Content

1 Introduction

The rapid development of the automobile market demands an efficient and precise suspension development approach, in which the optimisation on the suspension kinematics plays a major part. Suspension kinematics refers to the variation of toe angle, camber angle, track width, etc. during wheel travel and steering. Optimisation with these multi objectives is hard to achieve simultaneously. The optimisation of single objective has been successfully achieved [YAN09], but an efficient multi-objective optimisation method capable to deal with those characteristics at the same time and also applicable for different suspension types is still under development.

The modern intelligent multi-objective optimisation algorithms have been researched for decades[ROS67] and have many successful applications. The goal of this work is to optimise the suspension kinematics using the multi-objective optimisation algorithm. Firstly, with the given suspension parameters, the kinematics should be simulated quickly and with sufficient accuracy. An in-house developed MS Excel based software “aksis” developed by fka is here used as the simulation tool to determine the kinematic characteristics of a suspension. Secondly, multi-objective algorithm is programmed in MATLAB. Its optimisation toolbox in MATLAB provides various algorithms that can be directly deployed for optimisation.

Literature research is done at the beginning of this work. The details about suspension kinematics and its influence on the vehicle dynamics will be introduced at first. Then various multi-objective optimisation algorithms are briefly presented, followed by its applications in suspension kinematics’ optimisation field.

A suitable algorithm is then chosen. Using already existing functions in MATLAB, the main task is to find the proper settings of the algorithm to run the optimisation accurately and efficiently. Various evaluation criteria have been adopted to determine the most robust objective function and appropriate optimisation settings are also determined. The selection process is detailed in the Chapter 4.3.

The scope of the optimisation method is illustrated with the help of an application example, where the desired behaviour of each characteristic is already given as the goal in the form of two dimensional curves presenting toe angle, camber angle, track width variation curves during wheel travel. Optimisation aims to optimise the initial characteristic curves to approach the desired curves, which is called two-dimensional problem. The optimised result enables the characteristic curves to superpose the desired curves precisely, as is shown in Chapter 5.1.

In order to find the superposing influence of the wheel travel and steering on the front suspension kinematic behaviour, a preliminary research is carried out to optimise the three-dimensional characteristic surface to the desired surface. Comparison and analysis of the performance of the optimisation both in two-dimensional and three-dimensional situations are made. Besides, the outlook of this work is presented to give some ideas for future improvement.