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A Prediction of CO2 Emissions by HEVs or EVs with Modified Drivetrains of Engine Powered Delivery Truck

Noritaka Matsuo [1)]

1) Matsuo Engineering Office
1-15-12 Asahigaoka, Kakegawa, Shizuoka, 436-0062, Japan (E-mail: mec-matsuo@mail.wbs.ne.jp)

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The wave of EV shift is approaching delivery vehicles such as home delivery trucks, but it will be a heavy management burden for delivery companies to replace their engine vehicles with EVs. Therefore, we devised a modification in drive trains of diesel trucks for gradually converting to HEVs and even EVs, then predicted CO2 emissions by the converted HEVs or EVs.

First, a diesel truck was converted into a parallel HEV with a planetary gear type power split device(Fig.1,2) and a multi-speed transmission. The planetary gear device enables the speed ratio between the engine and the motor to vary continuously to keep the engine operated in the best fuel consumption condition, so called 'Sweet-Spot'(Fi.3), and the multi-speed transmission enables the battery keep the SOC within an allowable range by means of changing the shift pattern according to the battery SOC. In the simulation result, the fuel economy of the HEV in the drive cycle assuming a home delivery use was improved by 48% compared to the base diesel truck(Table-1).

Next, the HEV was converted into a two-motor EV by replacing the engine with a drive motor with equivalent output. By the simulation, the vehicle could improve mileage in the drive cycle by 9% compared to an EV with one motor and a decelerator without shift function, using the control mode of the planetary gear device to fix the speed ratio between two motors.(Table-2)

In the two motor EV, a continuously variable speed ratio mode(Parallel) had lower efficiency than a fixed speed ratio mode (Power) , contrary to previous expectation. The EV obtained may not be able to take full advantage of the continuously variable speed ratio, so we plan to consider optimizing the system in the future.

Finally, we compared the CO2 emissions of diesel trucks, HEVs, and EVs, and found that HEVs are 1/2 of diesel vehicles, and EVs are 1/2 of HEVs.(Table-3)

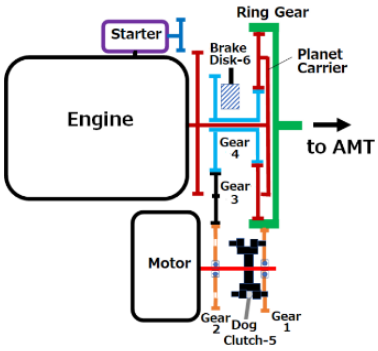

Fig.1Schematic of Powe Splt Device

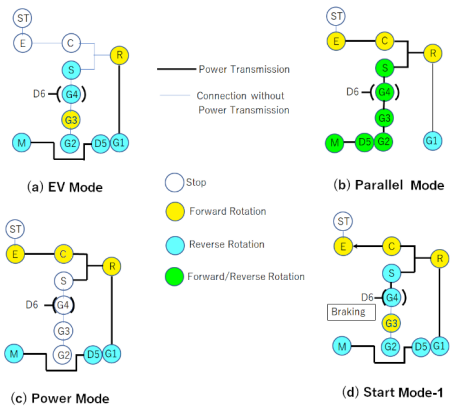

Fig.2 Power Transmission in Powe Splt Device

Table-1 Simulation Result of Fuel Economy in Drive Cycle

ICEV	HEV
9.34km/L	18.11km/L(△48%)

Table-2 Electric Mileage in Drive Cycle

1-Motor EV	2-Motor EV	
	Parallel Mode	Power Mode
4.67km/kWh	5.06(△7.7%)	5.14(△9.2%)

Table-3 Comparison of CO2 Emissions

ICEV	HEV	2-Motor EV
0.299kg/km	0.154kg/km	0.078kg/km

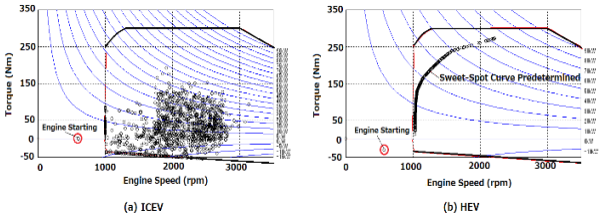

Fig.3 Distribution of Engine Operating Point