The Thirteenth International Symposium on Operations Research and Its Applications (ISORA 2018)

Guizhou, China

August 22-26, 2018

PROGRAM

BOOK OF ABSTRACTS

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The 13th Int'l Symposium on Operations Research and Its Applications

Guiyang Confucius Hotel, Guiyang, China；贵阳大成精舍酒店，贵阳

August 22-26, 2018；2018 年 8 月 22-26 日

August 22 (Wednesday)；8 月 22 日(星期三)		
Lobby；大堂	13:00-18:00	Registration at the Lobby of the Hotel; 报到（酒店大堂）
Tianyu 2# 天宇 2#	15:00-17:30	Board Meeting of ORSC Journals; 中国运筹学会期刊编委会
Supper; 晚餐	18:00-19:30	Buffet Reception; 自助晚餐
Tianyu 2# 天宇 2#	19:30-21:00	Prize Committee Meeting of ORSC；中国运筹学会评奖委员会

August 23 (Thursday)；8 月 23 日(星期四) Meeting room: Tianyu 2# 天宇 2 号		
Opening Speeches	08:30-08:40	Xiaodong Hu, ORSC & Academy of Math and System Science, China Tatsuo Oyama, ORSJ & National Graduate Institute for Policy Studies, Japan
Session 1 **Chair:** Tatsuo Oyama	08:40-09:25	Network-based Multiple UAVs Search Planning for Disaster Relief Hozumi Morohosi, National Graduate Institute for Policy Studies, Japan
Tea Break; 茶歇	09:25-10:00	Group Photo; 合影
Session 2 **Chair:**	10:00-10:25	Knapsack Problem at Nanoscale Maciej Ogorzalek, Jagiellonian University, Poland
	10:25-10:50	The Least Distance Problem in Data Envelopment Analysis Xu Wang, Takashi Hasuike, Jianming Shi, Kuan Lu Waseda University, Japan
	10:50-11:15	Analysis of a Production-Inventory System with a Positive Service Time and Backordering Dequan Yue, Yaling Qin, Yuying Zhang, Yanshan University, China/ Wuyi Yue, Konan University, Japan
	11:15-11:40	Forecasting Call Center Arrivals using a Hybrid Model Composed by Multiple Regression and LSTM Yutaka Akiyama, Yutong Zhang, Hiroya Sato, Sumika Arima University of Tsukuba, Japan
Lunch; 午餐	12:00-13:30	Buffet Lunch; 自助午餐
Session 3 **Chair:**	14:00-14:45	Risk and Potential: A Perspective from Mean-Variance Induced Utility Functions Duan Li, Chinese University of Hong Kong, China
	14:45-15:10	Pricing European Lookback Options by Monte Carlo Simulation Linjing Zou, Chunhui Xu, Masakazu Ando, Chiba Institute of Technology/ Takayuki Shiina, Waseda University, Japan
	15:10-15:35	Proposal of Japanese Vocabulary Words List for Automated Essay Scoring Support System using Rubric Megumi Yamamoto, Nabuo Umemura, Hiroyuki Kawano Nagoya University of Foreign Studies, Japan
Tea Break; 茶歇	15:40-16:00	

Session 4 **Chair:**	16:00-16:25	A First Come First Served Feedback Queue with Multi-Class Customers Jerim Kim, Bara Kim, Korea University, Korea/ Hsing Luh, National Chengchi University, Taiwan
	16:25-16:50	Dynamic Capacity Allocation and Scheduling for Multi-Type Resource Sharing Systems Huizhen Bu, Hiroyuki Motomiya, Sumika Arima University of Tsukuba, Japan
	16:50-17:15	Improved Benders Decomposition for Solving Network Maintenance Scheduling Problem Xi Liu, Lanbo Zheng, Wuhan University of Technology, China
	17:15-17:40	Algorithms for the 2-Layer Crossing Minimization Problem Yue Song, Aleksandar Shurbevski, Hiroshi Nagamochi Kyoto University, Japan
Banquet；晚宴	18:30-19:30	Banquet Hall of the Hotel

