Multi-Objective and Muti-Scenarios Control Methodology: Application to Car Lateral Control Synthesis

Contexte

The Tuning of ADAS's Control Laws

► Ensure safe and efficient behavior: for public acceptance
► Tuning criteria: efficiency, comfort, safety, consumption, stability robustness
   What is the right trade-off?
► 1 tuning: for each vehicle and each configuration
   Long process

Objectives

Reduce time of ADAS tuning

► Give the designers a 1st synthesis insuring a certain level of stability and performance.
► Establish linkage between tuning parameters and performance criteria to facilitate understanding of calibration and retouching.
► Design a generic method to quickly adapt to different configurations and models.

Optimize the performance

► Use of multi-objective optimization algorithms based on simple criteria.
► Manage more nominal cases for a controller (to limit the size of the embedded software).

Methodology

LCA: Lane Centering Assistance

Vehicle model

Service

► Conversion of service’s specifications to criteria usable by an optimization algorithm

Synthesis Algorithms

► Multi-objective and multi-model optimization in a framework
► No analytical solution
► Non-convex and non-smooth problem

Use of Non-Smooth Algorithms

Non-convex: local minimums
Non-smooth: the gradient does not exist at every point, leading to difficulties in defining the descent direction.

Results

► Simulations based on real tracks
► Dispersion of uncertain parameters for the simulations
   The black dashed line represents the nominal values. Each parameter varies between +/- 20% from its nominal value.
   ► Lateral error
   ► steering angle
   ► 10 random sets of uncertain parameters (blue) and of the nominal one (red).

Conclusion

A methodology to design a LCA, which structure is constrained according to engineering specifications is presented. Convenient indicators, closely linked to practical specifications are used in the optimization process in order to keep a physical significance. What we call a multi-scenarios approach is to consider performance with regard to different cases of use, e.g. curves or gusts of wind. Finally, parametric uncertainties are explicitly taken into account by using multi-model synthesis.