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Analysis of vehicle's hybrid electric powertrain

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This paper deals with theoretical proposals for the co-operation of internal combustion engine and electric motor in series-parallel hybrid vehicle, to as low fuel consumption as possible and allow for dynamic driving. This is the car Volkswagen Touareg Hybrid with the 3.0 TSI engine.

1. Introdustion

The disadvantage of a conventionally powered vehicle (a vehicle powered purely combustion engine cooperating with manual gearbox) is that the firm has a dynamic characteristic which is caused by a given fixed transmission ratios of gears in the gearbox. The addition of conventional power in series-parallel hybrid electric vehicle by reason of the low efficiency of the internal combustion engine.

The effectiveness of today's internal combustion engines is around 30 to 40%. Petrol (gasoline) engines are mostly lower efficiency than diesel engines. But efficiency alone is given by the thermodynamic cycle, which in this type of internal combustion engine that runs and has its physical limitations, which are already today on its border. Another problem is that this effect can be achieved only under optimal conditions, which in normal traffic are difficult to achieve and also the internal combustion engine can operate only in a certain area of speed. Therefore, internal combustion engines need a transmission. But the mere use of the gearbox brings substantive additional mechanical losses and the limited number of gears.

Compared to internal combustion engine stand motors, whose efficiency is around 95% and this effect have relatively wide speed range. The disadvantage of using the car battery is a big weight and slow recharge (10-12h). Characteristic of the hybrid vehicle is the optimal use of both types of drives and allows for a hybrid vehicle several driving modes, which can optimize the economic efficiency and driving dynamics to the needs of the driver. Control of treatment depends on many parameters such as vehicle speed, load and speed of the internal combustion engine, coolant temperature, battery ...

2. VW Touareg Hybrid operating modes

Start – stop function: This feature allows the vehicle is stationary internal combustion engine off automatically when the vehicle is stationary at lights or in

traffic. This function is active only if the required conditions are met, such as. Vehicle must have a zero speed, engine speed shall be less than 1200 rev. / min., coolant temperature must be between 25 to 100 ° C, the energy in the battery must be sufficient, and also must be sufficient vacuum in the vacuum system. With automatic transmission, the driver must keep the intersection of the brake pedal. When the driver releases the pedal, the combustion engine starts automatically. High voltage network provides a vehicle air conditioning compressor operation, despite the engine stopped.

Electric drive: the vehicle is driven only electric vehicle, and thus produces no emissions and fuel consumption is zero. The scheme is subject to vehicle speed (up to 30 km / h), coolant temperature (at least 30°C) and battery charge status. [1]

The electric motor working in generator mode: the lack of electricity in the battery, three-phase electric motor will operate in generator mode. Through a voltage converter is supplied with electricity 12 volt on-board vehicle network and is charged with the high voltage battery. [1]

BOOST mode: the need for maximum power when overtaking for example, where the required maximum acceleration of the vehicle control unit switches to electric power system. Then the maximum total system power is 279 kW. Then the motor is supplied with electricity from high-voltage battery. The scheme is subject to sufficient charging high voltage batteries, maximum pressing the accelerator. [1]

Regenerative braking mode: When braking, the kinetic energy of the vehicle begins to transform vehicle kinetic energy through the electric machine into electricity, which then charges the high voltage battery. When braking, the brakes gently using only the electric motor, but when it exceeds a certain position of the brake pedal and the brake starts with conventional hydraulic brakes. [1]

Sailing Mode: The drive system is operated without an active drive, ie, when there is no active combustion engine or electric motor. The VW Touareg Hybrid will apply “concept of sailing.” At higher speeds, when the driver releases the gas pedal and turns off the internal combustion engine and the vehicle is moving freely, without braking (vehicle glides). Brake only electric motor, which operates in generator mode to feed the electricity board vehicle network. [1]

3. Analyzes of the complete characteristic of an internal combustion engine

The complete characterization of the internal combustion engine can be seen that maximum power is 245 kW in the range 5500 to 6500 rev / min. Maximum torque is 440 Nm at a speed range from 3000 to 5000 rev / min. It can be reflected in the chart to monitor individual running resistances acting on the vehicle that the gearbox gear. From this we can determine how much power and torque must be made to overcome the road load acting on the vehicle that the gearbox gear.

