-composites use less plastic—a good thing in a world of rising petroleum prices—and are both stronger and lighter. They can also be engineered to have other key qualities like increased fire resistance and flexibility.

Some car manufacturers are already using the new materials in some limited applications. But Dr.

MARIANNA KONTOPOULOU

Kontopoulou is pushing the outside of the envelope even further. Using specialized devices funded in part by the Ontario Innovation Trust, she's experimenting with new ways to combine clay and polymer to achieve different properties. And recently, she's been experimenting with an alternate partner for plastics: silica. The three-dimensional spherical shape of silica molecules—as opposed to the sheet structure of clay—promises a new generation of even stronger materials.

Think fewer trips to the body shop.

*

If using clay to build car components seems counterintuitive, the idea of using wood seems…well, quaint. But to Dr. Mohini Sain, it's anything but.

Dr. Sain's research focuses on "bioplastics"—materials that share key characteristics with petroleum-based plastics, but are made from plant fibre sources like corn and soy bean.

To which list Dr. Sain would add hemp—and even more surprisingly, wood pulp. The University of Toronto scientist got his start working as an engineer in the polymer processing industry, and he's spent years exploring pulp as a replacement for plastic. Right now, he's experimenting with a process that uses heat, pressure and chemicals to produce a nano-composite evenly suffused with microfibres of cellulose. The fibres give the new material both the strength of steel and the resilience of plastic. The potential result: interior panels made of hemp and bumpers made of wood pulp. Who knew?

Performance characteristics like strength are important, but in these days of climate change, a new material is only good if it's also green. How much oil do we use to make it? How much greenhouse gas do we produce? How easily can it be recycled? An important priority of Dr. Sain's research is environmental sustainability—and bioplastics come out ahead on every score.

But there are even broader considerations, especially when you start making plastics from food crops like corn and soy. "We have to come up with an industrial crop that will enable us to make these materials independent of the food chain," says Sain.

And nobody nibbles on wood pulp.

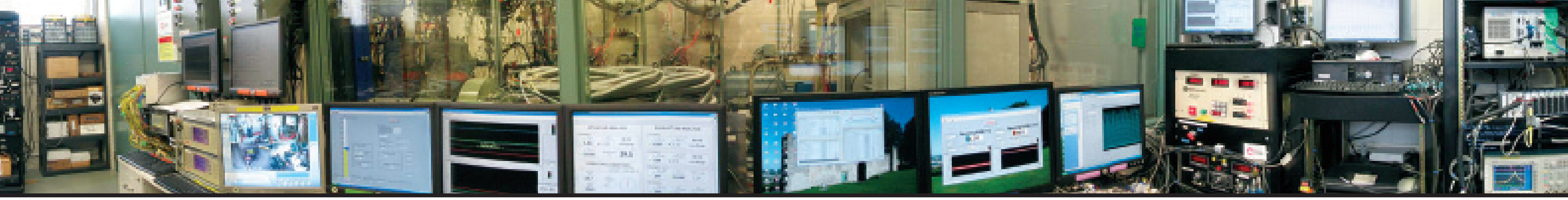
*

If visions of veggie-cars are dancing in your head, here's a reality-check. Metal is still alive and well as an automotive material.

That's because it holds a very big ace card: metal is much easier to recycle using current technology, reducing its long-term environmental impact. On the

UNIVERSITY OF TORONTO RESEARCHERS ARE EXPERIMENTING WITH "BIO-PLASTIC" CAR PARTS CREATED WITH CELLULOSE INSTEAD OF PETROLEUM.

MOHINI SAIN



A HIGH-TECH DIESEL LAB AT THE UNIVERSITY OF WINDSOR.

MUKESH JAIN

down-side, however, it tends to be heavier than the new nano-composites.

To stay competitive, steel makers are experimenting with new, lighter alloys. And the manufacturers of aluminum—anxious to build on their weight advantage over steel—are looking at new ways to cast their product in large thin sheets more amenable to stamping body parts, rather than the traditional slabs and ingots.

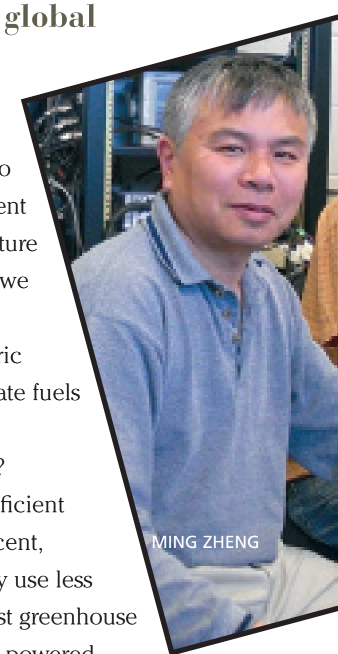
The new forms of steel and aluminum, however, don't always play nice with existing means of shaping sheet metal for car bodies. Techniques developed for older, thicker materials can result in cracking and uneven forming.

Dr. Mukesh Jain, of McMaster University, wants to, well…smooth out the transition. Dr. Jain is experimenting with new ways to bend and twist metal in the sinuous shapes of today's—and tomorrow's—automobiles.

He and his colleagues start by developing and working with computer models that simulate the behaviour of metals under the immense pressures of an industrial press. But as that famous researcher Yogi Berra (supposedly) once said: In theory, theory and practice are the same. In practice they aren't. That's why the Ontario Innovation Trust helped to fund a full-size, functional metal press—just like the ones used by major car makers—to let Dr. Jain test his computer models.

The results are literally helping to shape the future of the automobile.

The quest for new materials is being driven by two forces: rising oil costs and rising degrees on the global thermometer. And those same pressures are also fueling the pursuit of greener…, well, fuels.



MING ZHENG

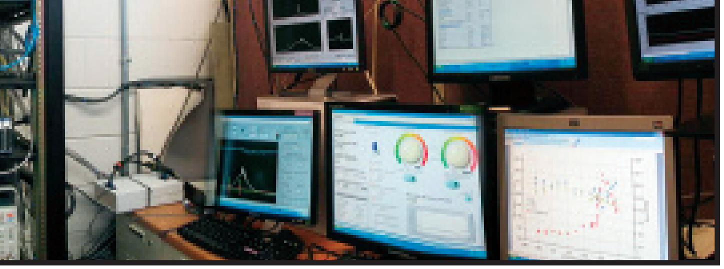
Not that gas pumps are going to disappear any time soon. Our investment in oil-based technology and infrastructure is too big to let us go cold turkey. But we can make a start on reducing our petro-addiction with hybrid gas/electric cars, bio-fuels like ethanol and alternate fuels like diesel.

Wait a minute. Diesel? Greener?

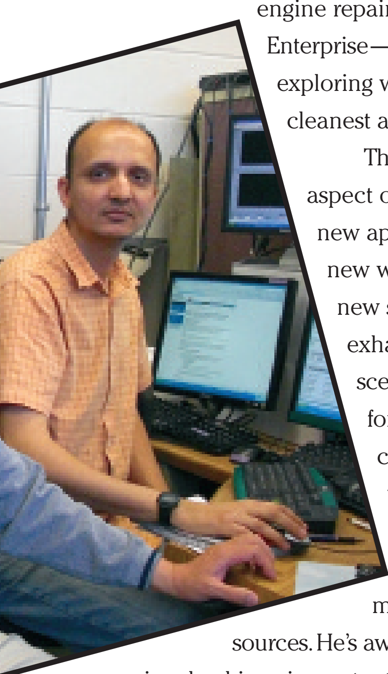
Yes. Diesel engines are more efficient than gas engines—from 30 to 70 percent, depending on who you talk to, so they use less petroleum. And their emissions of most greenhouse gases are about one-tenth of their gas-powered cousins, before exhaust treatment.

But there's the rub. Catalytic converters do a good job cleaning up emissions from gas engines, but there's no comparably efficient technology for diesel. And while new filters have eliminated the black smoke, diesels still emit significant amounts of nitric oxide—a big contributor to smog.

Dr. Ming Zheng, at the University of Windsor, wants to change that. Working in the Clean Diesel Engine



Laboratory—a state-of-the-art facility that crosses an engine repair shop with the bridge of the Enterprise—Dr. Zheng and his colleagues are exploring ways to make diesel one of the cleanest and most efficient fuels going.



The team is re-thinking every aspect of diesel operation, working out new approaches to mixing fuel and air, new ways to control combustion, and new systems for treating diesel exhaust using novel substances. One scenario: a stop at the service station for tomorrow's diesels may mean checking the ammonia as well as the washer fluid.

Dr. Zheng is also working on biodiesel—formulations made entirely from renewable sources. He's aware of the complex issues involved in using potential food crops for fuels, but like many researchers, he believes in our seemingly limitless ability to innovate. "Humans are very smart," he says. "It's unpredictable what they can do."

Sooner or later, however, petroleum will be passé. And one of the reasons may be the hydrogen fuel cell.

The fuel cell car is the darling of many environmentalists because of its almost magically green promise: cars that produce only water vapour as exhaust. But there are obstacles. How do we generate the massive

SHORTENING A SEASON: CONCRETE STEPS TO IMPROVE INFRASTRUCTURE

There are really just two seasons in Canada: winter and construction. But bridge-building techniques proposed by Amir Fam may shorten one of them.

Dr. Fam, a Canada Research Chair in civil engineering at Queen's University, is looking for solutions to a fundamental problem that plagues steel-reinforced concrete bridges. When the concrete cracks—and it always does—water can get to the steel inside and rust it. And since rusted steel actually occupies more volume, the resulting force kicks the concrete apart from the inside. This causes more cracks, which… well, you get the idea. Most concrete bridges have to be "re-jacketed" every five to ten years—the concrete jackhammered off down to the rusted steel, the steel cleaned or replaced, and a new layer of concrete applied. Result: major traffic delays. Over and over.

AMIR FAM

Dr. Fam wants to break that cycle by removing steel from the equation altogether. Back in the early 90s, he began replacing traditional steel reinforcement with rods of fibreglass or other composite materials that don't corrode. The technique is moving towards the mainstream, but Dr. Fam is now thinking—quite literally—further outside the box. Why not move all the reinforcement to the outside, by pouring concrete into forms made of the new materials? The forms would stay in place, providing the necessary strength and at the same time repelling water.

