Preface

Many kinds of practical problems such as engineering design, industrial management and financial investment have multiple objectives conflicting with each other. Those problems can be formulated as multiobjective optimization. In multiobjective optimization, there does not necessarily a unique solution which minimizes (or maximizes) all objective functions. We usually face to the situation in which if we want to improve some of objectives, we have to give up other objectives. Finally, we pay much attention on how much to improve some of objectives and instead how much to give up others. This is called "trade-off." Note that making trade-off is a problem of value judgment of decision makers. One of main themes of multiobjective optimization is how to incorporate value judgment of decision makers into decision support systems. There are two major issues in value judgment (1) multiplicity of value judgment and (2) dynamics of value judgment. The multiplicity of value judgment is treated as trade-off analysis in multiobjective optimization. On the other hand, dynamics of value judgment is difficult to treat. However, it is natural that decision makers change their value judgment even in decision making process, because they obtain new information during the process. Therefore, decision support systems are to be robust against the change of value judgment of decision makers. To this aim, interactive programming methods which search a solution while eliciting partial information on value judgment of decision makers have been developed. Those methods are required to perform flexibly for decision makers' attitude. At early 1980s, many interactive programming methods for solving multiobjective optimization have been developed. Above all, the aspiration level approach to multiobjective programming problems has been widely recognized to be effective in many practical fields.

Another major issue is that in many practical problems, in particular in engineering design, the function form of criteria is not given explicitly in terms of design variables. Given the value of design variables, under this circumstance, the value of objective functions is obtained by real/computational experiments such as structural analysis, fluid mechanic analysis, thermodynamic

analysis, and so on. Usually, these experiments are time consuming and expensive. One of recent trends in optimization is how to treat these expensive criteria. In order to make the number of these experiments as few as possible, optimization is performed in parallel with predicting the form of objective functions. This is called sequential approximate optimization with metamodeling. It has been observed that techniques of computational intelligence can be effectively applied for this purpose. Moreover, techniques of multiobjective optimization themselves can also be applied to develop effective methods in computational intelligence. For example, the authors developed several kinds of support vector machines using multiobjective optimization and goal programming.

Recently, researches of generating Pareto frontier are actively made. It is useful to visualize Pareto frontier, because decision makers can make trade-off analysis very easily on the shown figures of Pareto frontier. However, it is difficult to generate Pareto frontier in cases with more than two or three objectives. At this event, a method combining aspiration level approach and sequential approximate optimization using computational intelligence was proposed and recognized to be effective in many practical problems.

This book describes those sophisticated methods for multiobjective optimization using computational intelligence along with real applications. This topic seems quite new. No book on this topic has been seen to our knowledge in spite of its importance. The book is self-contained and comprehensive. The potential readers are researchers, practitioners in industries and students of graduate course and high grade of undergraduate course.

We hope that the readers of both theoretical researchers and practitioners can learn through this book several methodologies on a new trend of multiobjective optimization which is very important and applicable in many practical fields.

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