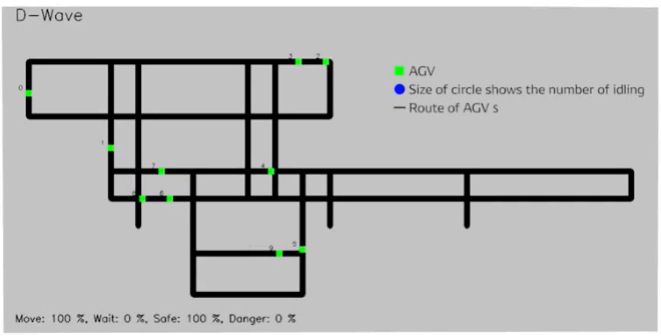
DENSO: Imagining An Optimized Future with Quantum Computing

A Case Story

"In a future where everything is connected, there will be an expanding range of possibilities. The solution that appears to be the best will be derived instantly from this vast range of possibilities. We are imagining the future utilization of big data."

DENSO Corporation



The amount of time each Automated Guided Vehicle (AGV) spent waiting for a clear route to open up was reduced by an average of 15% in this proof-of-concept.

Destination: Quantum

DENSO Corporation is the leading supplier of advanced automotive technology, systems, and components for most of the world's major automakers. In a time of major change for the industry, they are racing toward the future, exploring new frontiers of innovation such as quantum computing to understand how it will benefit their business, their customers, and their partners.

With their focus on automation, efficiency, and sensing, communication, and AI technologies, DENSO anticipates a broad need for the power of quantum computing in future business. In addition to creating smarter, safer, more environmentally friendly automotive components, the company envisions incorporating quantum computing into everything from production and robotics to scheduling and logistics for product delivery.

Work is already underway to make that vision a reality. DENSO recently completed proof-of-concept work aimed at optimizing control of Automated Guided Vehicles (AGVs) on their factory floors. These robotic transports move materials around the factory using automated guidance systems. Given the number of AGVs working at a time, striking a balance between smooth control of each machine and collision avoidance while keeping pace with production needs is of paramount importance.

Using the power of hybrid classical-quantum computing, DENSO narrowed down and ranked the optimal number of paths AGVs could take around the factory. Then, they focused on reducing traffic congestion across the ecosystem.

The results were significant: researchers were able to produce solutions that reduced the amount of time each AGV spent waiting for a clear route to open up by an average of 15%, even when focusing on safety over speed.

Shifting Gears on Connected Mobility

Optimizing traffic routes for multimodal transportation systems might seem like a strange goal for an automotive manufacturer, but that's exactly what DENSO is working towards next. In 2018, the company announced plans to use a quantum computer to analyze IoT traffic data in partnership with Toyota Tsusho. Since then, DENSO has undertaken several projects to assess how the D-Wave system can aid in the optimization of traffic flow.

DENSO Game-Changing Technologies

Quantum Computing

Optimize the Moment.

One project focused on coordinating ride share and taxi services with large vehicle services, like buses. In this proof-of-concept, DENSO compared the results obtained on the D-Wave 2000Q™ system against a classical mathematical solver. Numerous constraints—including vehicle and passenger location and destination, existing bus routes, and the placement of transit junctures—made route optimization challenging. Even so, on a small scale, focusing on a small number of passengers and less than 52 variables, the D-Wave system found good solutions more quickly. Even after scaling the problem up, the D-Wave system found feasible solutions within a margin of 10%.

Another project looked at the problem of optimizing delivery vehicle scheduling and routing, taking into account variables such as time windows for deliveries, vehicle capacity, and traffic conditions. As in the first proof-of-concept, the quantum algorithm that DENSO developed worked better for small examples than classical computing methods and tools.

Encouraged by these results, DENSO plans to expand their approach in the future to address larger problems that mirror real-world applications. A larger D-Wave processor will be integral to continuing the team's research, as will another of DENSO's projects: developing increasingly effective hybrid algorithms.

An Algorithm for the Future

In tandem with their ongoing work, DENSO has continually looked for ways to refine and improve the methods by which they obtain answers to critical research questions.

In 2019, DENSO and Tohoku University announced the creation of an algorithm designed to improve the ability of a D-Wave system to handle complicated problems. The algorithm partitions an original, large problem into a group of subproblems. The D-Wave system then iteratively optimizes each subproblem to eventually solve the original, larger one. "The proposed algorithm is also applicable to the future version of the D-Wave quantum annealer, which contains many more qubits," said Masayuki Ohzeki, Associate Professor at Tohoku University. "As the number of qubits mounted in the D-Wave quantum annealer increases, we will be able to obtain even better solutions."

At DENSO, taking up challenges is part of their culture. Their work in quantum computing continues to inspire others to "imagine the future" and "optimize the moment".

D-Wave

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