Bridges built this way could last much, much longer. "No major maintenance for perhaps fifty years or more," says Dr. Fam. "Isn't that beautiful?"

Drivers everywhere can only agree.

QUEEN'S RESEARCHERS ARE DEVELOPING REINFORCING ELEMENTS MADE OF COMPOSITE MATERIAL THAT CAN BE EMBEDDED IN CONCRETE BRIDGES.

IN 2008, HONDA'S CLARITY BECAME THE FIRST FUEL CELL CAR AVAILABLE TO THE PUBLIC.

KUNAL KARAN

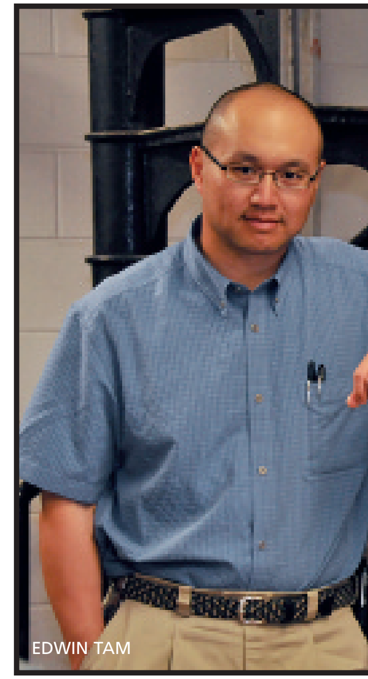
amount of hydrogen needed for millions of cars—preferably with carbon-neutral processes and/or renewable sources? And how do we safely contain and distribute it? Then there's the fuel cell system itself. How can we make it as cheap and reliable as the time-tested internal combustion engine?

This last question is top-of-mind for Dr. Kunal Karan at the Queen's University Fuel Cell Research Centre. In particular, he's interested in reducing platinum usage in fuel cells. Some of the most promising fuel cell technology relies on the metal as a catalyst to transform hydrogen into the electricity that powers the wheels of a fuel cell car. But platinum is pricey, and its cost is one of the reasons that fuel cells are too expensive for the mass automotive market.

"I believe we can reduce platinum use in fuel cells to ten percent of current levels," says Dr. Karan. "But it requires altering the nano structure of these catalyst layers."

There's the "n-word" again. Like Marianna Kontopoulou and Mohini Sain, Dr. Karan applies engineering design at the nano-level to achieve high performance at the macro-level. By re-arranging the "building blocks" of a fuel cell's incredibly thin catalyst layer—about one-quarter the thickness of a human hair—he hopes to help make fuel cells cost-competitive with the good old gas engine.

There's still a long way to go. But every car manufacturer has a major fuel cell strategy, and in 2008, Honda began leasing its first fuel cell vehicles to the public in California. Predicts Dr. Karan: "We'll see wide-scale deployment in 10 to 15 years."



EDWIN TAM

They're going to be lighter, stronger, greener, smarter. But the cars of the future, like any machines, will eventually wear out and die. Thanks to researchers like Dr. Edwin Tam, however, that sad last trip to the wrecker may be brightened with hopes of rebirth.

The recycling process usually begins with "dismantlers," who pull off valuable parts and drain fluids. Then the wreck is put through a "shredder,"

emerging as a tangled mass from which magnets and other technologies can extract much of the metal.

But the remaining 20 percent of automotive left-overs—a mix of plastics, composites and fibres known in the salvage industry as "shredder fluff"—is much harder to process.

The plastics and composites could theoretically be recycled, but first they would have to be sorted; mixing and melting different varieties together renders them unusable. Throwing them away is easier and cheaper.

It's an irony of the modern car. We've increased fuel efficiency by replacing many metal parts with lighter plastic—but more of those new materials have been finding their way to landfills. "We're solving one environmental problem," says Dr. Tam, "but we're creating another."

The University of Windsor researcher is tackling the problem by taking a closer look at shredder fluff itself. He's feeding small loads of plastics and composites through a "solids sizer" unit that uses a camera and sophisticated software to classify the pieces by colour, size and shape. The results may offer clues for better sorting techniques. One particular kind of plastic, for example, may shatter into pieces of a unique size and shape in the shredder, enabling it to be separated from other plastics using a carefully designed sieve.

In the past, classifying shredder fluff in the lab has been a tedious, mind-numbing task for Dr. Tam's grad students. But the new solids sizer, funded in part by the Ontario Innovation Trust, lets them spend their time on ideas—ideas that will help make us as smart and green in the way we dispose of cars as we'll be in the way we make them, fuel them and drive them.

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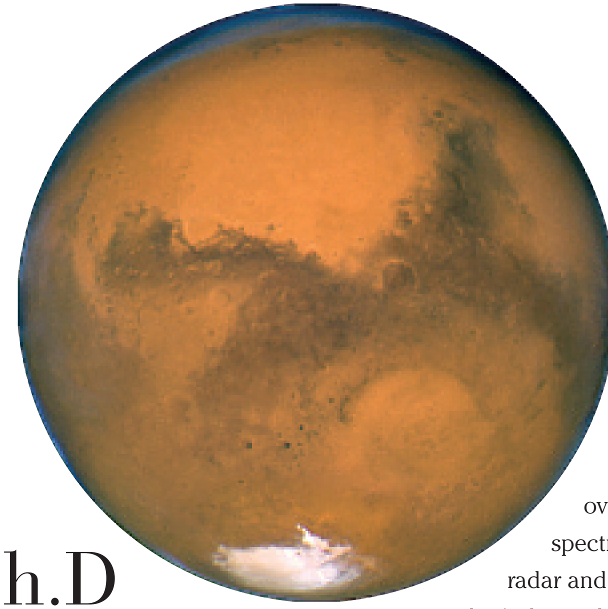
These aren't exactly great days for the auto sector in Ontario. (See today's newspaper.)

But there's light at the end of the tunnel—and it's coming from the high-beams of research. Talented scientists all over the province—with a little help from the Ontario Innovation Trust—are helping to transform Ontario from a twentieth-century car manufacturing giant into a twenty-first century leader in transportation innovation.

Buckle up. It's going to be a great ride. ✻ ✻ ✻

BUCK ROGERS Ph.D

TALENTED AND VISIONARY TORONTO-AREA SCIENTISTS ARE MAKING CANADA A WORLD LEADER IN AEROSPACE.



"We're currently looking for a ride to Mars."

If Dr. Brendan Quine of York University is successful in his attempts at interplanetary hitchhiking, Canada could be just the third nation on earth to successfully land a spacecraft on another heavenly body.

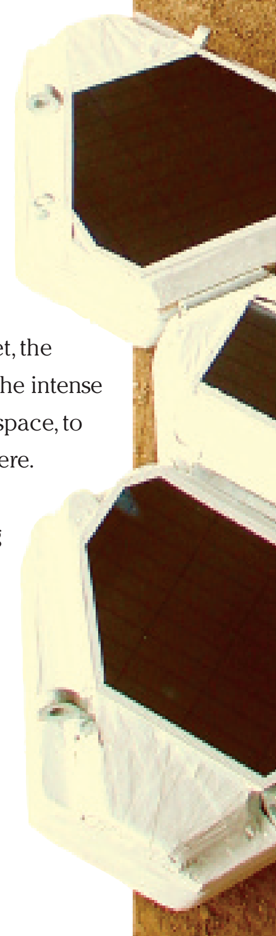
BRENDAN QUINE

Dr. Quine is Associate Professor of Planetary Space and Physics at York—and the leader of Northern Light, an all-Canadian effort to land a rover on Mars. It could happen as early as 2009, if the mission can catch a ride on a Russian rocket. Otherwise, things look good for 2011.

The Northern Light package is typically Canadian—modest but thoroughly innovative. The rover vehicle weighs just over six kilograms, but boasts a spectrometer, ground penetrating radar and digging tools to collect and grind samples for analysis under an onboard microscope. It's dubbed—not surprisingly—"the Beaver."

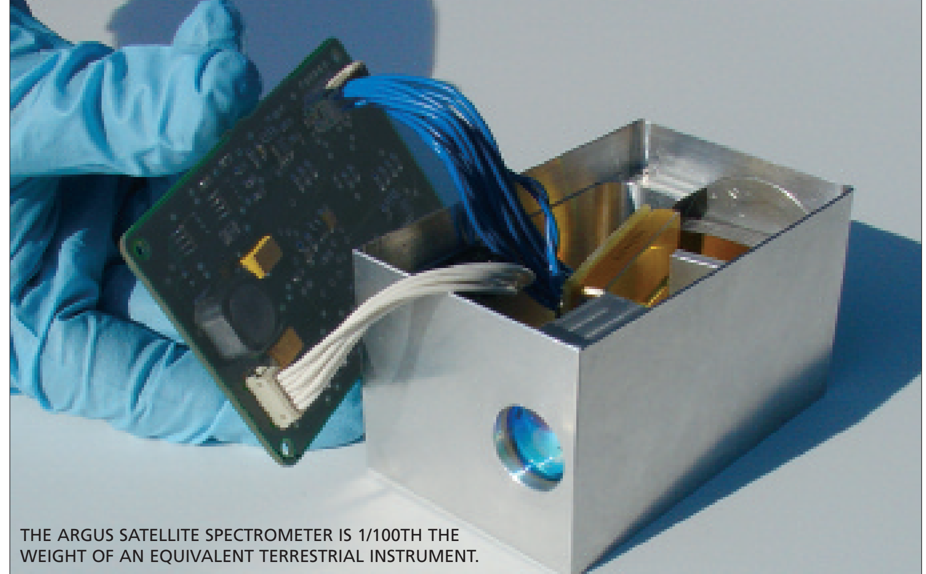
And there's more innovation in the landing system. Unique airbag technology will bring the probe to a soft stop within two metres of its impact point. The current NASA system, by comparison, bounces its payload up to 15 times over a kilometre or more, decreasing landing accuracy and increasing the possibility of damage.

