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Design and Development of Simple Control System for Small Hybrid Electric Vehicle

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Abstract. This research describes the scope of design and test a traction controller to combine a 6.54 kW gasoline engine power and 2x48VDC/0.5 kW electrical brushless motors in a serial-parallel type of small hybrid electric vehicle. A central control system was designed to operate the engine which is equipped with continuous variable transmission and electric motor on rear wheel side in order to select the optimal torque in normal driving condition. The battery charging system draws its energy from the engine using two alternators: 80 Watt built-in alternator and 300 Watt additional alternator which is driven using a power take-off unit. To increase the electric charging capacity, the electric motor is able to operate as a generator during acceleration or deceleration condition (regenerative system). The static preliminary testing shows that the electric motor can generate about 38% of nominal motor's power at 730 rpm of wheel rotation.

Introduction

Increasing in demand and high price of fossil fuels coupled with issue of global warming has stimulated scientists interest to create a "green transportation". Hybrid Electric Vehicle (HEV) has been commercialized since ten years ago and is intended to reduce fuel consumption to three times lower than conventional vehicles and aims to reduce exhaust emissions to lower significant amount. Correspondingly, a smart control system was needed to distribute the power of more than two prime movers to the wheel effectively. The system is able to control the power, maintain an adequate energy reservation in the storage devices (batteries) and enable all of the electrical and mechanical components to work together automatically [1]. Since 2001, Mechanical Engineering Department Universitas Indonesia has built five Hybrid Electric Vehicles, but none of these vehicles uses automatic transmission and fully hybrid automatic controller system [2]. This paper explains about the development of a real small hybrid electric vehicle using its smart control.

Design of Small Light HEV

Most of HEV developed by automobile manufacturers are not affordable to the Indonesian market. Development of light, small, and cheap HEV will bring these vehicles closer to the needs of the society. Availability of substitute components in local market and HEV's manufacture practicability also become consideration. Fig. 1a shows configuration design for series-parallel HEV. The vehicle used 2 electric 0.5 kW/48 VDC brushless motors installed on both rear wheels. A 6.54 kW commercial scooter engine equipped with continuous variable transmision was installed to propel the rear wheels using chain and sprocket transmission (Fig. 1b). A freewheel coupling was used on both rear wheels to anticipate the different wheel rotation as the vehicle turns. Similar system was introduced to release different load between IC engine and electric motor (Fig. 2).