Abstract

This dissertation addresses the development of an integrated magneto-mechanical design for the final prototyping of a magnetic gearbox transmission, integrating in a single device three different components, as clutch, gearbox, and torque limiter, to overcome the typical issues, as noise, wearing and vibrations, of mechanical power transmission systems. In the thesis, both magnetic and conventional transmission technologies are investigated with numerical, simulative, and experimental approaches.

In the first part of the dissertation, a novel methodology for the assessment of Dual Clutch Transmission vibrations during gear shifts is proposed, to predict, through numerical simulations and an offline post-processing, in a specific point of the gearbox housing its accelerations, which are used as a dynamic quantity to objectively evaluate the vibrational behaviour of gearbox inner elements during experimental tests. A sensitivity on the main geometrical parameters of gearbox has been conducted, with promising benefits in the reduction of gearshift noise.

On the other side, magnetic gears are proposed as structures able to transfer power and torques between two or more mechanical axles with a given speed ratio. They allow to transfer motion without contact between the moving parts, hence the possible adoption of a planetary magnetic gear (PMG) inside a hybrid automotive driveline has been investigated, designing a PMG able to transfer the torque needed without altering the powertrain dynamics. To handle these requirements, a multi-objective optimisation approach is carried out by a deterministic optimisation algorithm coupled to a weighted sum approach of objectives. Results are used in a transmission model developed in Simulink.

Finally, a constant effort has aimed at the development and design of several technological construction solutions, to validate the patented idea, to verify the effectiveness of the proposed system, and to highlight any possible critical aspect in different kinematic and dynamic operative conditions of the magnetic gearbox.