「知能技術とデータモデリングに関するワークショップ」
Workshop on Intelligent Techniques and Data Modeling
知能技術応用研究会

(Special Interest Group of Intelligent Techniques & Applications)

日本設備管理学会 (SOPEJ: Society of Plant Engineers Japan)

日本設備管理学会 知能技術応用研究会

2018 年度第 2 回知能技術応用研究会 ワークショップ開催委員会

主 催： 知能技術応用研究会

共 催： 一般社団法人・日本設備管理学会 (SOPEJ)

協 賛： 一般財団法人・ファジィシステム研究所 (FLSI)

開催日時 (Schedule):

March 15, 2019: pm 4:30 – 6:00 Registration (Participant: 5,000 円, Student: 3,000 円)
at Meeting Room, College of Eng., Univ. of the Ryukyu

March 16, 2019: am 9:00 – 12:00 Keynote Session & Technical Session 1
pm 0:00 –1:00 Lunch
pm 1:00 – 2:30 Technical Session 2
pm 2:30 – 3:00 Coffee Break
pm 3:00 – 4:30 Technical Session 3

March 17, 2019: Optional Social Program
(World Heritage: Shurijo Castle: Private schedule by participant)

発表会場 (Venue):

琉球大学工学部 知能情報コース・会議室 (工学部 1 号館 5 階)

Meeting Room, Building No. 1 5F, College of Engineering,
University of the Ryukyu, Okinawa, Japan

Organizing Chair:
Prof. Mitsuo Gen, Fuzzy Logic Systems Institute & Tokyo University of Science
E-mail: gen@flsi.or.jp

Organizing Co-Chair:
Prof. Kenichi Ida, Maebashi Institute of Technology, Japan
E-mail: ida@maebashi-it.ac.jp

Local Organizer Chair:
Prof. Itaru Nagayama, College of Engineering, University of the Ryukyu
E-mail: nagayama@ie.u-ryukyu.ac.jp

「知能技術とデータモデリングに関するワークショップ」
Workshop on Intelligent Techniques and Data Modeling

Date: 2019 年 3 月 15 - 17 日
Venue (発表会場): 琉球大学工学部 知能情報コース・会議室 (工学部 1 号館 5 階)
  Meeting Room, Building No. 1 5F, College of Eng., Univ. of the Ryukyu, Okinawa, Japan

March 15 (Fri) 16:30 ~ 18:00
16:30 – 18:00 Registration at Venue

March 16 (Sat) 9:00 ~ 17:00
9:00 ~ 9:10 **Opening Workshop**: M. Gen
9:10 ~ 10:50 **Keynote Session**: Session Chair: Dr. Gen
  Talk 1: Baoding Liu; Tsinghua University, China
  "Uncertainty Theory: A Branch of Mathematics for Modelling Belief Degrees"
  Talk 2: Mitsuo Gen; Fuzzy Logic Systems Institute & Tokyo University of Science, Japan
  "Enhancing Evolutionary Algorithms by Learning: Recent Advances"
10:50 ~ 11:50 **Technical Session 1: Intelligent Technology;** Chair: Dr. Nagayama
  Talk 3: Swe Swe Aung, Shiro Tamaki and Itaru Nagayama; University of the Ryukyus, Japan
  "A High-Performance and Noise-Robust Classifier from K-Dimensional tree-based Dual kNN"
  Talk 4: Krisanarach Nitisiri, Hayato Ohwada and Mitsuo Gen; Tokyo University of Science, Japan
  "Parallel Hybrid Genetic Algorithm and Auto-tuning Parameters Strategy with GPU Computing"

11:50 ~ 13:00 Lunch

13:00 ~ 14:30 **Technical Session 2: Intelligent Technology and Applications;** Chair: Dr. Izui
  Talk 5: 椋田 實 (Minoru Mukuda); 前・日本工業大学(Former Nippon Institute of Technology), Japan
  "優先線路のある通信ネットワークの GA による最適経路探索" (Optimum Path Search by GA of
  Communication Network with Priority Line)
  Talk 6: 下坂 将貴 (Masaki Shimosaka), 泉井 一浩 (Kazuhiro Izui), 山田 崇恭 (Takayuki Yamada),
  西脇 眞二 (Shinji Nishiwaki); 京都大学大学院工学研究科, Japan
  "多目的最適化とデータマイニングに基づく鉄道ダイヤの意思決定支援" (Train Diagram Decision-making
  Support System based on Multiobjective Optimization and Data Mining Techniques)
  Talk 7: Jianquan Guo, Xiaohua Yang and Mitsuo Gen; Univ. of Shanghai for Sci. & Tech., China
   "Robust optimizing a multi-period closed-loop supply chain network for perishable product using
   meta-heuristic algorithm: A case study of cross-region network"

