Argonne NATIONAL LABORATORY

THE ADVANCED MOBILITY TECHNOLOGY LABORATORY

Argonne's mobility technology assessment team leads the charge in electrified, connected and automated vehicles

With the number and variety of vehicle propulsion technologies increasing combined with the emergence of connected and automated vehicles (CAVs), evaluating the impact of these advanced technologies and capabilities on overall vehicle efficiency becomes ever more necessary.

Comprehensive and system understanding of the impacts and sensitivities of a particular advanced vehicle technology regularly requires a combination of on-road, on-track, and laboratory (chassis dynamometer) testing with instrumentation and data collection equipment tailored to the desired research objectives.

RESEARCH FEATURES

- Research staff with expertise in advanced vehicle technologies, instrumentation, testing, and analysis
- Vehicle communication (CAN) decoding, recording, replay, and override
- Vehicle-in-the-loop capability to evaluate CAV technologies and behavior
- In-house-developed, customizable robotic driver with adaptive learning capability
- Experience with light- and medium duty, 2-, 3-, and 4-wheeled vehicles
- Detailed 10Hz vehicle- and component-level data analysis

TESTING STRATEGIES AND TECHNOLOGY ASSESSMENT

Argonne's vehicle technology assessment and test facility provides the ability to measure performance and efficiencies for nearly any type of vehicle and energy source — from conventional and hybrids to all-electric and alternative-fuels models — in a controlled laboratory environment. Today, experts at the Advanced Mobility Technology Laboratory (AMTL) combine on-road, on-track, and laboratory experiments to accurately characterize propulsion technologies, advanced driver assistance, and automated driving systems to evaluate their impact on energy consumption as well as other criteria such as following behavior and traffic flow.

A range of stakeholders relies on our expertise in developing and executing approaches for advanced technology assessment with a mix of advanced analytical and experimental techniques. Argonne's facility and experience are key elements of the U.S. Department of Energy's (DOE's) vehicle and mobility research efforts and serve as DOE's premier technology assessment laboratory. Overall vehicle performance, typical operating behavior, and control, as well as detailed component-level data present key inputs for the development and validation of Argonne's state-of-the-art vehicle powertrain and transportation system modeling tools.

U.S. DEPARTMENT OF ENERGY
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ARGONNE'S CAVS TEST BED

Argonne's engineers use the facilities, tools, and capabilities to study transportation and mobility issues holistically. As connectivity and automation bring about new opportunities for vehicle operation and refinement, so too grows the need for validation data. This need applies to both specific components and traditional control aspects and new parameters such as driver behavior and the impact of Advanced Driving Assistance System features on the surrounding traffic. To better understand the ever-increasing spectrum of data relevant to and coming from emerging CAV technologies, recent efforts have seen the team deploy advanced technology vehicles as mobile sensors for on-road data collection.

While standardized testing today still relies on human drivers, AMTL experts also employ robotic drivers and vehicle-in-the loop (VIL) capabilities to accurately and realistically investigate the efficiency implications of a range of automated driving technologies and connected vehicle operating strategies. Comprehensive VIL operation typically requires intercepting and manipulating vehicle communication (CAN and V2X), effectively having a vehicle think it is driving on-road in typical conditions, as opposed to a controlled laboratory environment. In addition to the obvious technology assessment benefits this capability brings, it is also a critical link with Argonne's cybersecurity experts, allowing for threats to be evaluated while still leveraging the safety and robustness benefits of a controlled laboratory environment.

The AMTL team also uses Argonne's campus collaboratively with the EV-Smart Grid and Interoperability Center to perform hardware-based research on grid-connected vehicles.

SYSTEM ENGINEERING APPROACH

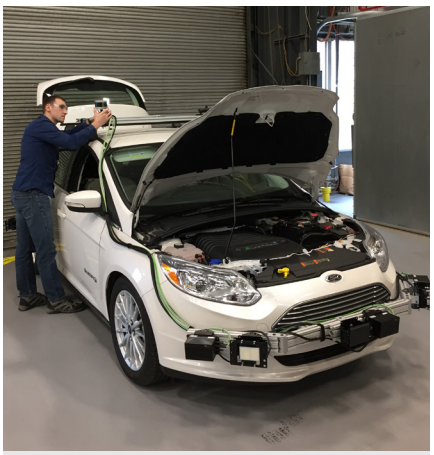
With multidisciplinary expertise and a comprehensive approach, Argonne:

- Evaluates technologies in a systems context over a wide range of realistic ambient test and driving conditions
- Uses novel instrumentation to directly capture the power flow and energy balances between powertrain components
- Assesses vehicle-to-vehicle interactions of novel automated driving strategies and technologies through a tailored mix of on-road and on-track data collection and laboratory-based experiments
- Creates component loss and efficiency maps as well as vehicle and component operating regimes to help develop and validate simulation models
- Develops and executes multi-vehicle and multi-fuel research studies to answer big questions with data

FORWARD-LOOKING RESEARCH

In addition to continually investigating the state-of-the-art as it relates to vehicle technologies, Argonne researchers are also looking to identify future synergies and challenges in the connected and automated vehicle landscape. Specifically, Argonne looks at how intelligent vehicles can improve overall transportation system efficiency as well as how vehicle electrification interacts with improved transportation and electrical grid efficiency and resilience.

At the prototype and small-pilot level, researchers find Argonne's closed and controlled campus and its upgraded communication and infrastructure ideal for evaluating automated vehicles and their surrounding scheduling and communications infrastructure.



INSTRUMENTATION HIGHLIGHTS

- 4WD chassis dyno within controllable thermal chamber (0-95F) with 5 gas emissions bench (modal and bag) and electrical power emulation to 200A@480VAC
- Modular, flexible data acquisition system with real-time data display
- Advanced sensor arrays (Lidar, Radar, Camera, V2X, GPS) enabling research into connected and automated vehicle technologies
- Portable instrumentation for high fidelity on-road, track, and dynamometer data analysis
- High-precision direct electrical power, direct fuel flow, in-cylinder pressure and in-situ component torque measurement

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