To succeed in reaching the red planet, the probe must endure a range of stresses, from the intense vibration of launch, to the absolute cold of space, to the alien chemistry of the Martian atmosphere. And that's where infrastructure funded in part by the Ontario Innovation Trust is playing a key role. Using the new Space Test Facility at York, scientists can subject the package to whatever it will encounter on its journey, using a large vacuum chamber and a sophisticated vibration table. "It's



unique," says Dr. Quine, "to have this equipment together in a university environment." The private sector is interested, too. "We're doing a growing amount of work for Canadian space companies like ComDev and MDA."

The prospect of Mars is hypnotic, but Dr. Quine also has an eye on terrestrial applications for space research. Through his technology company, Thoth, he's developing "Argus" satellite technology for environmental monitoring. The system uses some of the same miniaturization techniques as the Mars probe. Weighing only 235 grams, an on-board spectrometer performs the work of a 20-kilogram terrestrial instrument and can pinpoint sources of greenhouse gases to within a kilometre. In a coming era when internationally traded emissions credits will be worth tens of billions of dollars, the ability to independently verify emissions will be important in helping to determine who is or isn't entitled to those credits—and a network of satellites using Argus technology may give Canada a leg up.



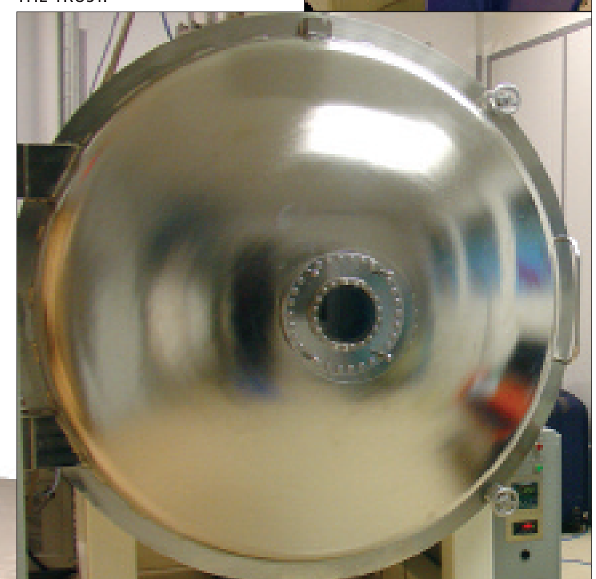
THE ARGUS SATELLITE SPECTROMETER IS 1/100TH THE WEIGHT OF AN EQUIVALENT TERRESTRIAL INSTRUMENT.

Dr. Quine has even applied for a patent on that most exotic of aerospace concepts: the space elevator, first imagined by Russian scientist Yuri Artsutanov and popularized by author Arthur C. Clarke. The Thoth version will be (again) characteristically modest and startlingly unusual: a 20-kilometre high, 300-metre wide inflated structure that will serve as a far-reaching communications platform, and will cut the cost of rocket launches by 30 percent.

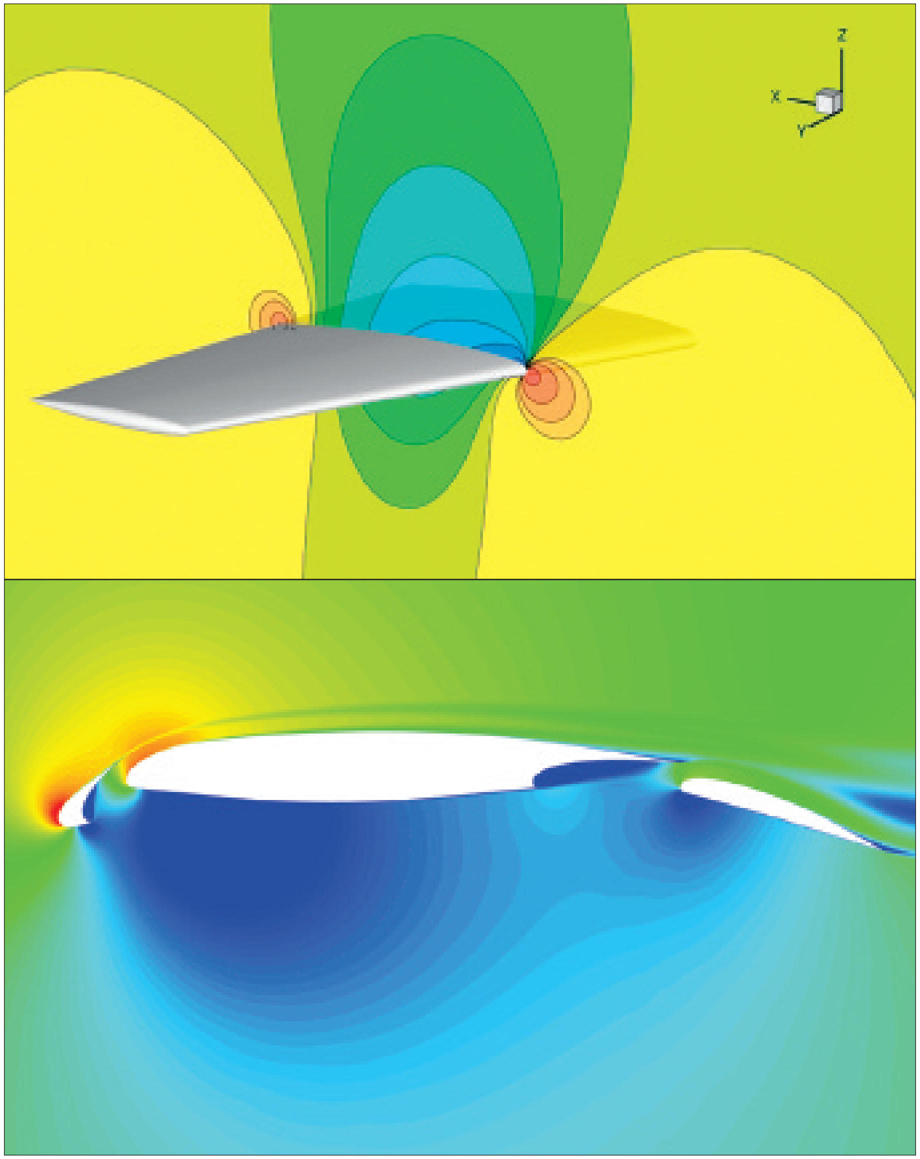
"You can't innovate by making very small changes to the technologies you have," says Dr. Quine. "Things like space exploration force you to think outside the box—far outside."

The freshness of Brendan Quine's Mars lander and space elevator concepts is typical of the many ways Ontario researchers are pushing at the frontiers of aerospace. Their efforts—with a little help from the Ontario Innovation Trust—are helping maintain Canada's

THE CANADIAN MARS MISSION IS TESTING ITS PROBE IN A VIBRATION TABLE AND VACUUM CHAMBER FUNDED IN PART BY THE TRUST.



COLOUR CONTOURS INDICATE THE VARYING SPEEDS OF AIR TRAVELING OVER THE SURFACES OF A POTENTIAL WING DESIGN. SUCH GRAPHICS ARE GENERATED WHEN DESIGNS ARE FED INTO DAVID ZINGG'S COMPLEX MATHEMATICAL MODELS OF AIR FLOW.



remarkable position as the fourth-largest player in the international aerospace market.

Dr. David Zingg, director of the University of Toronto Institute for Aerospace Studies (UTIAS), is another example of how research in Ontario is literally reshaping the field. "The current layout of an airplane—a tube with wings—has been around for 50 years," he says. "It's so fully developed that it has limited room for improvement. We need to look at alternatives."

Developing new aircraft used to involve long hours in the wind tunnel and lots of trial and error at the drawing board. Today, wind tunnel testing is still important at a later stage, but advanced computer modeling has revolutionized every step of the process. In fact, computers do a lot of the actual design work themselves—guided by sophisticated software rules—"algorithms"—developed by people like Dr. Zingg.

"A designer can specify objectives and constraints," he explains, "and some basic parameters for the aircraft, all of which can be extremely detailed or a bit more general. Then the task of the computer and the algorithm is to search intelligently through the possible designs to find the one that satisfies all the constraints and maximizes the objectives."

It may sound easy, but it isn't. It takes an incredible amount of talent and experience to endow long strings of 1s and 0s with the ability to design something. And it doesn't stop there. "Even formulating the problem is complicated," continues Dr. Zingg, "because there are a lot of competing objectives and many, many constraints. But that's where the fun comes in."


DAVID ZINGG

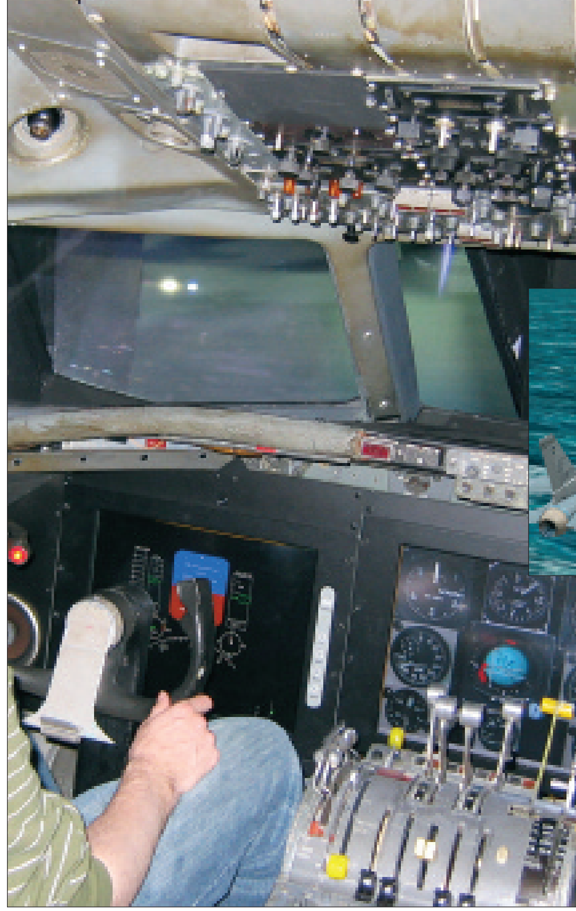
In the case of Dr. Zingg, the fun involves creating algorithms and framing problems about how air flows over the surfaces of an airplane. Reducing drag is a key objective here. The more easily a plane slips through the air, the less fuel it will use. In fact, the design of fuel-efficient, environmentally friendly aircraft is an important focus at UTIAS. Dr. Zingg works on external flows; others of his colleagues look more closely at gas flows inside jet engines, creating software rules to guide the design of a new generation of quieter, more efficient propulsion systems.