August 24 (Friday)；8 月 24 日(星期五)		
Session 5 **Chair:**	08:30-9:15	On the Binary Eisenberg-Noe Model and its extensions Yuhong Dai, Academy of Math and Systems Science, CAS, China
	09:15-09:40	Effect of Payload Size on Goodput When Message Segmentations Occur: Case of Packet-Corruptions Recovered by Stop-and-Wait Protocol Takashi Ikegawa, Waseda University/The University of Tokyo, Japan
	09:40-10:05	Forecasting Daily Electricity Demand by Applying Artificial Neural Network with Fourier Transform and Principal Component Analysis Techniques Yuji Matsuo, Tatsuo Oyama, The Institute of Energy Economics, Japan
Tea Break; 茶歇	10:05-10:30	
Session 6 **Chair:**	10:30-10:55	The Optimal Location Problem of Hydrogen Refueling Stations in Nagoya Area with Consideration of Cost Ruoyi Chen, Yu Song, Fukuoka Institute of Technology, Japan
	10:55-11:20	GPS Localization Problem: A New Model and its Global Optimization Xiaohui Wang, Hao Zhang, Yong Xia, Beihang University, China
	11:20-11:45	Solving Optimization over the Efficient Set of a Multiobjective Programming as a Mixed Integer Problem Kuan Lu, Shinji Mizuno, Jianming Shi, Tokyo Institute of Technology, Japan
	11:45-12:10	Performance Evaluation and Social Optimization of an Energy-Saving Virtual Machine Allocation Scheme within a Cloud Environment Xiushuang Wang, Shunfu Jin, Xiuchen Qie, Yanshan University, China/ Wuyi Yue, Konan University, Japan
Lunch; 午餐	12:15-13:30	Buffet Lunch; 自助午餐
Poster Session	14:00-18:00	Poster Session；海报展示
Supper; 晚餐	18:00-19:30	

August 25 (Saturday)；8 月 25 日(星期六)		
Forum 1	07:00-08:00	Breakfast；早餐
	08:20-12:00	Forum on OR's Future Development；运筹学的未来发展论坛

Lunch; 午餐	12:00-13:30	
Forum 2	14:00-18:00	Forum on OR's Applications；运筹学的应用论坛
Supper; 晚餐	19:00-20:00	
August 26 (Sunday)；8 月 26 日(星期日)		
Panel Meeting	07:00-08:00	Breakfast，Check out；早餐，退房
	08:20-12:00	China-Japan Bilateral Meeting；中日双边会议
Lunch; 午餐	12:00-13:30	
Departure	14:00-18:00	ISORA2018 closes, return home；会议结束，返程

Invited Speakers

Network-based Multiple UAVs Search Planning for Disaster Relief

Hozumi Morohosi & Yasuyuki Yamakoshi.
National Graduate Institute for Policy Studies, Japan
E-mail: morohosi@grips.ac.jp

This paper studies the use of multiple unmanned aerial vehicles (UAVs) for searching victims at the very early stage of disaster. We propose a network-based optimization model for planning the search path of multiple UAVs in a disaster-stricken area and estimating the necessary number of UAVs. Two heuristic algorithms are devised to solve the optimization model.

They are applied to the problem instances taken from potential hazard areas in Japan. Our computational result shows relatively small number of UAVs is enough to cover the area in most of cases. This result suggests multiple UAVs search planning should be a reasonable precautions against a disaster.

Keywords: Multiple UAVs, Disaster Management, Network Flow Model.

Risk and Potential: A Perspective from Mean-Variance Induced Utility Functions

Duan Li
City University of Hong Kong, China
Email: dli226@cityu.edu.hk

We introduce a family of mean-variance induced utility functions which keep two of the main features leading to the popularity of the mean-variance framework, namely the intuitive explanation of the objective and the availability of an easily computable optimal investment strategy. The utility functions are motivated by the equivalence between the mean-variance objective and a quadratic utility function and parametrized by a target wealth, a potential-aversion parameter and a weighting parameter. Taking the perspective of mean-variance induced utility functions naturally leads to the two measures of risk - the average weighted outcomes below the target wealth - and potential - the average weighted outcomes above the target wealth. We establish a semi-analytical solution for the optimal trading strategy under this novel framework and provide numerical examples showing that lowering the potential-aversion leads to better investment performance.

