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REAL-TIME CONTROL ALGORITHM FOR HYBRID SYSTEM USING GEAR SHIFT MAP AND MODE CONVERSION MAP

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ABSTRACT–In this paper, we propose a new control logic for hybrid vehicle control technology using predictable real road information. The newly proposed control logic is implemented in real time by applying the shifting map of the engine and transmission applied to the hybrid vehicle and the mode conversion map extracted from various driving modes. The proposed control logic has the advantage of minimizing the loss compared to the theoretical maximum fuel consumption implemented in the backward simulation and achieving more stable shifting and mode conversion. As a result of applying the proposed control algorithm to the omnidirectional simulation, the result showed better fuel efficiency improvement than the existing rule base control method. The newly proposed control algorithm can be used as a hybrid control algorithm that can solve the computation time problems required for the optimization process through the conventional reverse simulation and can perform stable shift and mode conversion in real time.

KEY WORDS : Hybrid vehicle, Real-time control algorithm, Pre-driving information, Gear shift map, Mode conversion map, Power distribution, Power split ratio

NOMENCLATURE

$\dot{m}_{fc}$	: instantaneous fuel consumption (g/s)
T_{eng}	: engine torque (Nm)
ω_{eng}	: engine speed (rad/s)
$P_{motelec}$	: electric power of battery (W)
T_{mot}	: motor torque (Nm)
ω_{mot}	: motor speed (rad/s)
F_{load}	: road road (N)
m_v	: mass of vehicle (kg)
a_v	: accelearation of vehicel (m/s^2)
C_r	: coefficient of rolling resistance
ρ_a	: air density (kg/m^3)
A_f	: frontal area of vehicle (m^2)
C_d	: coefficient of aero dynamic drag (–)
V_v	: velocity of vehicle (m/s)
r_{tire}	: tire radius (m)
P_{eng}	: engine power (kw)
P_{mot}	: motor power (kw)
ω_{in}	: speed of input shaft (rad/s)
ω_{out}	: speed of output shaft (rad/s)
F_{TM}	: gear ratio of final drive (–)
Q_{bat}	: capacity of battery (Ah)
V_{bat}	: open circuit voltage of battery (V)
R_{bat}	: internal resistance (Ω)
P_{bat}	: output power of battery (W)

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SUBSCRIPTS

S	: time (sec)
DP	: dynamic programing
HCU	: hybrid control unit
PSR	: power split ratio
G	: gravity (m/s^2)

1. INTRODUCTION

Due to recent severe weather, countries are strengthening the eco-friendliness of automobiles through regulation on fuel efficiency and emission of vehicles in operation. In order to cope with this, many efforts are being made to develop and distribute environmentally friendly vehicles. There are hybrid vehicles, electric vehicles and hydrogen fuel cell vehicles classified as eco-friendly vehicles. Hybrid cars can be considered a realistic alternative because of the drawbacks such as the high prices of electric cars and hydrogen fuel cell cars and the lack of charging infrastructure.

The hybrid vehicle is a vehicle driven by two or more power sources, and the performance of the vehicle is determined by a capacity of the power source constituting the hybrid vehicle and a control strategy for controlling the power sources while driving the vehicle. To determine the power source capacity ratio of the hybrid vehicle that can realize the optimum fuel economy in the design stage,