The development and testing of these design algorithms takes high-flying computer power; Dr. Zingg and his colleagues use advanced infrastructure provided in part by the Ontario Innovation Trust. But high-speed computing is also a key resource for another UTIAS researcher, Dr. Peter Grant, who's approaching aircraft design from a different angle: "human-in-the-loop" simulation.

Computer-driven simulators are increasingly being used to get test pilot input on an airplane's handling characteristics without the need for anyone to leave the ground. Programmed with the potential airplane's engineering parameters, the simulator gives pilots the "feel" of the proposed aircraft and lets designers tweak those characteristics—all before a single part is machined.

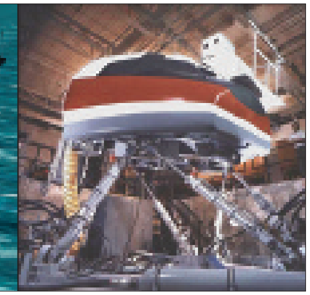

PETER GRANT

The challenge is making the simulation accurate enough that test pilot feedback is valid. And that can be difficult. The motion platform in a simulator is obviously much more limited than an actual aircraft in terms of the distance and speed with which it moves, causing a variety of subtle disconnects with the projected images the pilot sees. "Visual cues are telling you one thing," explains Dr. Grant, "and cues from your inner ear are telling you something slightly different." At its worst, the experience can even cause a form of disorientation and nausea known as "simulator sickness."



In a theme park simulator ride, the worst consequence is that someone loses lunch. But if you're depending on pilot comments from a simulator to make important design decisions, those mismatches may compromise the accuracy and usefulness of that feedback.

Dr. Grant is working at the problem from two angles. He's studying human perception to determine what kinds of sensory disconnects most seriously



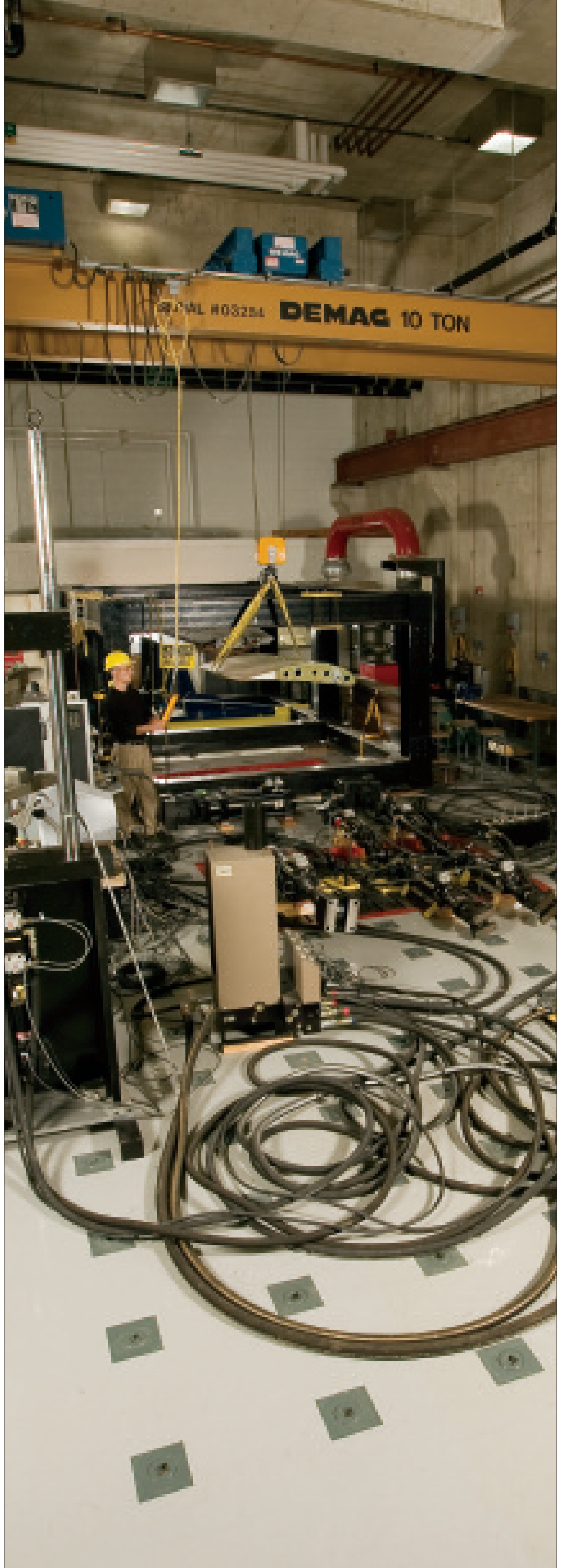
AND NOW...BACK TO THE AUTOMOBILE.

You simulate driving in much the same way you simulate flying. It's just that the view is a little different.

That's why the company that created a state-of-the-art simulator for Toyota came to Dr. Peter Grant at the University of Toronto Institute for Aerospace Studies to develop the system's motion software.

The result is the world's most realistic car simulator. Housed in a vast open building, the seven-metre simulator pod contains a full-size car. The pod tilts, turns and moves on a complex system of steel belts while video projected on the inside completes the illusion.

Feedback from "drivers" of the simulator is helping Toyota's designers fine-tune safety systems in tomorrow's cars—with a little high-tech help from Ontario.



degrade the fidelity of the simulator experience. And he's perfecting motion platform software algorithms that minimize or eliminate those mismatches. The result is the kind of accurate simulation that makes virtual test pilot comments and suggestions valid—and future planes better.

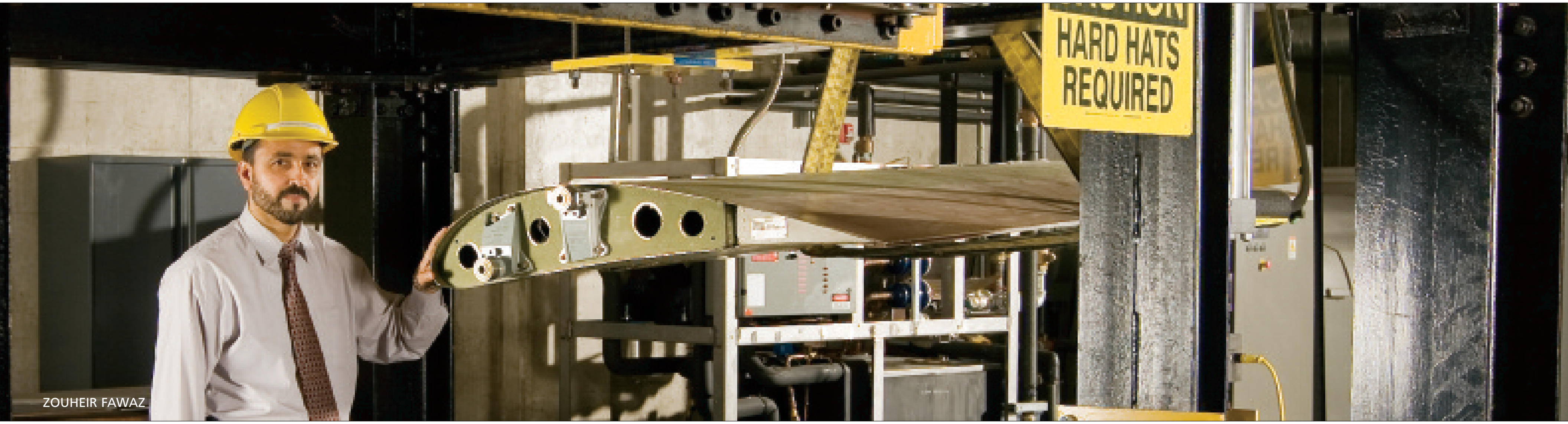
The cavernous room at Ryerson University is hard-core industrial: beefy girders, high-capacity hoists, pneumatic presses, gleaming ducts and snaking cables. It all seems a long way from the glamour of aerospace research. But the task here is to prevent headlines, not make them.

Aircraft are subject to powerful stresses: freezing air and hot sun batter the fuselage, wings flex and twist in flight, joints and components are jolted during take-off, landing and turbulence. Over thousands of flight cycles, these forces can result in cracks and other forms of material fatigue. If undetected, the wear and tear can culminate in catastrophic failure—and terrible front-page news.

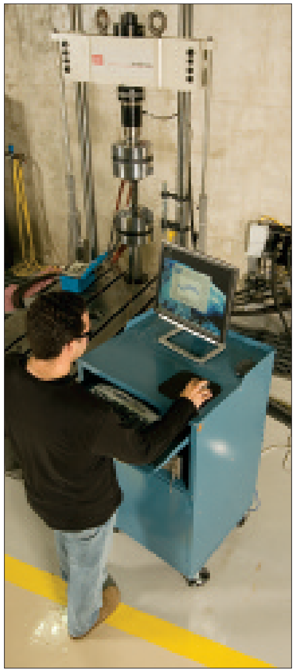
That's why Dr. Zouheir Fawaz and his colleagues are using all the heavy-duty hardware in their lab to crush, stretch, twist, bend, freeze and scorch the next generation of aircraft materials and components. The high-tech torture is being inflicted at Ryerson's FRAMES—Facility for Research on Aerospace Materials and Engineered Structures—with equipment that can compress a lifetime of hard use into months or even days.

The focus of the facility—funded in part by the Ontario Innovation Trust—is on testing new materials that aircraft manufacturers are using to build lighter, more fuel-efficient planes. One example: the fibre-metal laminate used for the upper fuselage of the new Airbus 380 "super jumbo" double-decker jet. The material comprises thin sheets of aluminum sandwiched with layers of adhesive containing long parallel strands of fine glass fibre. The result is very light and very strong—a sort of high-tech version of plywood.

