

Multi-Objective and Non-deterministic Optimization of Vehicle Restraint Systems

Gengjian Qian¹, Michel Massenzio^{1,a}, Denis Brizard¹, Mohamed Ichchou²

¹ Univ Lyon, Université Claude Bernard Lyon 1, IFSTTAR, LBMC UMR_T9406, F69622, Lyon, France

² Laboratoire de Tribologie et Dynamique des Systèmes, École Centrale de Lyon, 69134 Ecully, France

Abstract – Procedures for Multi-Objective Non-deterministic Optimization (MONO) of complex engineering systems are discussed and the optimization of a Vehicle Restraint System (VRS) is realized with Finite Element (FE) simulation. In the previous studies: performances of a VRS have been tested by crashing with a vehicle and the FE model of the crash test has been created; the critical factors whose uncertainties contribute the most to the performance uncertainties of the VRS have been identified through sensitivity analysis. In this article: the inputs' space of design variables and outputs uncertainties are studied to define design intervals and the constraints of optimization; Kriging interpolation method is used to create the surrogate model and the precision of the surrogate model is estimated with a new approach; uncertainties of the critical factors are considered and the VRS is optimized through MONO with the surrogate model; performances of the optimized device are evaluated under different crash conditions.

Key words: crash simulation / multi-objective optimization / robust design / uncertainty analysis / sensitivity analysis / Vehicle Restraint Systems