Keywords: Utility Functions.

On the Binary Eisenberg-Noe Model and its Extension

Yuhong Dai
Academy of Mathematics and Systems Science
Chinese Academy of Sciences, China
Email: dyh@lsec.cc.ac.cn

In a financial network, the failure of a key institution can spill over to other institutions and even to the whole network. It is an important problem how to identify these key institutions. In this paper, we analyze the binary case of the linear optimization model introduced by Eisenberg and Noe (2001). We develop a conservative bankruptcy strategy assuming that banks in the network only have two status: bankrupt or totally solvent. Key institutions can efficiently be found out with bailout fund invested in a network under this assumption. Then the system risk management problem can be formulated into a mixed integer linear programming (MILP). In order to maximize the number of totally solvent banks, an L_0 term is added to the objective function, thus leading to a sparse MILP. We prove that such a sparse MILP is an NP-hard problem. We also provide an efficient Lagrange algorithm on the problem structure. Numerical results are presented to show the efficiency of the algorithms. This is a joint work with Zhilong Dong, Fengmin Xu and Jiming Peng.

Keywords: Financial Network, Eisenberg-Neo Model.

Contributed papers ordered by sessions

Knapsack Problem at Nanoscale

Katarzyna Grzesiak-Kopec and Maciej Ogorzalek
Department of Information Technologies
Faculty of Physics, Astronomy and Applied Computer Science,
Jagiellonian University in Krakow, ul. Lojasiewicza 11, 30-348 Krakow, Poland
Email: katarzyna.grzesiak-kopec@uj.edu.pl, maciej.ogorzalek@uj.edu.pl

We propose in this paper to consider the problem of place-ment of devices and building blocks in the design of 3D integrated circuits as a multi-dimensional knapsack problem. Solution of such an IC design problem must satisfy topo-logical and technological constraints and requirements. The goal function for the optimization problem has to take into account all the design requirements including minimization of interconnections and chip volume, power consumption, heat distribution etc. As the dimensionality of the problem can be huge heuristic approaches together with Quasi-optimal methods must be employed. We describe us-age of a swarm agent optimization approach and indicate the strengths and weaknesses of such an approach.

Keywords: Integrated Circuit Design, Knapsack Problem, 3D Placement, 3D integration, Combinatorial Optimization.

The Least Distance Problem in Data Envelopment Analysis

Xu Wang, Takashi Hasuike
Waseda University, Japan
Email: xu.wang@ruri.waseda.jp, thasuike@waseda.jp
Jianming Shi
Tokyo University of Science, Japan
Email: shi@rs.tus.ac.jp
Kuan Lu
Tokyo Institute of Technology
Email: lu.k.aa@m.titech.ac.jp

Data envelopment analysis (DEA), introduced by Charnes, Cooper and Rhodes (CCR) in 1978, has been widely applied to evaluating the relative efficiency of decision making units (DMUs). DEA does not only measure efficiency performance of each assessed DMU but also provides an efficient target that can improve efficiency. The traditional DEA models find an efficient target by determining the farthest efficient point to the assessed DMU. However, the closest efficient point needs less effort to make the DMU efficient from the perspective of managers of DMUs. Most of the existing studies on obtaining the closest efficient point focus on proposing a model. But to compute the optimal solution to these proposed models is difficult because the efficient frontier is defined in an implicit way. In our research, the Karush-Kuhn-Tucker (KKT) conditions of an auxiliary problem is used to define the efficient frontier. With

this definition, we can obtain the closest efficient point by solving an optimization problem with linear complementarity constraints. Then, we propose a branch and bound algorithm to solve this problem, which can guarantee to reach the exact closest efficient point. The proposed approach is capable of obtaining an efficient target that is closer to the assessed DMU than those provided by the traditional DEA models or previous researches over the least distance problem and making the inefficient DMUs efficient with less effort.

