

Unlocking the gridlock

Oliver Moore

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Equipped with artificial intelligence, Professor Baher Abdulhai's traffic lights know how to learn.

A project by the University of Toronto professor of civil engineering marries cameras with computers to create traffic lights that can measure vehicle flow, understand what it means, and adapt signal patterns to reduce gridlock.

"We want the traffic light to learn from experience," explained Prof. Abdulhai, who is principal investigator on the University of Toronto project, dubbed MARLIN, and an expert in intelligent transportation systems (ITS).

"In the Toronto experiment we cut down delays by 40 per cent, on average."

This work is part of a broader recognition that something has to be done about gridlock that threatens to paralyze the city. Congestion already has drivers here suffering some of the worst commute times in North America and, according to the Toronto Region Board of Trade estimate, is costing the economy \$6-billion annually.

The search for solutions has been part of a series of public discussions by Metrolinx, which is seeking ideas for how to fund the next generation of transit expansion. The Greater Toronto Civic Action Alliance has also rolled out a lobbying campaign and the city has held public consultations. Next week, the city will ask the public to comment as part of the Downtown Transportation Operations Study, which is looking at ways to improve mobility and safety.

All of these efforts recognize that solutions are overdue. And it's only going to get worse. With a rising population, an uncertain future for the Gardiner Expressway, the Pan-Am Games expected to bring thousands of people in 2015 and scores of condo buildings under construction, there's little time to waste.

THE SILVER LINING

Of course, traffic isn't all bad.

"Some congestion is a sign of vibrancy," says Prof. Abdulhai in the draft of an upcoming report for the **Residential and Civil Construction Alliance of Ontario**, "but too [much] congestion has

many negative consequences. ... The good news is that there are plenty of approaches to address congestion, traditional and non-traditional, technical and non-technical.”

The report calls for a mix of increased road capacity, smarter traffic signals and judicious road tolling, acknowledging that the last is a controversial suggestion.

Small steps toward road tolls were among the proposals this week from the local board of trade, which offered political cover to right-wing leaders by suggesting new taxes and fees dedicated to transit.

But solutions aren't always easy to find at city hall, so The Globe and Mail turned to the experts.

Khandker Nurul Habib, assistant professor in the department of civil engineering at the University of Toronto, stresses that measures targeting congestion must be coupled with demand management, because less traffic will only encourage more people to drive.

“If you remove traffic congestion, demand will [rise],” he said. “If you try to build new roads ... there'll be new demand out there. People who were not driving before will find it easier and faster and will start driving.”

It's a well-documented phenomenon known as “induced demand” and it explains why expanding road capacity is too often a short-term political solution, although traffic experts are generally too polite to say it.

One way to get around this is to reduce the desirability of driving. This can be done through disincentives such as tolls or taxes that hit motorists. But without alternatives, driving will continue to be what's known as an inelastic behaviour – people will keep doing it in spite of increasing cost because they have no choice.

“We have to invest in transit,” Prof. Nurul Habib said. “There's no other way to do it”

This is where Metrolinx comes in. The regional transit agency is devising an investment strategy to fund a slate of expansion plans. They have proposed a network of transit lines throughout the Greater Toronto and Hamilton area, a grid-style system that reflects the current reality that not everyone wants to be funnelled into the downtown core.

Most of the projects are not funded, though, and it will be several years, in the most optimistic scenario, before shovels are in the ground on these.

In the meantime, people are increasingly upset about the situation. Forthcoming research by IBM Canada analyzed Twitter traffic, finding that the messages sent by Toronto drivers suggest they are the most unhappy in the country.

While transit is an overarching priority, experts say there are other things that can be done to help ease the flow on roads, and these efforts are essential to reduce environmental damage and overall frustration.

Fortunately, there are bright ideas being developed that keep cars moving, and drivers sane.

THE HIGHWAY FACTOR

A good place to start looking for efficiencies is local on-ramps. According to Eric Miller, professor of engineering at the University of Toronto and former director of the Cities Centre, gains can be made by something as simple as delaying vehicles approaching highways. Each vehicle that enters the mass of faster-moving traffic can be disruptive, he explained, and speeds may be improved with a traffic light that allows only one or two cars at a time to merge.

