Multi-objective optimization of metal forming processes based on the Kalai and Smorodinsky solution

Lorenzo Iorio, Lionel Fourment, Stéphane Marie, Matteo Strano

Abstract

The Game Theory is a good method for finding a compromise between two players in a bargaining problem. The Kalai and Smorodinsky (K-S) method is a solution the bargaining problem where players make decisions in order to maximize their own utility, with a cooperative approach. Interesting applications of the K-S method can be found in engineering multi-objective optimization problems, where two or more functions must be minimized. The aim of this paper is to develop an optimization algorithm aimed at rapidly finding the Kalai and Smorodinsky solution, where the objective functions are considered as players in a bargaining problem, avoiding the search for the Pareto front. The approach uses geometrical consideration in the space of the objective functions, starting from the knowledge of the so-called Utopia and Nadir points. An analytical solution is proposed and initially tested with a simple minimization problem based on a known mathematical function. Then, the algorithm is tested (thanks to a user friendly routine built-in the finite element code Forge®) for FEM optimization problem of a wire drawing operation, with the objective of minimizing the pulling force and the material damage. The results of the simulations are compared to previous works done with others methodologies.

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