Keywords: Data Envelopment Analysis, Least Distance Problem, Linear Complementarity Conditions, Branch and Bound Algorithm.

Analysis of a Production-inventory System with a Positive Service Time and Backordering

Dequan Yue, Yaling Qin, Yuying Zhang
Yanshan University, China
Email: ydq@ysu.edu.cn
Wuyi Yue
Konan University, Japan
Email: yue@konan-u.ac.jp

In this paper, we study a production-inventory system with a positive service time. We assume that the customer who arrives during the time when the inventory level is depleted is backordered. Customers arrive in the system according to a Poisson process, and require service provided by a single server. The service times are assumed to be exponentially distributed. A production facility gradually replenishes items in the inventory based on an (s,S) policy, and the production process is assumed to be a Poisson process. Firstly, we discuss the system stability. Under the condition of the system stability, we then obtain the steady-state probabilities of the system by using a matrix-geometric solution method. Next, several performance measures are computed. Finally, we develop the total cost function and analyze the effect of the parameters on the total cost function and some performance measures by using numerical examples.

Keywords: Production-inventory System, Backordering Matrix-Geometric Solution, Performance Analysis, Cost Analysis.

Forecasting Call Center Arrivals using a Hybrid Model Composed by Multiple Regression and LSTM

Yukata Akiyama, Yutong Zhang, Hiroya Sato, Sumika Arima
University of Tsukuba, Japan
Email: arima@sk.tsukuba.ac.jp

In time series forecasting, typical methods like ARIMA, multiple regression model etc., are widely used to catch the linear pattern in the past years. At the same time, nonlinear modeling methods, for example the artificial neural networks (ANNs) are developed and have generated

several branches, which can be used to do forecasting, also have good performances. Meanwhile, time series data from actual world, is always difficult to be completely caught by linear patterns or nonlinear patterns and there is limitation for forecasting using single models. Therefore, in this paper, for doing an accurate call center arrivals forecasting, a hybrid methodology that make up of multiple regression model and Long Short-Term Memory (LSTM) is proposed to take both advantages of linear and nonlinear modeling. The results with real data shows that hybrid model can give a better performance than single models and forecasting accuracy are improved obviously.

Keywords: Call Center, Time Series Forecasting, Multiple Regression, Neural Network, LSTM, Hybrid Model.

Pricing European Lookback Options by Monte Carlo Simulation

Linjing Zou, Chunhui Xu, and Masakazu Ando
Chiba Institute of Technology, Japan
Takayuki Shiina
Waseda University, Japan
Email: xchunhui@yahoo.co.jp

Monte Carlo simulation is one alternative for pricing derivatives when other methods are not available, like in the pricing of path-dependent options and American put options. It is known that estimation accuracy relies on the assumption made about the future price of the underling asset and the number of scenarios generated in simulation, however, how to decide a proper number of scenarios has been an open issue. Our study aims to propose a method for determining the number of scenarios needed for obtaining an estimation with required accuracy.

Since the true value of the price is not known, it is impossible to get the absolute error of an estimation obtained from simulation. This study defines the notion of relative error ratio as a measure of estimation accuracy, basing on the length of the interval estimation of the price with respect to the mean of the price, and then proposes a method to determine the minimal number of scenarios for obtaining an estimation with the required accuracy.

We illustrate the proposed method by doing estimation experiments, taking an European lookback call option as example. Our computing results show that this method is a proper way for determining the necessary number of simulation for estimating European lookback options.

Keywords: Option Pricing, Monte Carlo Simulation, Scenarios Estimation Error, Interval Estimation.

