Light-Weight In-Wheel Module

Introduction
Electric vehicles were popular in the late 19th century and early 20th century. Unfortunately, they were replaced soon by internal combustion engine (ICE) vehicles because of their disadvantages in efficiency, power density, and controllability at that moment. However, since the end of the 20th century, public focus has reverted to electric vehicles due to rising concerns on environment and great development on battery, power electronics, and electrical machine technology.

The fast developing technology of hybrid-electric and electric vehicles (HEV/EV) has also introduced a revolutionary traction concept to vehicle designers, namely in-wheel traction. By putting electrical motors in the wheels, the mechanical axes can be removed to reduce the total weight and enlarge the cargo space (Fig. 2).

However, direct drive in-wheel motors significantly increase the wheel mass and consequently reduces the ride comfort. Therefore, a light-weight in-wheel module is proposed, in which the electrical motor is indirectly driving the wheel through a gearbox (Fig. 3).

Requirements and options
It is a challenge to select and design a suitable electric motor for this light-weight in-wheel module due to strict requirements as follows:
- Compact / Light / Efficient
- High torque at low speed
- Wide constant power speed range (CPSR)

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Objective
This project is aiming at an optimal design of in-wheel motors for light-weight in-wheel traction based on investigation of different types of electrical motors in terms of torque density, speed ratio, and efficiency.

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