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Top -level research and data

Experimental analysis of various energy conversion devices and modeling of their components (motor, inverter, battery, engine, catalyst), cooling systems, and numerical prediction models of energy consumption and emission gas for various automotive powertrain devices.

Keyword

- Experimental Measurement
- Thermal Energy Conversion Reactions
- Thermo-fluid dynamics
- Numerical Prediction Technology

Deployment targets (sites, materials, etc.)

Numerical prediction of various automotive and stationary energy converter systems (engine, motor & inverter, battery, catalyst)

Features (implementation means, etc.)

Experimental and numerical studies are conducted utilizing a vehicle chassis dynamometer with 4-motor independent control system, engine and motor test cells, catalytic reactors, and battery test system. As an example shown in Figure 1, we conduct battery charge/discharge characteristic tests using battery test bench, measure the temperature distribution inside the battery pack, coolant flow rate, coolant temperature, and coolant pressure drop during the driving test cycle, and build a battery thermal management model (charge/discharge characteristics, battery temperature, coolant temperature and pressure drop). Carbon-neutral fuels synthesized from renewable energy sources should also be searched for H_2, NH_3, and eCH_4 (e-methane) as well as for drop-in fuels whose properties are similar to those of gasoline and Diesel fuels because drop-in fuels which are sometimes called as e-fuel can be used without modification at existing service stations (SS). Numerical prediction by chemically reacting thermo-fluid simulation will be conducted to develop higher efficiency and cleaner energy conversion devices. Figure 2 shows a visualized image of the inside of a cylinder in which a burnt gas jet generated in a pre-chamber of methane + H_2 mixture is injected into the main combustion chamber.

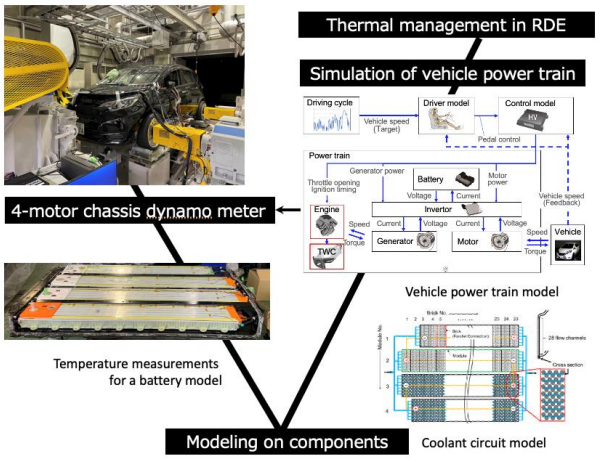

Figure 1: Battery temperature prediction modeling

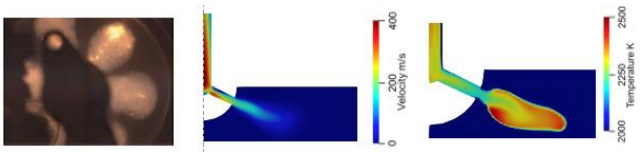

Figure 2: Methane-Hydrogen Mixed Combustion Experiment and Numerical Simulation Visualization Image

Associated proprietary technologies

Various measurement, modeling, and numerical simulation (chemical reaction, heat and mass transport phenomena) technologies to realize the above.
Facilities: Test benches for engines and motors (8 rooms), 4-motor independent chassis dynamometer, Laser measurement room, rapid compression and expansion machine, constant volume chamber, YAG laser, single fuel cell test equipment, reactors for catalyst testing (2 units), under-floor maintenance pit for vehicle test set-up

Expected outcome/ applications

Research and development of HEV and EV powertrains, heavy-duty vehicle engines, various stationary energy conversion devices, emission gas purification catalysts, hydrogen generation (e.g., water electrolysis) equipment, and evaluation and development of new fuels

Associated SDGs