The material, of course, has already been extensively investigated by Airbus. But on-going testing will lead to improvements in how such laminates are made and repaired—as well as uncovering any problems that may emerge only with time. And because Ryerson is a public institution, FRAMES is making the results available to a wide audience. "I'm sure Airbus has tested this material and generated a lot of data," says Dr. Fawaz,



ZOUHEIR FAWAZ



"but they don't necessarily want to share that proprietary information. On the other hand, we can publish what we find, and enrich the database. Everybody can benefit—hopefully first and foremost, the Canadian aerospace industry."

Fibre-metal laminates are just one of several new and exotic aircraft materials FRAMES is testing; they're also looking at new generations of carbon fibre composites. And in a unique new initiative, Dr. Fawaz and his colleagues are developing a system of fibre optic sensors that can be embedded in aircraft materials to constantly monitor their condition.

The goal: new aircraft that are stronger, lighter, more environmentally friendly—and safer than ever.

The imagination and insights of researchers like Zouheir Fawaz—and David Zingg, Peter Grant and Brendan Quine—are helping to drive Canada's leadership in the aerospace industry—and the economic benefits that accrue from innovation.

But there's another benefit—less tangible, but perhaps as important. It's the pride and confidence that comes from realizing that Canadian scientists are on the global cutting edge in this most cutting edge of sectors—that innovative thinking from Ontario is shaping how we'll fly in the 21st century, around the planet and beyond.

INHABITING TOMORROW

A MESSAGE FROM THE CHAIR

To meet a research scientist is to meet someone who is already living in the future. Look into the eyes of the faces on these pages and you'll see a vision of what tomorrow could be.

We saw it in last year's report, in the eyes of researchers who were looking ahead to the challenges of climate change long before Al Gore's laudable public campaign.

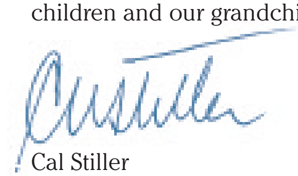
And we see the same pattern again this year. The auto and aerospace industries are scrambling to be smarter and greener. But Ontario scientists have been living in that future for years. Often using Trust-funded infrastructure, they're already shaping new generations of cars and aircraft. And some of them are even looking to transportation beyond our own planet.

The same holds true of the other projects profiled on these pages. Where is Greg Pyle living if not in a tomorrow where we exist in harmony with nature? What do we see in the eyes of Molly Shoichet but a future full of incredible possibilities for healing? And what other vision drives Pierre Blier except the certainty that one day we will finally understand, to human benefit, the last great frontier: the brain?

Our society currently faces enormous economic challenges. And it's natural and right that we focus our best efforts on meeting the urgent needs that confront us now. But in caring about today, we mustn't make the mistake of diverting resources from those visionary scientists who are creating a better tomorrow: the innovators on the cutting edge of research in Ontario.

Our province has always been a leader in this regard—and under the enlightened stewardship of the Ministry of Research and Innovation, I'm glad to say that this tradition continues. As a result, we are well positioned to make an even greater contribution to the global quest for knowledge—especially in those areas where Ontario already has a significant critical mass of personnel and infrastructure: life sciences, information technology and the environment. As we lead in these fields, so we will thrive and prosper in the years ahead.

I hope you're as inspired by the stories in this annual report as I've been. And I hope that, through the eyes of these researchers, you'll be able to glimpse something of the future they already inhabit—a healthier, greener and even more prosperous tomorrow for us, our children and our grandchildren.



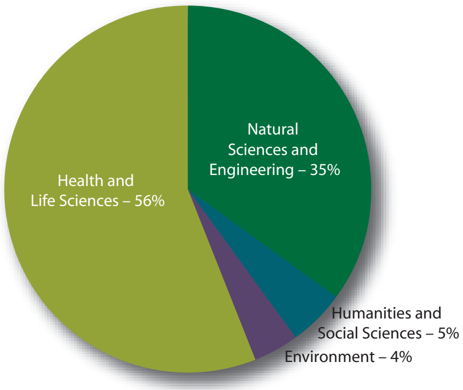
Cal Stiller
Chair
Ontario Innovation Trust

THE TRUST AT NINE

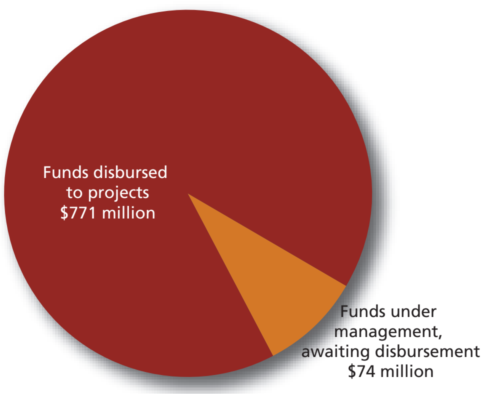
The Ontario Innovation Trust completed the ninth year of its ten-year mandate on March 31st, 2008. All funds—including original principal and earned interest—have been committed, to a total of 1,250 projects.

Here's a snapshot look at how those funds have been allocated and dispersed.

INVESTMENTS BY DISCIPLINE



STATUS OF DISBURSEMENTS



All investments have been for research infrastructure. Priority has been given to projects that have secured funding from the Canada Foundation for Innovation, and that have the potential to:

- enhance innovation, prosperity, healthcare and the environment
- attract and retain highly-qualified personnel
- encourage collaboration with the private sector
- facilitate sharing of research resources among institutions
- build on Ontario's existing strengths in research

THE BOARD

THE BOARD OF DIRECTORS OF THE ONTARIO INNOVATION TRUST

The Trust is governed by a volunteer Board of seven Directors appointed for a fixed term. Two Board members are appointed by the universities of Ontario, one by Ontario's hospitals, one by Ontario's community colleges, and three by the Ontario Government, through Orders-in-Council.

BOARD MEMBER	TERM OF SERVICE	APPOINTED BY
Calvin Stiller *Chair*	1999 – present	Universities
Ian D. Clark	2007 – present	Universities
Bette Stephenson	1999 – present	Hospitals
Rick Miner	2002 – present	Community Colleges
Phil Howell	2005 – present	Province of Ontario
Janet Mason	2005 – present	Province of Ontario
George Ross	2006 – present	Province of Ontario

INNOVATION PROVINCE-WIDE

AN INSTITUTION-BY-INSTITUTION OVERVIEW OF TRUST-SUPPORTED RESEARCH IN ONTARIO

Ontario Innovation Trust Investments 1999 – 2008

CITY	INSTITUTION	NUMBER OF OTHER FUNDING PARTNERS	NUMBER OF PROJECTS	TOTAL PROJECT COST	OIT FUNDING
Barrie	Georgian College	5	1	$1,161,469	$464,588
Belleville	Loyalist College	2	1	$459,300	$183,720
Guelph	University of Guelph	150	93	$147,433,518	$53,687,338
Hamilton	McMaster University	200	138	$189,477,974	$64,138,427
Hamilton	Mohawk College	5	2	$429,248	$171,345
Hamilton	St. Joseph's Hospital	2	2	$28,156,836	$11,262,736
Kingston	Queen's University	117	101	$230,801,690	$66,804,893
Kingston	Royal Military College of Canada	11	6	$5,689,479	$1,702,272
Kitchener	Conestoga College	10	2	$2,612,504	$920,648
London	Fanshawe College	8	1	$619,360	$243,230
London	Lawson Health Research Institute	3	1	$9,247,734	$2,864,000
London	London Health Sciences Centre	3	1	$7,992,143	$2,818,062
London	London Regional Cancer Centre	2	1	$820,000	$211,500
London	Robarts Research Institute (The University of Western Ontario)	3	4	$26,085,008	$8,624,260
London	The University of Western Ontario	170	116	$277,351,649	$90,261,215
North Bay	Nipissing University	1	1	$418,203	$166,646
Oakville	Sheridan College	5	4	$4,617,016	$1,694,992
Ottawa	Algonquin College	5	3	$2,881,392	$1,045,482
Ottawa	Carleton University	113	50	$121,290,826	$37,608,466
Ottawa	University of Ottawa	154	98	$212,166,283	$73,058,559
Peterborough	Sir Sanford Fleming College	5	2	$2,651,218	$1,060,487
Peterborough	Trent University	17	17	$20,088,473	$5,573,252
Sarnia	Lambton College	5	1	$1,806,964	$722,786

CITY	INSTITUTION	NUMBER OF OTHER FUNDING PARTNERS	NUMBER OF PROJECTS	TOTAL PROJECT COST	OIT FUNDING
Sault Ste. Marie	Sault College	22	4	$4,659,459	$1,827,851
St. Catharines	Brock University	33	23	$17,615,815	$5,396,828
St. Catharines	Niagara College	11	6	$4,542,752	$1,675,253
Sudbury	Laurentian University	35	19	$9,341,663	$3,483,959
Thunder Bay	Confederation College	8	1	$692,000	$276,800
Thunder Bay	Lakehead University	28	20	$12,564,055	$3,869,347
Toronto	Baycrest Centre for Geriatric Care / Rotman Research Institute	2	1	$31,089,517	$10,712,000
Toronto	Centennial College	4	1	$707,700	$284,930
Toronto	MaRS Discovery District	23	1	$25,000,000	$10,000,000
Toronto	Humber College	19	1	$1,747,900	$698,900
Toronto	Mount Sinai Hospital	25	8	$93,129,740	$35,246,997
Toronto	Ryerson University	37	25	$8,787,544	$3,433,018
Toronto	Seneca College	11	4	$3,627,587	$1,243,774
Toronto	St. Michael's Hospital	7	2	$8,878,207	$3,520,595
Toronto	Sunnybrook Health Sciences Centre	17	4	$42,308,229	$16,561,292
Toronto	The Hospital for Sick Children	3	5	$31,636,872	$10,522,437
Toronto	University Health Network	7	7	$72,312,480	$23,024,995
Toronto	University of Toronto	251	263	$546,919,868	$206,498,126
Toronto	York University	107	51	$40,673,835	$15,210,768
Waterloo	Perimeter Institute for Theoretical Physics	3	1	$21,788,010	$5,624,892
Waterloo	University of Waterloo	165	88	$125,433,053	$45,594,725
Waterloo	Wilfrid Laurier University	21	26	$16,572,452	$6,574,321
Windsor	University of Windsor	39	43	$22,826,581	$8,040,750
			1,250	**$2,437,113,606**	**$844,611,462**

ACROSS A BRIDGE OF PARTNERSHIPS

The future is reached over a bridge of partnerships. Without the undergirding support of government, public institutions and private enterprise, none of the innovators in this report would be able to pursue their research.