14:30 – 15:00 Coffee Break

15:00 ~ 16:30 **Technical Session 3: Uncertain Modelling and Applications;** Chair: Dr. Gao
  Talk 8: Chengji Liang, Yue Zhang and Xiaoyuan Hu; Shanghai Maritime University, China
  "Transportation patterns of Underground Logistics System"
  Talk 9: Jinwu Gao; College of Information Science, Renmin University of China, Beijing, China
   "Uncertainty, Risk, and Behavior in Optimization"
  Talk 10: Zhongfeng Qin; School of Economics and Management, Beihang University, China
   "Uncertain Random Portfolio Optimization"

March 17 (Sun): Optional Social Program (World Heritage: Shurijo Castle: Private schedule
    by participant).

「知能技術とデータモデリングに関するワークショップ」
Workshop on Intelligent Techniques and Data Modeling

Keynote Session:

<u>Talk 1</u>: "**Uncertainty Theory: A Branch of Mathematics for Modelling Belief Degrees**"
Baoding Liu, Dept. of Mathematical Sciences, Tsinghua University, Beijing, China
liu@tsinghua.edu.cn; http://orsc.edu.cn/liu
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Abstract: When no samples are available to estimate distribution functions, or some emergency (e.g., war, flood, earthquake, accident, and even rumour) arises, we have to invite some domain experts to evaluate belief degree that each event will happen. Perhaps some people think that belief degree should be modeled by subjective probability or fuzzy set theory. However, it is usually inappropriate because both of them may lead to counterintuitive results in this case. In order to rationally deal with personal belief degrees, uncertainty theory was founded in 2007 and subsequently studied by many researchers. Nowadays, uncertainty theory has become a branch of mathematics.

This talk will introduce some fundamental concepts of uncertainty theory and discuss why uncertainty theory is useful. This presentation is based on the speaker's book *Uncertainty Theory* published by Springer-Verlag, Berlin (http://orsc.edu.cn/liu/ut.pdf).

Biography: Baoding Liu received his B.S. degree in 1986 from Nankai University, and his M.S. degree in 1989 and Ph.D. degree in 1993 from Chinese Academy of Sciences. He joined Tsinghua University as Associate Professor in 1996 and was appointed Professor of Mathematics in 1998. Dr. Liu's research led to the development of *uncertainty theory* that is a branch of mathematics for modeling belief degrees. (http://orsc.edu.cn/liu)

<u>Talk 2</u>: "**Enhancing Evolutionary Algorithm by Learning: Recent Advances**"
Mitsuo Gen, Fuzzy Logic Systems Institute & Tokyo University of Science, Japan
gen@flsi.or.jp
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Abstract: Evolutionary Algorithms (EAs) has attracted significantly attention with respect to complexity scheduling problems, which is referred to evolutionary scheduling. However, EAs differ in the details and the nature of the particular scheduling problem applied. In order to have an effective implementation of EAs for manufacturing scheduling, this paper focuses on making a survey of researches based on using hybrid EAs. Starting from scheduling description, we present the various representations, Estimation of Distribution Algorithm (EDA), hybridization techniques and machine-learning techniques to enhancing EAs. Finally, we also present successful applications in manufacturing scheduling based on the following typical references:
- M. Gen, X.C. Hao and W.Q. Zhang, 2016: Advances in Hybrid Metaheuristics for Stochastic Manufacturing Scheduling: Part I Models and Methods & Part II Case Studies, *Advances in Intelligent Systems and Computing*, vol.502, Springer, pp.1063-1077 & pp.1079-1094

- M. Gen, W.Q. Zhang, L. Lin, and Y.S. Yun, 2017: Recent Advances in Hybrid Evolutionary Algorithms for Multiobjective Manufacturing Scheduling, *Computers & Industrial Engineering*, vol.112, pp.616-633.
- L. Lin and M. Gen, 2018: Hybrid Evolutionary Optimization with Learning for Production Scheduling: State-of-the-Art Survey on Algorithms and Applications, *Int. J. of Production Research*, vol. 56, no.1-2, 193–223

Technical Session 1: Intelligent Technology

Talk 3: "A High-Performance and Noise-Robust Classifier from K-Dimensional tree-based Dual kNN"

Swe Swe Aung[1], Shiro Tamaki[1], and Itaru Nagayama[1]

[1]Dept. of Information Engineering, University of the Ryukyus, Okinawa, Japan
nagayama@ie.u-ryukyu.ac.jp
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Abstract: The k-nearest neighbors (kNN) method is highly effective in many application areas. However, according three considerations (simplicity, processing time, and prediction power), the classic kNN algorithm lacks high-speed computation as well as maintenance of high accuracy for different values of k. To cover these issues, this paper introduces a k-dimensional (kd)-tree–based dual-kNN approach that concentrates on two properties to maintain classification accuracy at different k values and that also reduces computational time. By conducting experiments on real data sets, it was experimentally confirmed that the kd-tree–based dual-kNN is a more effective and robust approach for classification than pure dual-kNN and classic kNN.