“Dynamic speed control” is a more advanced technique that modifies limits based on traffic conditions and has been implemented in Spain, England and Germany. The idea is rooted in the way small delays ripple back through traffic to cause a large slowdown – for example, when people gawk at an accident. The faster you’re going, the more jumpy you are on the brake, Prof. Miller explained, and the more likely you are to cause tiny delays that cascade through the system. With dynamic speed control, increasing congestion provokes a small reduction in the speed limit.

“If you bring the average speed down just a little bit, you’re reducing those stopping distances a bit and you’re keeping people more comfortable in the denser flow,” he noted. As a result, people are less likely to touch the brakes.

THE DRIVER-DRIVEN METHOD

Want to manage vehicle flow in real time? Crowd-sourcing taps motorists for data and leaves them feeling more in control. Updates about traffic conditions would be provided by drivers through a cheap-to-develop app, either automatically or using a voice-to-text interface.

A professor in San Diego has created the [California Traffic Report](#), allowing drivers to contribute to a picture of traffic patterns. And Alberto Leon-Garcia, professor of electrical and computer engineering at U of T, says the technology already exists for traffic lights to adapt to such a stream of incoming data. If enough people participate, the data could have a real benefit.

“What the system does is it has to translate that into a set of signals ... that basically make the appropriate amount of capacity, travel capacity, available and hence meet the demand at that point in time,” the scientific director of the NSERC Strategic Network for Smart Applications on Virtual Infrastructures (SAVI) said after a briefing organized by IBM Canada, one of SAVI’s corporate supporters.

Although it would cost millions to set up such a traffic signal system across the entire city, Prof. Leon-Garcia noted that the Pan-Am games could offer a chance to test-drive the concept on a smaller scale.

SMART LIGHTING

Toronto's traffic-light system is aging, according to Myles Currie, director of Toronto's traffic management centre, with its most advanced type dating to the early 1990s.

This part of the current system, dubbed SCOOT, involves sensors in the road that monitor traffic flow approaching intersections and communicate with the control centre to adapt to conditions. The city is assessing the system to see if it needs to be modified or replaced, and there are much fresher, innovative ideas out there, as scientists around the world race to develop smarter traffic signals.

One particularly futuristic-seeming concept, under development in Norway, analyzes pedestrian and cyclist behaviour and deduces whether they will be wanting to cross the road. Signals react accordingly. The MARLIN system Prof. Abdulhai has tested isn't quite as advanced, but he says it could cut travel times on major corridors such as the Lakeshore by 25 per cent, and reduce emissions by 30 per cent.

No major city is free from traffic problems, and urban planners say that the situation, while frustrating, is a sign of a healthy community. So along with all the congestion-busting ideas, the necessary final ingredient may be a different public attitude – a change in what we consider acceptable.

In his book *Fighting Traffic*, Peter Norton describes the early battles by the automobile lobby to gain pre-eminence on the road, over the objections of other users. Drivers won that fight and the idea has become entrenched to the point that some argue roads are for motorists only.

But even if roads were exclusively for motorists, still there would not be enough space. And others continue to insist that city streets remain multimodal, with space given over to cyclists, pedestrians and other users.

"Why motorists should have the priority is far from clear," Prof. Miller said. "Streets are for moving people, but they're for much more than moving people. They're part of our urban form."

THE WILL AND THE WAY

The good news for cities out of the federal budget this week is that they can count on stable infrastructure funding from Ottawa. The budget earmarked more than \$47-billion for infrastructure over 10 years. Much of this is re-allocation of existing funding, but there will be more money for municipalities, and Toronto is already angling for its share.

Toronto councillor and TTC Chair Karen Stintz responded to the federal budget by immediately calling for the city to apply for funding for a new subway line, taking pressure off the overloaded system. But a compatriot on council, Denzil Minnan-Wong, cautioned that the city's road and water systems are in need of serious investment.

There will not be enough money to make everyone happy. Setting priorities will involve difficult discussions and winning the suburbs is key. There's a net inflow into Toronto each day of about 230,000 people, many of whom don't have alternative modes of transport. This is a ready constituency for politicians who claim to be fighting against the so-called "war on the car."

Still, while road vs. rail is an old debate in Toronto, there are solutions out there. But it will take a dose of fresh thinking to break the deadlock.