Computed Commutes: The Mathematics of Getting from Here to There

We often take for granted everyday activities such as receiving a package, hailing a rideshare, or using an app to get directions. Mathematics and statistics have made these innovations possible and have shaped almost every aspect of our transportation system, including ■ transportation planning, ■ trip planning and logistics, and ■ the future of autonomous vehicles.

■ SCHEDULING DELIVERIES

The Traveling Salesperson Problem is a classic optimization problem that can be applied to delivery services. This helps find the shortest route to visit a given list of destinations.

■ RIDESHARING

Rideshare platforms solve a "matching problem" to assign drivers to passengers, minimizing total wait times. The optimal solution does not always match the closest vehicle to the closest passenger.

■ FIRST RESPONDERS

Statistical predictions are used to determine the optimal deployment of ambulances to minimize response times.

■ TRAFFIC FLOW

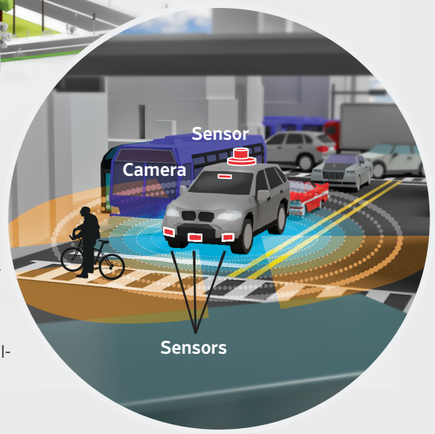
Braess's Paradox mathematically demonstrated that closing roads can sometimes lead to improved traffic flow. Although counter-intuitive, this has improved traffic in many cities.

■ REAL-TIME TRAFFIC/GPS

Advanced vehicle navigation systems suggest optimal routes by incorporating real-time statistical traffic conditions with machine learning predictions.

■ ALTERNATE MODES OF TRANSIT

Statistical modeling and simulations, along with mathematical optimization methods, determine optimal bus routes, placement of new bike lanes, and road closures for pedestrian thoroughfares.



■ AUTONOMOUS VEHICLES

Self-driving cars determine their location using Bayesian statistical techniques — which refresh analyses based on continually updated data — and recognize objects using machine learning.

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