Talk 4: "Parallel Hybrid Genetic Algorithm and Auto-tuning Parameters Strategy with GPU Computing"

Krisanarach Nitisiri[1], Hayato Ohwada[1] and Mitsuo Gen[2]

[1]College of Science & Engineering, Tokyo University Science, Noda, Japan
[2]Fuzzy Logic Systems Institute and Tokyo University of Science, Japan
krisanarach@gmail.com, ohwada@rs.tus.ac.jp, gen@flsi.or.jp
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Abstract: In this paper, we propose a hybrid genetic algorithm (HGA) and Auto-tuning Parameters Strategy with GPU Computing on Nvidia Compute Unified Device Architecture (CUDA) framework. By using Fuzzy Logic Control (FLC) strategy, the genetic parameters are auto-tuned depend on the convergence situation of the current generation, the exploitation and exploration can be balanced based on a change of the average fitness value of the current and previous generations. To get the best solution with a smaller computational time, the proposed HGA is implemented on the GPU which utilizes the computing power of GPU to accelerate the

computation of HGA. With a suitable kernel and GPU memory allocation design, the execution time can be significantly reduced compared to the sequential GA.

Technical Session 2: Intelligent Technology and Applications

Talk 5: "優先線路のある通信ネットワークの *GA* による最適経路探索" (Optimum Path Search by *GA* of Communication Network with Priority Line)

椋田　實 (Minoru Mukuda)

前 日本工業大学情報工学科 (Former Nippon Institute of Technology)

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Abstract: 優先線路のある通信ネットワークの線路故障や回線ネックなどを解析するために遺伝的アルゴリズム（GA: Genetic Algorithm）を用いて最適経路を探索する。通信ネックとなる通信路の探索や効率的な迂回路の整備など、基礎となる経路は順序付けられた複数目的の最適化である。経路探索に適した遺伝子（染色体）の表現方法，経路の選択順方式，デコードに「経路の優先割付」，順序付き最適化に「目的の順序による選択」を採用した。

Talk 6: "多目的最適化とデータマイニングに基づく鉄道ダイヤの意思決定支援" (Train Diagram Decision-making Support System based on Multiobjective Optimization and Data Mining Techniques)

下坂将貴(Masaki Shimosaka)，泉井一浩[1](Kazuhiro Izui)，山田崇恭(Takayuki Yamada)，西脇眞二(Shinji Nishiwaki)

[1]京都大学大学院工学研究科 機械理工学専攻，京都市西京区京都大学桂 *C*3 棟

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Abstract: 本研究では，優等列車による普通列車の追い越しを考慮した鉄道のパターンダイヤを対象として，NSGA-II に基づく多目的最適化法を開発し，さらに EM アルゴリズムによるクラスタリングとアソシエーション分析に基づいて，導出されたパレート最適解集合に対するデータマイニング手法を構築した．以上の方法により，最適化手法が，単に最適解を導出するためのツールとしてだけでなく，問題構造の理解が深め，より意思決定の支援を効果的に行うために利用できるという可能性について検討を行っている．

Talk 7: "Robust optimizing a multi-period closed-loop supply chain network for perishable product using meta-heuristic algorithm: A case study of cross-region network"

Jianquan Guo[1], Xiaohua Yang[1] and Mitsuo Gen[2]

[1]Business School, University of Shanghai for Science & Technology, Shanghai, China
[2]Fuzzy Logic Systems Institute, Tokyo University of Science, Tokyo, Japan
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Abstract:

Considering the high demand volatility, short shelf life and sales period of perishable products, it is necessary to analyze the application of multi-period distribution in closed-loop supply chain network (CLSC) system. In view of the uncertain quantities for perishable products in different periods, a MIP model and its corresponding robust optimization model of multi-period CLSC network for perishable product are established. The purpose of research is to obtain the optimal strategy of minimum total system cost, the beat facility location and vehicle route. The validity and feasibility of robust optimization model were verified by genetic algorithm (GA) and particle swarm optimization algorithm (PSO) with the case study of cross-region network in China. The numerical result shows that compared with the single period system, the multi-period system has the advantages of dynamic performance and lower system cost. Meanwhile, the importance of uncertain budget factors in the decision-making of robust optimization model is verified, which provides important insights on practical aspects of the problem, as well as a reference for the construction of multi-period CLSC network under the uncertain environment.