Proposal of Japanese Vocabulary Words List for Automated Essay Scoring Support System Using Rubric

Megumi Yamamoto
Nagoya University of Foreign Studies, Japan
Email: yamamoto@nufs.ac.jp
Nobuo Umemura
Nagoya University of Arts and Sciences, Japan
Email: d_chaser@nuas.ac.jp
Hiroyuki Kawano
Nanzan University, Japan
Email: kawano@nanzan-u.ac.jp

We are developing a Moodle plugin, which is an automated essay scor-ing system for basic education of university students. Vocabulary level is one of scoring items. It is calculated using Japanese Language Learners Dictionaries constructed by Sunakawa et al. Since this does not fully cover the words used in the student-level essays, we found that there is a problem with the accuracy of the vocabulary level scoring. In this paper, we propose to construct a comprehensive Vocabulary Words List using Japanese Wikipedia as the corpus. We apply Latent Dirichlet Allocation (LDA) to Wikipedia corpus and find word appearance proba-bility as one of indexes of word difficulty. For words whose appearance probability is hard to find because it rarely appears, the word difficulty is calculated from the TF-IDF value instead of LDA value. As a result, we have constructed a highly comprehensive Japanese vocabulary words list. It was confirmed that the vocabu-lary level can be scored all words in the test collection by using this dictionary.

Keywords: Automated Essay Scoring, Wikipedia, Corpus, LDA, Vocabulary Level, Dictionary, Rubric.

A First Come First Served Feedback Queue with Multi-class Customers

Jerim Kim, Department of Mathematics, University of Seoul
Bara Kim, Department of Mathematics, Korea University
Hsing Luh, Dept. of Math. Sciences, National Chengchi University, Taiwan
Email: slu@nccu.edu.tw

In the presentation, we derive functional equations for the stationary probability distribution of the queue size and the total response time of each class of customers for a feedback queue of First Come First Served service policy with multi-class customers. However, the solutions of nonlinear functional equations are not easy to be written in an exact Mathematical form explicitly. Numerical examples of the weighted round-robin queue are given to show that moments of the queue sizes and of the total response times can be easily computed.

Keywords: Feedback Queue, Stationary Probability Distribution.

Dynamic Capacity Allocation and Scheduling for Multi-type Resource Sharing Systems

Huizhen Bu, Hiroyuki Motomiya, and Sumika Arima
University of Tsukuba, Japan
Email: bokucleo@gmail.com; s1720521@s.tsukuba.ac.jp; a arima@sk.tsukuba.ac.jp

This paper introduces a 2-step procedure of a dynamic resource allocation and scheduling, particularly for the consequences of the additional engineering or trail products in the semiconductor wafer test process. The static resource allocation was extended to dynamically adjust the allocation under two types of constraints for multi-types shared resource simultaneously used. In addition, two algorithms for the dynamic adjustments were evaluated and improved the due-date delay and the low utilization as the result of the numerical experiments of a real factory.

Keywords: Scheduling, Dynamic Capacity Allocation, Semiconductor manufacturing.

Improved Benders Decomposition for Solving Network Maintenance Scheduling Problem

Xi Liu and Lanbo Zheng
Wuhan University of Technology, China
Email: liuxichina@whut.edu.cn; lanbozheng@whut.edu.cn

We consider a problem concerning a network and a set of maintenance requests to be undertaken. In this problem, the network with arc capacities is given, along with a set of maintenance requests, associated with every arc, which need to be carried out within specific time windows. We wish to schedule the maintenance of arcs on the network in such a way as to maximize the total flow over the planning time horizon. The underlying core problem is formulated as maximum total flow with flexible arc outages(MaxTFFAO), which is originated in infrastructure maintenance scheduling of a coal chain network. It is a strongly N P-hard problem with a mixed structure of scheduling and network flow in nature. A considerable amount of work has been done to investigate the problem from different aspects in literature. In this paper, we present an improved decomposition algorithm based on a Benders reformulation of the problem from previous result. We present a local branching strategy to produce high quality solutions at early stages of the computation and speed up the sub-problem solving algorithm with a preflow-push based method. We implement and compare this approach with previous work under the same computational environment. The computational results show the efficiency of the new method. Additionally, we include a resource limit constraint in the network maintenance scheduling model and thereby to address the problem within a more practical industrial scenario.