At the Ontario Innovation Trust, we acknowledge and commend the contributions made by our key partners in providing research infrastructure for Ontario scientists:

The Canada Foundation for Innovation has been an invaluable source of information and expertise as we have evaluated and monitored progress on many hundreds of jointly-funded projects, usually matching CFI commitments.

The Ontario Ministry of Research and Innovation has also been a partner in funding, and in promoting the importance of advanced research to the future of the province. In particular, the Trust commends the Ministry on its recent adoption of an aggressive innovation agenda for Ontario, built on the province's unique resources in creativity, diversity, work-force skills, education and research expertise.

The support of the *Private Sector* and *Public Institutions* completes the bridge of partnership. In many cases these partners provide 20 percent of infrastructure support needed for a given project.

To all of our partners: our respect and gratitude.

Canada Foundation for Innovation
Fondation canadienne pour l'innovation

Canada Foundation for Innovation
www.innovation.ca

Ontario

Ministry of Research and Innovation
www.mri.gov.on.ca

MORE DESTINATIONS

OTHER PLACES ONTARIO RESEARCHERS ARE TAKING US.

HEALING IN THE GARDEN OF THE BODY

UNIVERSITY OF TORONTO RESEARCHER **MOLLY SHOICHET** IS CULTIVATING HOPE FOR VICTIMS OF SPINAL AND BRAIN INJURY.

MOLLY SHOICHET

Agriculture is the metaphor that Dr. Molly Shoichet—cautiously—uses to describe her research. "If you're trying to grow a certain crop, you need the soil and the right nutrients. Then you plant the seeds, and with the right environment you can grow it."

But when the "crop" is new brain or spinal tissue, and when you have to create your own versions of both soil and seed, and when the environment is as complex as the human body…well, it's not so simple.

Dr. Shoichet is working at the University of Toronto on the frontiers of a field known as tissue engineering or regenerative medicine. Her research may one day enable surgeons to place a microscopic three-dimensional matrix or "scaffolding"—think of it as "soil"—in a damaged section of brain or spinal cord, and then infuse it with stem cells—"seeds"—that will grow into a fresh crop of healthy nerve tissue.

PROJECT:
Engineering Neural Tissue

INSTITUTION:
University of Toronto

RESEARCH SECTOR:
Engineering/Health Sector

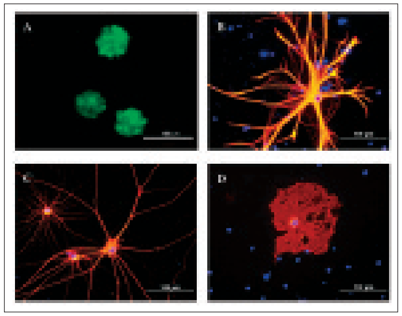
PRINCIPAL INVESTIGATOR:
Molly Shoichet

TRUST INVESTMENT:
$319,190

CFI INVESTMENT:
$319,190

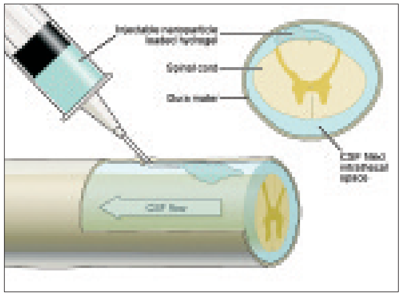
TOTAL RESEARCH INVESTMENT FROM ALL SOURCES:
$826,587

The challenges are immense. What kind of material is best for the scaffolding? (Dr. Shoichet is looking at a range of natural and synthetic polymers.) What kinds of stem cells turn into the appropriate tissue, and how? What kinds of growth factors—nutrients—are required? And how can we keep the body's immune system from rejecting the harvest of new growth?



VERSATILE "SEEDS:" A SINGLE VARIETY OF STEM CELLS (UPPER LEFT) CAN GROW INTO SEVERAL DIFFERENT KINDS OF NERVE CELLS.

Such a thicket of questions demands an interdisciplinary approach; Dr. Shoichet, whose background is in chemistry and engineering, works closely with cell biologists, neuroscientists and surgeons. She sees their collaborative efforts leading to step-by-step improvements in restoring function after a brain or spinal injury.



HOW TO KEEP STEM CELLS FROM BEING CARRIED AWAY FROM AN INJURY BY SPINAL FLUID? A NANO-ENGINEERED GEL.

But how long will it be before paraplegics can walk away from their wheelchairs? She refuses to even speculate. "We're not there yet, but I can see it in the future. And that's very motivating, very exciting."

PUSHING THE MAGIC FURTHER

CAN WE MAKE ONE OF THE OLDEST TREATMENTS FOR CANCER EVEN MORE EFFECTIVE? **DAVID JAFFRAY** AT THE UNIVERSITY HEALTH NETWORK SAYS YES— A LOT MORE.

"We're using something that has no taste and no smell, and something that doesn't touch the patient physically, to treat an illness inside the patient."

PROJECT:
Spatio-Temporal Targeting and Amplification of Radiation Response (STTARR) Innovation Centre
INSTITUTION:
University Health Network
RESEARCH SECTOR:
Life Sciences
PRINCIPAL INVESTIGATOR:
David Jaffray
TRUST INVESTMENT:
$2,682,788
CFI INVESTMENT:
$7,786,354
ONTARIO RESEARCH FUND INVESTMENT:
$1,210,389
TOTAL RESEARCH INVESTMENT FROM ALL SOURCES:
$9,824,217

Dr. David Jaffray isn't describing some dodgy New Age therapy. He's talking about the almost magical power of a tool physicians have been using for more than a hundred years: radiation.

Despite its effectiveness, radiation therapy has always had a major downside: the destruction of healthy tissue around a tumor. But over the last decade, advances in medical imaging, computers and robotics have been leading to radical improvements in the ability to target only cancer cells. "We're able to hit much smaller targets, and

avoid healthy tissue altogether," explains Dr. Jaffray.

He and his colleagues are helping to explore the frontiers of increasingly precise radiation therapy at STTARR—Spatio-Temporal Targeting and Amplification of Radiation Response—a facility within Toronto's Princess Margaret Hospital funded in part by an investment from the Ontario Innovation Trust.

The capacity for more focused treatment is pushing researchers at STTARR to ask different and more fundamental questions in biology. Just how high can the dosage go? And what exactly happens in a cancer cell at those higher levels? These questions demand an interdisciplinary approach; Dr. Jaffray, a physicist, is working closely with colleagues Dr. Michael Milosevic, an engineer turned physician, and Dr. Robert Bristow, a physician and biologist. The answers they find may lead to significantly more effective—and perhaps less expensive—radiation therapy.

"Things are moving very quickly," says Dr. Jaffray. "The next ten years will see us squeeze every last ounce of performance out of these therapies. We could see a 15 percent increase in controlling cancer without increasing toxicity. Everyone wants a blockbuster treatment, but I'd be happy with 15 percent—that's a lot of people."


DAVID JAFFRAY

THE GAITS OF PERCEPTION

NIKOLAUS TROJE AT QUEEN'S UNIVERSITY IS EXPLORING HOW WE READ PEOPLE BY THE WAY THEY MOVE.

"Well, you can tell by the way I use my walk,
I'm a woman's man: no time to talk…"

The old BeeGees tune may not exactly have the flavour of scientific discourse. But the band was onto something; just ask Dr. Nikolaus Troje. Dr. Troje is studying the important information we derive from watching the movements of others. In his lab at Queen's University, he attaches up to 60 reflective markers to his subjects' bodies, then uses high-speed cameras to photograph them walking. A computer tracks the changing positions of all the markers and creates a simplified, animated model of the movement, stripped of other cues such as facial features, clothing and body shape.

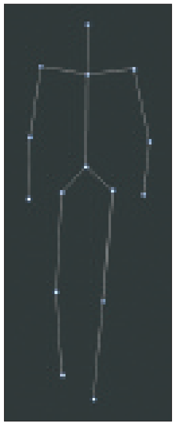
PROJECT:
Real-Time Motion Capture System and Virtual Social Reality Laboratory
INSTITUTION:
Queen's University
RESEARCH SECTOR:
Life Sciences
PRINCIPAL INVESTIGATOR:
Nikolaus Troje
TRUST INVESTMENT:
$200,000
CFI INVESTMENT:
$200,000
TOTAL RESEARCH INVESTMENT FROM ALL SOURCES:
$500,000

By showing the growing database of models to experimental subjects, and noting what they infer from different gaits, he's learning more about the many subtle ways we read movement for cues about others' moods, intentions and character. The results could have important commercial and artistic applications

NIKOLAUS TROJE'S RESEARCH WAS RECENTLY RECOGNIZED WITH THE AWARDING OF A PRESTIGIOUS STEACIE FELLOWSHIP FROM THE NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL.

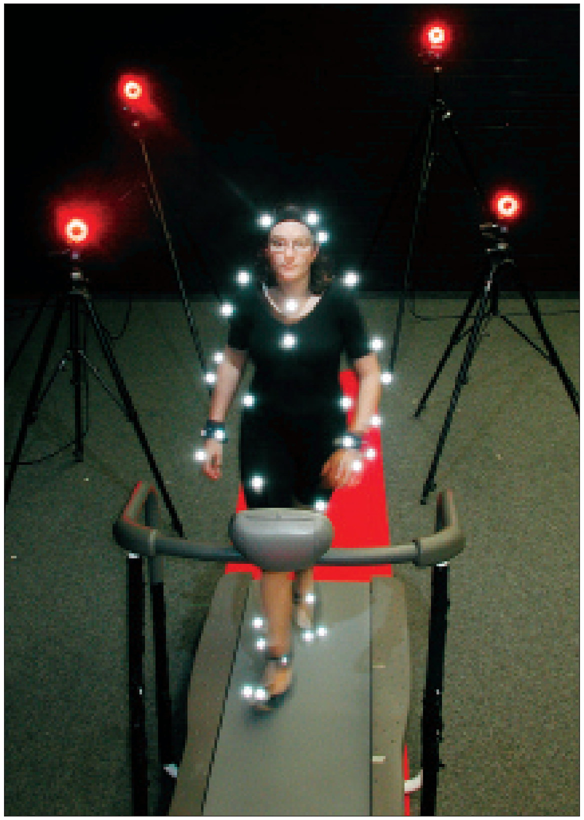
in the growing field of computer animation, helping make the movements of on-screen characters, avatars and instructors more realistic.