Key words: perishable products; multi-period; closed-loop supply chain network; robust optimization model; facility location and vehicle routing; genetic algorithm; particle swarm optimization algorithm

Technical Session 3: Uncertain Modelling and Applications

Talk 8: "Transportation patterns of Underground Logistics System"

Chengji Liang[1], Yue Zhang[1] and Xiaoyuan Hu[1]

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Abstract: The underground logistics system refers to achieve full-automatic transportation, loading and unloading, sorting, distribution and other Logistics services in major diameter underground tunnels by using specific vehicle. It will effectively solve the increasingly concerned contradictions of land resources, port and city congestion, logistics transportation, environmental pollution and so on. The paper introduces the development of underground logistics in the world, and then introduces the transportation patterns, loading and unloading

modes, layout of connection area of underground logistics system at present, as well as the future prospects. With the trend of large-scale and diversified development of ports, the traditional port land collection and distribution system, which is mainly based on road transportation such as highways, has an increasingly sharp contradiction in port and city traffic. Meanwhile the emergence of underground container logistics and transportation system, it can greatly improve the conditions of the city's traffic. As a subsystem of the container collection and distribution system, the underground container logistics and transportation system is independent and closely related to other subsystems. Based on the definition of collaborative reliability of the underground container logistics collection and distribution system, this paper analyzes the characteristics and reliability of the underground container logistics collection and distribution system. The paper establishes fault tree and fuzzy random network method to study the reliability of underground container collection and distribution system coordination qualitatively and quantitatively, and introduces fuzzy set theory to blur the elements of all transfer matrix in system steady state probability equations. The matrix equations are finally declassified by the reliability index. The results of the collaborative reliability of the underground container logistics collection and distribution system are obtained, which serves as a theoretical basis for the collaborative research of the underground container logistics collection and distribution system.

Key words: Underground logistics system; Transportation patterns; Layout of connection area; collection and distribution; fault tree; fuzzy stochastic Petri net

Talk 9: "Uncertainty, Risk, and Behavior in Optimization"

Jinwu Gao

[1]College of Information Science, Renmin University of China, Beijing, China

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Abstract:

Real decisions are often made in the state of indeterminacy (randomness and uncertainty), which leads to risks. There have different attitudes toward to risks that are traditionally modeled in an indirect way by concave and convex utility functions. This paper proposes a concept of gain at confidence to model the risk attitudes, where the confidence level is a direct and natural measure of the degree of decision-maker's risk attitudes. Taking transportation problem as an example, we compare the methods gain at confidence and expected utility under stochastic and uncertain environments, respectively. Results show that i) in the stochastic environment, the gain at confidence criterion and the expected utility criterion generate the same order relation for a set of feasible solutions. The gain at confidence criterion is efficient and draws better conclusions. ii) In the uncertain environment, it is proved that the same sorting of feasible solutions can be obtained under the two evaluation criteria.

While the computation of GaC is less difficult than that of expected utility. iii) Under the same structure and parameter settings, the order relations for the set of feasible solutions are the same both in stochastic and uncertain environments. It implies that in some of the problems using uncertain theory to alternate the probability theory is easy to calculate and effective.

Talk 10: "Uncertain Random Portfolio Optimization"

Zhongfeng Qin

[1]School of Economics and Management, Beihang University, Beijing, China

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Abstract:

The determination of security returns will be associated with the validity of the corresponding portfolio selection models. The complexity of real financial market inevitably leads to diversity of types of security returns. For example, they are considered as random variables when available data are enough, or they are considered as uncertain variables when lack of data. We consider such a hybrid portfolio selection problem in the simultaneous presence of random and uncertain returns. The risk measures of portfolio returns are given and defined based on uncertainty theory. Then we may formulate and solve the corresponding uncertain random portfolio optimization models.

Post-Workshop Publication (ワークショップ後の特集号):

- **SOPEJ 会誌**特集号(Journal of the Society of Plant Engineers Japan):

  Deadline for Submission in Japanese or English: April 30th, 2019

  Guest Editors: Mitsuo Gen, Kenichi Ida and Itaru Nagayama

  Mailing Address: gen@rs.tus.ac.jp

  Tentative Publication Schedule: October 2019

- Open Access Journal: Special Issue by **Mathematics**:

  "Genetic Algorithm-Based Approaches and Their Applications in Operations Research"

  Deadline for Submission in English: June 30th, 2019

  Guest Editors: YoungSu Yun and JeongEun Lee