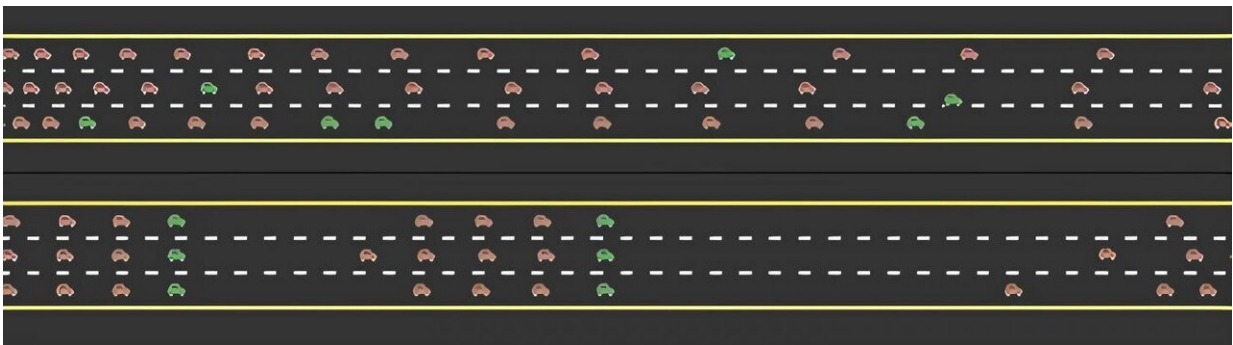


A small number of self-organizing autonomous vehicles significantly increases traffic flow

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With the addition of just a small number of autonomous vehicles (AVs) on the road, traffic flow can become faster, greener, and safer in the near future, a new study suggests. Dr. Amir Goldental and Prof. Ido Kanter, of Bar-Ilan University, present a simple set of guidelines and regulations for achieving the self-organization of AVs into constellations that dynamically control the entire traffic flow in *Journal of Physics A: Mathematical and Theoretical*. The researchers suggest guidelines for efficient regulations, such that AVs can cooperate and significantly enhance traffic flow even when fewer than 5% of the vehicles on the road are autonomous. This image shows a transition from mixed traffic containing human-operated vehicles (red) along with a small number of AVs (green) to self-organized constellations of AVs. Credit: Dr. Amir Goldental, Bar-Ilan University

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The study, published in *Journal of Physics A: Mathematical and Theoretical*, focused on the anticipated hybrid [traffic flow](#) of the future, which will combine traditional, human-operated vehicles with a small fraction of AVs. This scenario raises several questions as to whether [traffic](#) flow would actually improve and, if so, how many AVs would be required to produce significant change.

It may seem that a large number of AVs is required for a significant impact on traffic flow, especially on multilane freeways, as human drivers can simply ignore and bypass AVs. But this isn't necessarily so. In their research, Dr. Amir Goldental and Prof. Ido Kanter, from the Department of Physics at Bar-Ilan University, present a simple set of guidelines and regulations for achieving the self-organization of AVs into constellations that dynamically control the entire traffic flow.

The researchers suggest guidelines for efficient regulations, such that AVs can cooperate and significantly enhance traffic flow even when fewer than 5% of the vehicles on the road are autonomous, as seen in the accompanying video and image. In their article, the researchers describe how AVs should behave on a freeway in order to self-organize into groups that split the traffic flow into controllable clusters. It was observed that it takes less than two minutes to achieve self-organized high-speed, greener and safer traffic flow when starting from congested traffic.

"Without regulations on AVs, we face a classic example of game theory paradox, such as the prisoner's dilemma, where each [vehicle](#) tries to optimize its driving speed but the overall traffic flow is not optimal. In our research we examine how, with proper regulations, a very small number of AVs can improve the overall traffic flow significantly,

through cooperation," says Dr. Goldental.

Quantitatively, the authors report a substantial increase of up to 40% in traffic flow speed with up to a 28% decrease in fuel consumption. Also, traffic safety is enhanced as traffic becomes more ordered and fewer lane transitions occur. The study shows that these improvements can be achieved without a central agent that governs AVs and without communication between AVs using current infrastructure.

More information: Amir Goldental et al, A minority of self-organizing autonomous vehicles significantly increase freeway traffic flow, *Journal of Physics A: Mathematical and Theoretical* (2020). DOI: [10.1088/1751-8121/abb1e1](https://doi.org/10.1088/1751-8121/abb1e1)

Provided by Bar-Ilan University

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