But Dr. Troje is taking his research an intriguing step further, by turning the basic idea on its head.



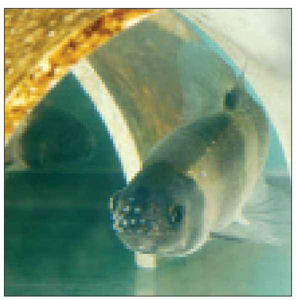
Collaborating with a clinical psychologist, he's trying to determine if gait can be used to diagnose depression, and to track the progress of treatment.

"If we can tell how much better people are feeling by the way they walk," he speculates, "can we teach people to feel better by teaching them how to walk as if they did?"



WHEN METAL MAKES NO SCENTS

TRACE METALS IN LAKES CAN TURN OFF A SENSE THAT FISH DEPEND ON FOR SURVIVAL. NIPISSING UNIVERSITY RESEARCHER **GREG PYLE** IS EXPLORING THE HOW AND WHY.



A SIMPLE TRANSPARENT MAZE WITH A SCENT SOURCE AT ONE END HELPS SCIENTISTS MEASURE DAMAGE TO A FISH'S OLFACTORY TISSUE.

"Yum, supper's ready…" "Wow, she's interesting!" "Hmm, better put out that cigarette!"

This is how our brain responds—in countless ways every day—to the steady stream of signals from our nose. The signals are generated when traces of chemicals in the air—from a steak, say, or perfume, or gasoline—bind with special tissues in our noses and spark a tiny electrical burst. The signals convey vital nutritional, sexual and survival cues about what's going on around us.

PROJECT: Aquatic Ecotoxicology Laboratory
INSTITUTION: Nipissing University*
RESEARCH SECTOR: Environment
PRINCIPAL INVESTIGATOR: Gregory Pyle
TRUST INVESTMENT: $166,646
CFI INVESTMENT: $166,646
TOTAL RESEARCH INVESTMENT FROM ALL SOURCES: $418,203

Aquatic animals—both fishes and crustaceans—rely on a similar interaction between sensory tissues and water-borne chemicals to gather information from their environment. But trace amounts of metals from mine tailings and other industrial sources damage the tissue. And the result can be a dangerous inability to sense food, potential mates or predators.

Dr. Gregory Pyle is looking at how and why it happens. And in doing so, he's laying the groundwork for new environmental practices—and a new way of benchmarking environmental impacts.

Working with equipment funded in part by the Ontario Innovation Trust, Dr. Pyle and his colleagues have found, for example, that fish embryos exposed to metals produce adults with a permanently damaged sense of smell. Fish that have already hatched, however, can recover from exposure in a couple of weeks. The implication: mining companies could make a real difference by avoiding the release of metals during spawning periods—only about a week a year.

Even more significantly, Dr. Pyle's unique research may also provide scientists world-wide with a whole new way to assess the impact of industry on the environment. "Our model is already starting to attract attention from environmental regulators in Australia, New Zealand and the United States."

*AS OF FALL 2008, DR. PYLE IS ASSOCIATE PROFESSOR CANADA RESEARCH CHAIR IN ENVIRONMENTAL BIOTECHNOLOGY AND ECOTOXICOLOGY DEPARTMENT OF BIOLOGY, LAKEHEAD UNIVERSITY

NOTHING LOST IN TRANSLATION

THREE UNIVERSITY OF OTTAWA MEDICAL SCIENTISTS ARE TACKLING THREE VERY DIFFERENT AREAS WITH A COMMON APPROACH: RESEARCH AS A TWO-WAY CONVERSATION BETWEEN THE LAB AND THE CLINIC.

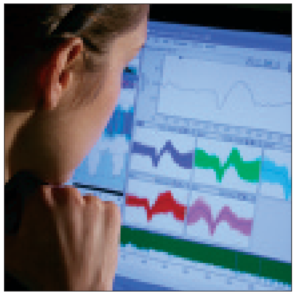
Ottawa research physician Pierre Blier sees his patients in a sunny corner of his office at the Ottawa Mental Health Centre. But when the morning's appointments are over, he pulls on a lab coat and takes a short walk up a flight of stairs to a state-of-the-art lab for the study of brain function, funded in part by the Ontario Innovation Trust.

It's a different kind of space from his office—much less warm and inviting. But the two are inextricably connected. What Dr. Blier learns here shapes his practice downstairs—and vice versa.

For a growing number of medical scientists, the conceptual—and sometimes physical—distance from "bench to bedside" is steadily shrinking. They emphasize what they call "translational" research—an iterative process that involves turning the insights of the lab into actual therapies—and insights from therapy into further directions for experimentation. It's a dialogue, and as in any good conversation, ideas pass both ways.

PROJECT: Elucidation and Optimization of the Mechanisms of Action of Antidepressant Treatments
INSTITUTION: University of Ottawa
RESEARCH SECTOR: Health Sciences
PRINCIPAL INVESTIGATOR: Pierre Blier
TRUST INVESTMENT: $124,812
CFI INVESTMENT: $124,812
TOTAL RESEARCH INVESTMENT FROM ALL SOURCES: $414,533

For Dr. Blier, the conversation is about depression, and how best to treat it. In the lab, he's attempting to better understand how different antidepressants actually work in the brain at the cellular level. And what he's learned has made him a pioneering advocate of an approach that's finding growing favour among psychiatrists: prescribing two antidepressants at once. Such dual therapies have traditionally been reserved for patients who don't respond to a single medication. But Dr. Blier argues that, with our growing understanding of anti-depressant medications, we can combine drugs with different "mechanisms of action," essentially opening two fronts on the assault against the disease. And there's a bonus: if



PIERRE BLIER

carefully chosen, the two drugs can cancel out each other's negative side effects.

In a perfect example of translational research, Dr. Blier has been able to test his insights from the lab in studies with his patients. And the results are encouraging. "Traditional monotherapies result in 25 percent remission rates in the first six weeks. With dual therapies, we can increase this to 50 and 60 percent."

A couple of kilometres away from Dr. Blier's office and lab, Dr. Kevin Burns is pursuing research on a different organ—but at the same intersection of concept and clinic.

Dr.Burns is Director of the Kidney Research Centre, located in a new wing of the University of Ottawa Health Sciences Building. Kidney patients from The Ottawa Hospital are only a few corridors away from the Centre's labs, which were built with support from the Ontario Innovation Trust. "Three of the six scientists here now also take care of patients in the hospital," explains Dr. Burns. "And we have access to patient materials to study directly in the lab."

PROJECT:
Infrastructure for Kidney Research Centre
INSTITUTION:
University of Ottawa and Ottawa Health Research Institute
RESEARCH SECTOR:
Health Sciences
PRINCIPAL INVESTIGATOR:
Kevin Burns
TRUST INVESTMENT:
$3,451,845
CFI INVESTMENT:
$3,451,845
TOTAL RESEARCH INVESTMENT FROM ALL SOURCES:
$8,629,611

KEVIN BURNS

In keeping with a translational approach, all new post-doctoral fellows—usually scientists with no formal medical training—are offered the opportunity to spend a week on the kidney wards, where they interact with patients and are exposed to the realities of clinical work. "We don't expect them to become physicians," says Dr. Burns, "but they learn the language of the clinic. And it allows physicians to hear more about what's going on in the lab and appreciate that side."

In this kind of collaborative setting, research is moving forward on several fronts, including the relationship between diabetes and kidney disease, and the effect that kidney disease has on blood vessels and blood pressure, and vice versa. But the science is always in the context of treatment—and that tends to keep the reason for research front and centre.

"I spend a fair amount of my time," says Dr. Burns, "caring for patients with kidney disease—about 25 percent at the bedside. That's always been my driving force."

It's no surprise that translational research often flourishes when patients and scientists are only a few steps apart. But Dr. Pascal Imbeault sometimes has to go much further to maintain the conversation between lab and clinic.

"It takes me 12 hours on the milk run to get there," he says, describing the remote First Nations communities he's visited twice during the last two years. "They're 300 kilometres north of Sioux Lookout."

Dr. Imbeault, based at Montfort Hospital in Ottawa, is looking at the causes of obesity and potential strategies for combating it. And this takes him from matters of nutrition and exercise to the complexities of metabolic chemistry.

On the nutrition side, his work with northern First Nations communities gives him a unique window onto a fundamental change that's taking place in human eating habits. In just 50 years, the people of this area have made the transition from a hunter-gatherer diet—a diet that shaped the evolution of human metabolism for hundreds of millenia—to modern processed food. He's hoping that his findings will help prevent a resulting epidemic of obesity and diabetes among First Nation peoples—and offer clues for treatment and prevention in the larger Canadian population.

PROJECT:
Behavioural and Metabolic Research Center for Obesity Prevention and Treatment
INSTITUTION:
University of Ottawa
RESEARCH SECTOR:
Health Sciences
PRINCIPAL INVESTIGATOR:
Pascal Imbeault
TRUST INVESTMENT:
$425,370
CFI INVESTMENT:
$425,370
TOTAL RESEARCH INVESTMENT FROM ALL SOURCES:
$1,487,706

True to the translational approach, however, Dr. Imbeault's work is also strongly rooted in fundamental science. Using a lab equipped in part by an investment from the Ontario Innovation Trust, he's investigating factors that control the sometimes surprising impacts fat can have on our bodies. In one set of experiments, he is studying the effect of cold using a refrigerated suit designed by an Ottawa company for soldiers in Afghanistan. Early results look like good news for Canadians: low temperatures produce more of an important fat-derived protein with antidiabetic and anticarcinogenic properties.