Keywords: Network Flows, Arc Maintenance Scheduling, Benders Decomposition, Local Branching.

Algorithms for the 2-Layer Crossing Minimization Problem

Yue Song, Aleksandar Shurbevski and Hiroshi Nagamochi
Kyoto University, Japan
Email: songyue@amp.i.kyoto-u.ac.jp
shurbevski@amp.i.kyoto-u.ac.jp
nag@amp.i.kyoto-u.ac.jp

IA 2-layer drawing of a bipartite graph is an embedding of the graph in the plane with two parallel lines (layers) such that the vertices in the graphs vertex partitions, are placed along respective layers, and the edges are drawn as straight lines in the area between the layers.

The problem of finding a 2-layer drawing of a graph that minimizes the number of edge crossings is known to be NP-hard, even for the case when the permutation of one layer is fixed. In this paper, we propose an iterative algorithm for polynomially-sized integer linear programming (ILP) formulations that starts with a subset of constraints, finds an integer solution, then adds violated constraints, and iterates in this manner until a feasible solution is found. This method has been used for solving ILP formulations with an exponential number of constraints, which cannot fit in the working memory of a computer, and our computational experiments show that it can also be advantageous with ILPs with polynomial size; for the one-sided version of the 2-layer drawing problem we observed an order of magnitude speedup over solving a complete ILP formulation in a single pass, but the same approach over the two-sided version did not offer much improvement.

Keywords: Graph Drawing, Layered Drawing, Crossing Minimization, Bipartite Graphs, Integer Linear Programming.

Effect of Payload Size on Goodput when Message Segmentations Occur: Case of Packet-corruptions Recovered by Stop-and-Wait Protocol

Takashi Ikegawa
The University of Tokyo and Waseda University, Japan
Email: tikegawa@ms.u-tokyo.ac.jp

This paper investigates the effect of payload size on goodput for communication networks where segmented packets through message segmentation function are lost due to bursty bit error and they are recovered by stop-and wait protocol. To achieve this, we derive the analytical form of goodput. From numerical results, we show that the curves of the goodput are concave in paylaod size under a high bit-error rate load condition. Furthermore, we indicate that the larger mean bit-error burst length yields less concave curves of goodput.

Keywords: Message Segmentation, Payload Size Goodput, Bursty Bit-error, Stop-and-wait Protocol

Forecasting Daily Electricity Demand by Applying Artificial Neural Network with Fourier Transform and Principal Component Analysis Techniques

Yuji Matsuo, Tatsuo Oyama
National Graduate Institute of Policy Studies, Japan
Email: matsuo@edmc.ieej.or.jp; oyamat@grips.ac.jp

Forecasting the electricity demand as accurate as possible is one of the most important topics challenged by many researchers. Regression models and time series approaches have long been applied as traditional techniques. Recently, artificial intelligence (AI)-based methods such as Random Forest (RF), Support Vector Machine (SVM) and artificial neural network (ANN) have been attracting attention as high precision prediction techniques. In this paper we propose two types of hybrid models for the short-term load forecasting (STLF) using ANN. One model calculates Fourier coefficients for the next-day load curve with an ANN, then obtains approximate load curves by applying discrete Fourier transform (DFT). Approximate curves are incorporated into the ANN to predict the next-day hourly load curve. Another model applies principal component analysis (PCA) scores to estimate an approximate load curve to link with the ANN.

We apply those models to the forecasting of electricity demand in the Metropolitan area in Japan by training the models using historical data since January 2008. Forecast results show that the proposed hybrid models predict next-day hourly loads more accurately with mean average absolute errors 2.7% for DFT and 2.6% for PCA, compared with that for a conventional three-layered ANN at 3.0%. In May, electricity demand is rather small with minor fluctuations, and our forecasting errors are the smallest among all models we compared even though differences were not so significant. We conclude that the hybridization of our models linked with ANNs can contribute to further improvements in forecasting electricity demand.

Keywords: Electricity Demand, Artificial Neural Network, Short-term Load Forecasting, Discrete Fourier Transform, Principal Component Analysis.