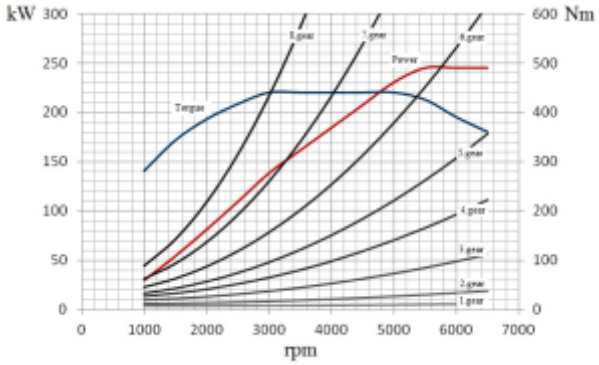

Figure 1: Complete characteristic of engine

By combining complete engine characteristics with a map of specific consumption, we can determine fuel consumption for a particular load, speed gear and the gearbox. This graph shows that the vehicle has the lowest consumption under load (about 300 Nm) at 7 and gear at 3000 to 3500 rpm.

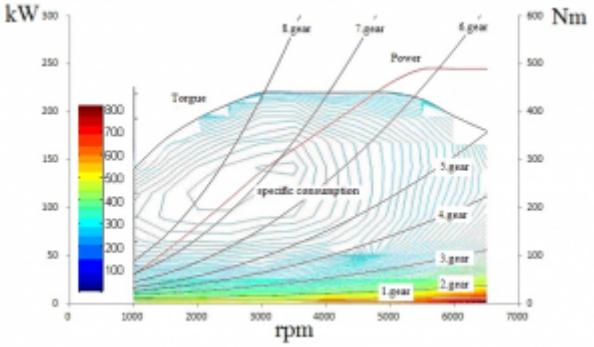

Figure 2: Complete characteristic of engine with a map of specific fuel consumption

4. Analysis of a complete characteristic of motor

On the complete characteristic of motor we see that the maximum electric power is 34.77 kW and maximum torque is 340 Nm. Furthermore, we can see traces of braking torque acting on the motor for a given gear, the gearbox and engine speed. By combining full speed characteristics of the map we can determine the efficiency of an electric motor which works best and when it again.

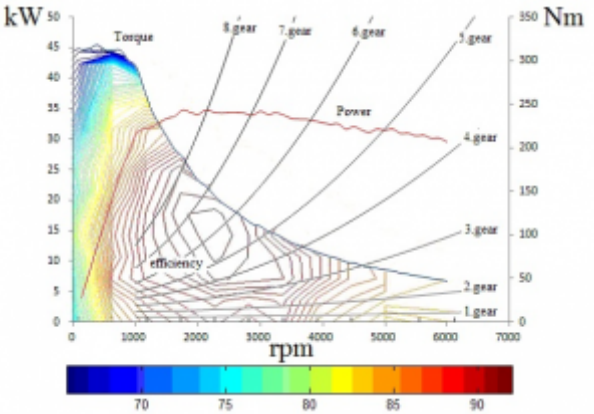

Figure 3: Complete characteristic of motor with map of efficiency

5. Conclusion

Appropriate management cooperation combustion engine and electric motor can achieve the lowest fuel consumption, with the highest efficiency of the hybrid system. This means that for example when the internal combustion engine is operating with low load and very high fuel consumption, the control unit, as far as conditions permit, set the motor to the generator, thereby increasing the load on the internal combustion engine and thus the internal combustion engine to operate with less fuel a generator can recharge the battery.

Conversely, if the internal combustion engine operates at high loads at high speed, the control unit adjusts the electric power system, which significantly reduces the combustion engine and can operate at lower power consumption while maintaining the required performance. The resulting control the hybrid system is another work.

References

1. http://green.autoblog.com/2009/02/02/volkswagen-to-launch-touareg-bluemotion-hybrid-in-2010/

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