Electric propulsion systems on HEVs: review and perspective

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Abstract

The present paper reviews in terms of topology and performance, what has been done so far on electric propulsion systems for HEVs, industry-wise and R&D-wise and introduces two novel systems (one for mild and the other for full HEVs). Electric propulsion systems on HEVs[1] are part of ICE vehicle electrification, to reduce fuel consumption and CO2 pollution and (or) increase human safety and comfort.

The electrification factor EF % is [1]:

\[
\text{EF} = \frac{P_{\text{electric}}}{P_{\text{ICE}} + P_{\text{electric}}} \times 100 (1)
\]

%EF is zero for standard ICE vehicles and 100% for purely electric vehicles. In between HEVs may be classified into 4 electrification factor regions (Fig.1). In terms of fuel economy HEVs produce in existing industrial solutions, results such as those shown in Fig. 1c.

While micro and mild HEVs require one electric machine plus PWM converter, the full hybrids may be parallel or series and require two electric machines (E-CVT), or dual mechanical port electrical CVT to keep the ICE around the sweet spot of max. efficiency (for certain speed and torque).

Apart from presenting representative recently proposed or commercial HEVs, the paper introduces two novel solutions: one is BEGA [2], Fig.2, for micro-mild HEVs and the other is the dual rotor single stator PMSM [3], Fig.3, for full hybrids.

Fig. 1 HEVs classification by a) EF, b) features, c) fuel economy [1]

References