The Optimal Location Problem of Hydrogen Refueling Stations in Nagoya Area with Consideration of Cost

Ruoyi Chen and Yu Song
Fukuoka Institute of Technology, Japan
Email: chenruoyi26@gmail.com; song@fit.ac.jp

This paper presents a facility location model that is incorporated with location cost consisting of land acquisition cost, travel cost and value of time. We use a p-median model to explore the optimal location of hydrogen refueling stations (HRSs) for fuel cell vehicles (FCVs) in Nagoya area, Japan. By using Gurobi optimizer, a mathematical programming software package, we obtain the theoretical optimal locations and then compare them with the HRSs location calculated by the classic p-median method.

Keywords: Linear, Facility Location, FCV p-median Model, Hydrogen Refueling Stations, Facility Cost.

GPS Localization Problem: a New Model and its Global Optimization

Xiaohui Wang, Hao Zhang, and Yong Xia
Beihang University, China
Email: yxia@buaa.edu.cn

This paper establish a new fractional squared least squares (FSLS) optimization model for the GPS localization problem, which provides more accurate solutions than the classical squared least squares model. We reformulate (FSLS) as a univariate optimization, where the functional evaluation corresponds to the generalized trust region subproblem. We employ the branch and bound algorithm to globally solve (FSLS) and establish the convergence. It further motivates a much faster iterative heuristic algorithm. Numerical examples are presented to show the accuracy of the new model (FSLS) and the efficiency of the two algorithms.

Keywords: Location Problem, Fractional Program, Least Square, Semidefinite Program, Trust Region Subproblem, Branch and Bound.

Solving Optimization over the Efficient Set of a Multiobjective Programming as a Mixed Integer Problem

Kuan Lu, Shinji Mizuno
Tokyo Institute of Technology, Japan
Email: lu.k.aa@m.titech.ac.jp; mizuno.s.ab@m.titech.ac.jp
Jianming Shi
Tokyo University of Science, Japan
Email: mathopt@gmail.com

This research concerns optimization over the efficient set (OE) of a multiobjective programming, which optimizes a real-valued function over the set of efficient solutions. Optimal conditions for efficiency have been discussed. We proposed mixed integer programming (MIP) problem to solve the general approach based on these discussions. In special cases, the necessary and sufficient conditions have been established. We propose to nd the optimal solution by solving the MIP problem directly in these cases. In linear cases, compared with previous work of MIP approach, the proposed MIP reduce p-1 binary variables and relax the condition for solving the problem as well. Then these problems can be solved with current state-of-art mixed integer programming solvers when the objective function of the OE problem is convex.

Keywords: Multiobjective Programming, Efficient Set Complementarity Conditions, Mixed Integer Programming.

Performance Evaluation and Social Optimization of an Energy-Saving Virtual Machine Allocation Scheme within a Cloud Environment

Xiushuang Wang, Shunfu Jin, Xiuchen Qie
Yanshan University, China
Email: jsf@ysu.edu.cn
Wuyi Yue
Konan University, Japan
Email: yue@konan-u.ac.jp

Achieving greener cloud computing is non-negligible for the open-source cloud platform. In this paper, we propose a novel Virtual Machine (VM) allocation scheme with a sleep-delay, and establish a mathematical model accordingly. Taking account of the number of tasks and the state of the Physical Machine (PM), we construct a two-dimensional Markov chain (MC), and derive the average latency of tasks and the energy-saving degree of system in the steady state. Moreover, we provide numerical experiments to show the effectiveness of the proposed scheme. Furthermore, we study the Nash equilibrium behavior and the socially optimal behavior of tasks, and carry out an improved adaptive Genetic Algorithm (GA) to obtain the socially optimal arrival rate of tasks. Finally, we present a pricing policy for tasks to maximize the social profit when managing the network resource within the cloud environment.

Keywords: Cloud Computing, Resource Allocation Scheme, Mathematical Analysis, Markov Chain, Socially Optimization, Genetic Algorithm.