

# 機械学習による価値関数のモデル化と多目的進化手法の連携を通じた 多目的意思決定

Multi-attribute Decision-making through Cooperating with Value Function Modelled by Machine Learning and  
Multi-objective Evolutionary Optimization Method

清水 良明

Yoshiaki SHIMIZU

Optimization Engineering Laboratory, y, Emeritus Professor of Toyohashi University of Technology  
4-10-90, Fuseya-cho, Izumi-city, Osaka, JAPAN

## Abstract

Recently, we are facing with various serious problems represented by COVID - 19, earth warming, fragmentation of society and so on. Though those are out of a multi-attribute decision-making in engineering problems, the essence seems to be same in such a sense that we need to find out the best compromise among the alternatives under conflicting goals and subject to complicated constraints. So we desire hopefully the way of engineering approach will be also helpful even for those problem-solving. For this purpose, we need to provide understandable approach for every situation. With such point of view, this paper has concerned with multi-attribute decision-making methods. Actually, we extended the previous procedure by using machine learning for modeling DM's value function and two-step method for reaching the preferentially optimal solution. As before, it is deployed in co-operation with our elite-induced multi-objective evolutionary algorithms (MOEA) and downsizing NSGA-II together with a technique to solve single-objective optimization problem using MOEA. As a preliminary numerical experiment, we have compared some properties among the several MOEAs using a simple mechanical design problem. Then, we moved to the practical car structure design problem that was considered previously only under simple linear type of value function. By solving the problem under value functions including nonlinear or human specific types, we confirmed the effectiveness of the proposed idea for qualified multi-attribute decision-making.

**Key words** : Multi-objective optimization, Machine learning, Downsizing NSGA-II, Elite-induced MOEA, Multiple car structure design

## 1. はじめに

昨今の新型コロナウィルスによるパンデミックの下における社会活動の規範として、経済性と蔓延防止(安全・安心)の両立が模索されてきて久しい。しかし、両者は本質的に両立せず互いに競合するものであるから正しくは最良の妥協点 (Best compromise) を見出す努力と言い換えるべきである。であるとすれば、この問題解決は数理的にモデル化できるか否かは別にして、まさに多目的意思決定の観点から取り組まれるのが相応しいといえる。また、経済成長と地球温暖化の関係や分断化社会の修復問題からも同様の見方ができる。これらの例のごとく複雑で多面性を持つ現代社会において、工学領域に限らず多様で競合する価値観の下で、迅速で柔軟な意思決定を支援する技法として総合的な評価に基づく最適化手法である多目的最適化とその周辺技術の利活用が期待されている。より一般的に言えば、柔軟で実践的な意思決定ための総合的枠組みといえる最適化工学 (清水, 2010) を規範とするアプローチが求められているといえる。

ところで近年の多目的最適化分野においてはパレートフロントの導出 (多目的解析と呼ぶ) のための多目