

Abstract: Permanent magnets synchronous motors are widely used for automotive applications, as they exhibit high torque density and high efficiency operations. In recent years, the trend is to adopt Interior Permanent Magnet (IPM) motors in applications requiring a wide operating speed range. However, the increasing cost of the rare-earth materials is going to change this trend. Innovative solutions consist in designing synchronous motors whose rotor includes both permanent magnets and excitation windings. Permanent magnets produce a constant flux linkage component, while excitation coils create a variable flux linkage. Excitation coils can either increase or decrease the permanent magnets flux, adding a further degree of freedom in the motor operation control. This machine is called Hybrid Excitation Permanent Magnet (HEPM) synchronous motor. The HEPM motor allows having an enhanced flux weakening operation, through a proper excitation current supply, so that a constant maximum power can be maintained after a certain speed. Alternatively, the HEPM machine can be employed designing a synchronous motor which allows a change of polarity. Thus, the machine behaves as two different polarity motors, extending the operating speed range. Some HEPM motor examples will be presented and each machine typology advantages and drawbacks will be discussed.