

**Key Characteristics:** Multi-objective design optimization regarding efficiency, cost, mass and package integration • Holistic approach considering all gearbox components (gears, shafts, bearings, housing) • Fully automated design method allowing effective development of gearboxes for electric vehicles • Provides solid basis for low-risk design decisions in the early product development phase •

## Holistic Gearbox Design Optimisation for Energy-Efficient Electric Vehicles

**The need for clean mobility, especially in urban and interurban areas, increasingly imposes strict environmental regulations on cars. This results in a rising demand for alternative drive systems.**

In order to secure their market shares, OEMs are required to reduce the time-to-market of newly developed cars and at the same time face the high degree of innovation in alternative powertrains.

This project aims to provide a design methodology capable of handling the resulting challenges. It focuses on a fully automated design process for gearboxes of xEV-axle drives by means of a multi-objective optimisation. Unlike published works, a holistic approach to the design problem is chosen by considering all machine elements found in xEV-gearboxes, including shafts, bearings, gears and housing.

Furthermore, all main design goals including the maximisation of efficiency, minimisation of cost and mass and favorable package integration are treated as objectives for the optimisation.

The analysis of the system 'gearbox' is done by state-of-the-art calculation schemes such as ISO 6336 for the load capacity calculation of the gears. Thus, the result serves as a solid basis for low-risk design decisions in the early product development phase. The current implementation permits 'overnight-optimisations' on a standard workstation computer, meaning that no resources are occupied during daily working time. The resulting Pareto front can be examined by experts and promising designs further investigated in the design process.

Accordingly, the proposed approach enables the effective development of efficiency-, cost-, mass- and package-optimal xEV-gearboxes •

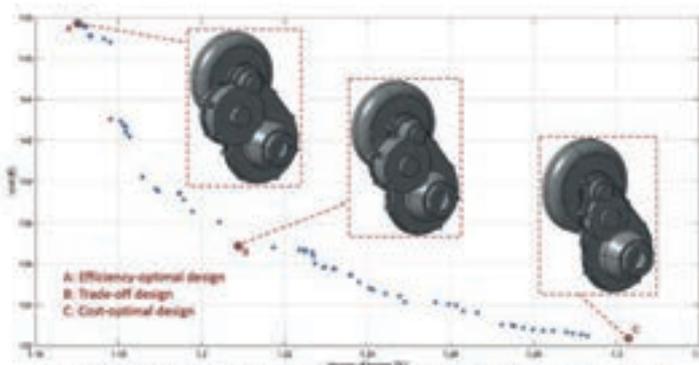


Figure 1: Gearbox optimization result for Peugeot iCt: Pareto front in dimensions 'cost' and 'degree of losses'