In an intriguing development, the cold suit research has attracted the attention of a large sportswear manufacturer; the potential may exist for a consumer version of the outfit as a weight-loss and exercise product.

A consumer application of Dr. Imbeault's research would certainly be in the spirit of bringing research ideas into every-day use. Perhaps a new translational research mantra might even be in order: "from concept to clinic to…health club."


PASCAL IMBEAULT

FROM LAB TO LIFE: A SUBJECT'S BODY TEMPERATURE IS LOWERED USING A WATER-COOLED SUIT. THE BLUE MASK CAPTURES EXHALED BREATH, WHICH PROVIDES INFORMATION ON WHAT'S HAPPENING METABOLICALLY. SUCH HIGH-TECH LAB EXPERIMENTS HELP INFORM DR. IMBEAULT'S MORE CLINICAL RESEARCH, LIKE HIS WORK ON DIET WITH FIRST NATIONS COMMUNITIES.

INNOVATION. (CONT'D.)

A FOLLOW-UP LOOK AT THREE RESEARCH INITIATIVES FEATURED IN EARLIER ANNUAL REPORTS OF THE ONTARIO INNOVATION TRUST.

"Something really extraordinary," was how Dr. Raymond Laflamme described the potential of the new Institute for Quantum Computing, profiled in the 2003/04 annual report of the Ontario Innovation Trust.

And extraordinary things have indeed happened since the Trust's 2002 investment in the Institute, located at the University of Waterloo. Dr. Laflamme now has a

total staff of 100 working under his direction. A new building will open by early 2011. And an important application of quantum computing has moved from the theorists' blackboards to a working prototype. Roof-mounted optical transceivers on the Institute's current building are sending quantum-encrypted information to other locations on campus—ushering in an age of completely secure Internet communication.

RAYMOND LAFLAMME

"Sometimes in research, you find out the things you don't want to know." Prof. Avrim Katzman is reflecting on ground-breaking animation tools he created for interactive television, described in the Trust's 2004/05 report. The possible applications were—and remain—exciting, from television gaming to participatory democracy. But after several years of intensive efforts to commercialize the technology, researchers realized that the broadcasting industry simply wasn't ready to make the leap.

The investment of time and funds, however, have been far from a loss. Prof. Katzman is now refocusing the technology to help producers prototype live action content before any money is spent on actors, sets or crews. And then there's perhaps the most important

AVRIM KATZMAN

dividend of all: "The students have learned a lot," notes Prof. Katzman, "and who knows where they'll end up? Research is a long-term investment."

"We now lead the world in biological life-support research activity." Dr. Mike Dixon is referring to work he and his colleagues are pursuing at the University of Guelph, profiled in the Trust's 2005/06 annual report.

It's a bold claim, but true. In the two years since the profile was published, Dr. Dixon and his team have been selected to lead the development of a major component of the European Space Agency's life-support test facility in Barcelona. Their work may one day enable the first long-term bases on the moon and Mars to grow their own food and recycle their water and air. And it's not just the Europeans who are turning to Guelph for help. "When we go to meetings internationally," says Dr. Dixon, "everybody looks to us in this area, including NASA."


MIKE DIXON

The research will have down-to-earth spin-offs as well—including home disinfectant systems that produce only oxygen as a residue, and wireless sensors that promise to revolutionize the greenhouse and wine industries.

SUMMARIZED FINANCIAL STATEMENTS

PKF Hill
CHARTERED ACCOUNTANTS

PKF Hill LLP
Toronto, Ontario, Canada
www.pkfhill.com

Auditors' Report

To the Directors of
Ontario Innovation Trust

The accompanying summarized balance sheet and summarized statements of operations and capital and changes in capital are derived from the complete financial statements of Ontario Innovation Trust as at March 31, 2008 and for the year then ended. In our auditors' report on the complete financial statements dated June 25, 2008, we expressed an unqualified opinion. The fair summarization of the complete financial statements is the responsibility of management. Our responsibility, in accordance with the applicable Assurance Guideline of the Canadian Institute of Chartered Accountants, is to report on the summarized financial statements.

In our opinion, the accompanying financial statements fairly summarize, in all material respects, the related complete financial statements in accordance with the criteria described in the Guideline referred to above.

These summarized financial statements do not contain all the disclosures required by Canadian generally accepted accounting principles. Readers are cautioned that these statements may not be appropriate for their purposes. For more information on the entity's financial position, results of operations and cash flows, reference should be made to the related complete financial statements.

PKF Hill LLP

Chartered Accountants, Licensed Public Accountants
June 25, 2008

Summarized Balance Sheet as at March 31

	2008	2007
ASSETS		
Current assets		
Cash and prepaid expenses	$ 156,957	$ 114,124
Short-term investments (2007 market value – $27,634,709)	82,249,145	27,745,822
Due from Innovation Institute of Ontario	-	80,000
	82,406,102	27,939,946
Long-term investments (2007 market value – $76,120,884)	-	76,406,081
Property and equipment	35,891	87,442
	$ 82,441,993	$ 104,433,469
LIABILITIES AND CAPITAL		
Current liabilities		
Accounts payable and accrued liabilities	$ 320,977	$ 216,995
Due to Innovation Institute of Ontario	129,082	79,169
	450,059	296,164
Capital		
Invested in property and equipment	35,891	87,442
Restricted for approved grants (internally restricted)	66,620,973	95,886,679
Unrestricted	15,335,070	8,163,184
	81,991,934	104,137,305
	$ 82,441,993	$ 104,433,469

YEAR ENDED MARCH 31, 2008

Summarized Statement of Operations and Changes in Capital
Year Ended March 31

	2008	2007
Revenue		
Investment income	$ 4,408,152	$ 4,372,705
Expenses		
Consulting and management services	657,660	662,707
Service fees paid to Innovation Institute of Ontario	568,406	620,619
Salaries and benefits	380,080	411,719
Investment and custody services	97,180	124,451
Office and general	84,370	103,756
Amortization	77,778	54,224
Travel	11,130	24,405
	1,876,604	2,001,881
Excess of revenue over expenditures before undernoted items	2,531,548	2,370,824
Eligible project disbursements	24,280,612	58,012,756
Deficiency of revenue over expenditures	(21,749,064)	(55,641,932)
Capital, beginning of year		
As previously stated	104,137,305	160,690,019
Change in accounting policy (note 1)	(396,307)	-
Correction of accounting for investment income	-	(910,782)
As restated	103,740,998	159,779,237
Capital, end of year	$ 81,991,934	$ 104,137,305

Compensation Disclosure

In accordance with the Public Sector Salaries Disclosure Act, all salaries in excess of $100,000 have been reported to the Province of Ontario and are as follows:

	2008	2007
David Bogart	$ 150,000	$ 143,750

Included with consulting and management services expenses are payments in the amount of $172,990 (2007 – $158,307) made on a purchase of services basis to Knox Innovations for the services of Kenneth W. Knox as President and CEO of the Trust.

Summarized Statement of Changes in Capital
Year Ended March 31

	2008				2007
	Invested in Property and Equipment	Restricted for Approved Grants (Internally Restricted)	Unrestricted	Total	Total
Capital, beginning of year					
As previously reported	$ 87,442	$ 95,886,679	$ 8,163,184	$ 104,137,305	$ 160,690,019
Change in accounting policy (note 1)	-	-	(396,307)	(396,307)	-
Correction of accounting for investment income	-	-	-	-	(910,782)
As restated	87,442	95,886,679	7,766,877	103,740,998	159,779,237
Deficiency of revenue over expenditures	(77,778)	(24,280,612)	2,609,326	(21,749,064)	(55,641,932)
Purchase of property and equipment	26,227	-	(26,227)	-	-
Transfer (note 3)	-	(4,985,094)	4,985,094	-	-
Capital, end of year	$ 35,891	$ 66,620,973	$ 15,335,070	$ 81,991,934	$ 104,137,305

Summarized Notes to Financial Statements – Year Ended March 31, 2008

1. Change in accounting policy

Effective April 1, 2007, the Trust adopted the provisions of CICA Section 3855, Financial Instruments—Recognition and Measurement and CICA Section 3861, Financial Instruments—Disclosure and Presentation which address the presentation, classification, recognition and measurement of financial instruments. As a result of adopting these changes, all financial instruments, previously measured at cost, are now measured at fair value.

The new standard has been applied retroactively, without restatement of prior year balances. The adoption of the provisions resulted in an increase in investments at March 31, 2008 of $965,862, comprised of an unrealized loss of $396,307 at April 1, 2007 and an unrealized gain of $1,362,169 for the year ended March 31, 2008.

2. Going concern

Notwithstanding the expected discontinuance of operations after March 31, 2009, the Trust has continued to use generally accepted accounting principles applicable to a going concern. Management believes that the asset carrying values are realizable. Costs associated with the wind down of the Trust will be recognized at March 31, 2009.

3. Transfer

In 2008, $4,985,094 was transferred from the restricted for approved grants fund to the unrestricted fund, after a review of project commitments revealed that a number of projects were finalized at an amount lower than the initial Board approval.

ABOUT THIS REPORT

This report covers the activities and financial position of the Ontario Innovation Trust up to March 31, 2008, with a particular focus on the last 12 months of that period. Significant program events that occurred after the reporting period may also be referenced.

The Ontario Innovation Trust was created by the Government of Ontario to invest in research equipment and facilities at Ontario's universities, colleges, research hospitals and other non-profit research institutions. The Trust is governed by an independent Board of Directors, according to the terms of a Trust agreement established by the Ontario government. A small professional staff administers the program.

HIGHLIGHTS AT A GLANCE

Ontario Innovation Trust Investment	$844.6 million
Investment from other sources	$1,592.5 million
Total Value of Infrastructure Investment	$2.43 billion
Number of Projects funded by the Ontario Innovation Trust	1,250
Private and Public Sector Partners involved	1,000+
Universities involved	18
Community Colleges involved	15
Research Hospitals and Health Science Research Institutions involved	11
Other Research Institutions involved	2

Ontario
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