Decentralized Shared Intelligence of Autonomous Vehicles With Real-Time Multi-Agent Reinforcement Learning

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According to the World Health Organization, over 1.3 million people are killed each year in road traffic crashes worldwide. Autonomous vehicles have the potential to solve these issues and are the future of transportation. For the last 10 years, several leading tech companies have been conducting extensive research into the field, with some developing Level 4 autonomous driving: vehicles that are fully self-driving with only manual override. However, while fully autonomous systems have been simulated in ideal conditions using deep learning, it is difficult to implement them in the real world. We devised an autonomous system for navigating highways using multi-agent reinforcement learning (MARL) using a shared intelligence system, allowing each agent (in this case the vehicles) to avoid collisions and efficiently move through traffic. We tested our algorithm first on a simulator, then generalized it to the real world. The movements of the physical cars are captured by the Vicon motion capture system (in place of GPS), and streamed to a remote server, where the data is inputted into the simulator and the outputs are the optimal acceleration and steering angle for each physical vehicle in real-time. To generalize our system to the real world, we trained our agent on varying parameters using a technique called active domain randomization. Our final collision rates on the simulator and physical track were 0.6% and 8% with average speeds of 25.7 m/s and 0.95 m/s. Our MARL algorithm has the potential to revolutionize transportation methods saving millions of lives while expediting traffic.

Awards Won:
Third Award of $1,000
SAE International: Best Projects
Fondazione Bruno Kessler: Award to participate in summer school "Web Valley"
Association for the Advancement of Artificial Intelligence: Honorable Mention
Association for the Advancement of Artificial Intelligence: AAAI Membership for the School Libraries of All 8 Winners (in-kind award / part of 1st-3rd prize and honorable mentions' prize)
Central Intelligence Agency: First Award: $1000 award