

Two new studies suggest ways of improving traffic flow

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(PhysOrg.com) -- Two studies have just been published that may help improve traffic flows. The first, presented as a Santa Fe Institute working paper for September, concluded that if traffic lights responded to measured traffic flow instead of being timed. The second, published in a special edition of *Philosophical Transactions of the Royal Society*, looked at how driver behavior affects traffic flow. Traffic congestion is a growing problem globally, and minimizing it would save money and cut emissions, as well as reducing stress and frustration in drivers.

Traffic lights are usually controlled by an "optimal" timed cycle maximized to suit an expected flow of traffic for the time of day, but the problem is the large variability of traffic volume and the direction vehicles travel on leaving an intersection even on a "typical" day. This

can lead to gridlocks or [traffic congestion](#) if too many vehicles are made to wait too long, and to frustration if drivers are made to wait at red lights when no vehicles are present on the intersecting road to take advantage of the green.

Co-author of the first study, Dirk Helbing of the Swiss Federal Institute of Technology in Zurich, said the current method of top-down control is not optimal because the average situation for which it is designed rarely occurs. With colleague Stefan Lämmer of the Dresden University of Technology, Helbing studied crowd movements through a narrow space and discovered a natural “[traffic light](#)” develops with many people from one side moving through the space and then the flow reversing suddenly and those waiting at the other side moving through.

Helbing said the natural movement oscillation is the result of build-up of pressure on the side where people are waiting, and they wondered if the same principle could be used to control traffic, so the [traffic flow](#) controls the light rather than the opposite.

They ran a simulation in Dresden city center, fitting two sensors to each traffic light to detect incoming and outgoing traffic flows. Each traffic light communicated only with its nearest neighbors, so that “platoons” of vehicles could be detected in enough time to give the next set of lights time to prepare and avoid stopping the large number of vehicles. The area covered in their experiment included 13 sets of traffic lights, 68 pedestrian crossings, seven bus and tram lines crossing the network every 10 minutes, and a train station handling over 13,000 passengers a day.

The results of the experiment showed traffic flow was improved for all vehicles and pedestrians, with trams and buses spending 56 percent less time waiting in traffic, other vehicles spending nine percent less time stuck, and a 36 percent reduction for pedestrians.

Adopting traffic light systems that improve the flow addresses only one part of the problem because vehicles are driven by humans and their behavior can have a significant effect on traffic flows. The second study found that drivers who are too aggressive are a major cause of traffic jams, because of their habits of driving too fast, tailgating, and frequently slamming on the brakes. Timid drivers also cause traffic to slow because they leave too big a space in front of them and “send a wave of deceleration” behind them.

The paper’s author, Dr Jorge Laval, of the Georgia Institute of Technology in Atlanta, said "stop and go" driving behavior is a frustration for drivers, which affects safety, and it increases fuel consumption and emissions.

With colleague Ludovic Leclercq of the University of Lyon in France, Laval studied traffic on stretches of freeway in Los Angeles and near San Francisco, and then created a mathematical model to match their observations.

Their results showed that changes of speed passed like a wave backwards through traffic, and the slowdown was worsened by aggressive drivers, who kept too small a gap between vehicles, causing them to frequently brake hard at the last moment and then drive more slowly to open up a gap. Traffic speed also slowed with timid drivers, because they deliberately drove even more slowly to increase the gap between their vehicle and the one in front.

The responsive traffic light system will soon be implemented in Dresden, and Zurich is also considering adopting the system. Laval and Leclercq suggest the driver behavior problems could be addressed by an increasing use of adaptive cruise control (ACC) that can keep the gap between cars at a set distance.

More information: A special edition of *Philosophical Transactions of the Royal Society*: 'Traffic jams: dynamics and control':
rsta.royalsocietypublishing.org ... content/368/1928.toc

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