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Opinion Makers Section

Multi-Objective Evolutionary Algorithms and MCDA

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Although relatively young, the area of Multi-objective Evolutionary Algorithms (MOEAs) has become a very active research area, and MOEAs are now widely recognized as a powerful and versatile tool to tackle complex multi-objective optimization problems. The following text will briefly introduce the idea of MOEAs, highlight their advantages, and discuss their combination with more classical MCDA techniques.

Single and multi-objective evolutionary algorithms

Single objective Evolutionary Algorithms (EAs) are general purpose optimization heuristics inspired by Darwin's principle of natural evolution. Due to the affinity to biology, many biological metaphors are used.
Starting with a set of candidate solutions (population), in each iteration (generation), the better solutions are selected (parents) and used to generate new solutions (offspring) through recombining the information of two parents in a new way (crossover) or randomly modifying a solution (mutation). These offspring are then inserted into the population, replacing some of the weaker solutions (individuals).
By iteratively selecting the better solutions and using them to create new candidates, the population "evolves", and the solutions become better and better adapted to the optimization problem at hand, just like in nature, where the individuals become better and better adapted to their environment through evolution.
As simple as these basic ideas may sound, they have proven to be very effective, and EAs are nowadays successfully employed on a wide variety of complex optimization problems including, for example, scheduling, transportation, or engineering design. Their appeal comes from the fact that they can deal with almost arbitrarily complex objective functions and constraints, making very few assumptions and not even requiring a mathematical description of the problem.

They can also be easily extended to multi-objective problems, and Multi-Objective Evolutionary Algorithms (MOEAs) have become one of the most active research areas in evolutionary computation. The most distinguishing feature of EAs compared to other heuristics is that EAs work with a population of solutions, and thus are able to search for a **set** of solutions in a single run. In the context of multiple objectives this means that they are able to search for a **representative set of Pareto-optimal solutions**, approximating the true Pareto set, **in a single run**. As MOEAs don't require any preference information from the user, they are often called "a posteriori" methods: The user reveals his/her preferences only after optimization, by picking a solution from the set.

What distinguishes multi-objective EAs from single-objective EAs is how they rank and select individuals in the population. If there is only one objective, individuals are naturally ranked according to this objective, and it is clear which individuals are best and should be selected as parents. In case of multiple objectives, it is still necessary to rank the individuals, but it is no longer obvious how to do this, and many different ranking schemes have been developed. Most people probably agree that a good approximation to the Pareto front is characterized by

1. a small distance of the solutions to the true Pareto frontier,
2. a wide range of solutions, i.e., an approximation of the extreme values, and
3. a good distribution of solutions, i.e., an even spread along the Pareto frontier.

MOEAs then rank individuals according to how much they contribute to the above goals. For example, the most prominent among all MOEAs, the Non-dominated Sorting Genetic Algorithm II (NSGA-II) [Deb et al., 2002], prefers all non-dominated solutions over the dominated ones (as proxy for the first goal), and among non-dominated solutions prefers the extreme solutions (second goal), then solutions with a larger distance to other solutions (third goal). More recent variants use a single indicator, e.g. the hypervolume, as quality measure for the Pareto front approximation, and rank individuals according to their contribution to this measure [Beume et al., 2007].
MOEAs have been a real success story, and the number of publications in this area has soared over the past 10-15 years. Carlos Coello-Coello maintains a repository of MOEA publications, and currently lists 6844 papers [http://delta.cs.cinvestav.mx/~ccoello/EMOO].

Combination with MCDM

In the beginning, the MOEA community has developed more or less independently from the "classical" MCDM community. Only in recent years, most notably with the initiation of regular Dagstuhl workshops, has it been recognized that MOEA and MCDM have a lot to offer to each other, and subsequently the communities have grown together. Nowadays, the typical MOEA conference, EMO, has an MCDM session, as well as the MCDM conference has sessions on MOEAs.

One obvious way for combining MOEA and MCDM techniques is to use an MOEA to generate an approximation of the Pareto frontier, but then use an MCDM technique to help the decision maker (DM) to select the best solution from this approximation set. While the latter step may be almost trivial in the case of two objectives (which was the focus of the MOEA community in the first years), an MCDM support may be very useful in the case of more objectives.

Another possibility is to start by eliciting partial user preferences, and use this information to narrow down the search of the MOEA. That is, rather than searching for an approximation of the entire Pareto optimal frontier, the search is focused on what is believed to be the most interesting region for the DM, consistent with the partial preferences specified. This has a number of advantages. First, it saves computation time. Second, it allows to cover the interesting region of the Pareto front with more individuals than if the entire frontier would have to be approximated, so it allows to produce a better approximation of the interesting region (at the expense of no or less coverage in the other regions). And third, but perhaps most importantly, MOEAs struggle as the number of objectives increases beyond three. A key reason is that they lose their selective pressure to converge towards the Pareto frontier, as almost all individuals tend to become non-dominated in higher dimensional objective spaces. Focusing the search on a region alleviates this problem by re-introducing a partial order among non-dominated individuals (between those that lie in the interesting region and the other ones).
There is a vast range of approaches in this category, with preference elicitation ranging from reference points [Fonseca&Fleming 1993] over dominance cones [Branke et al., 2001] to objective weights [Zitzler et al., 2007]. A survey on these approaches can be found in [Branke 2008].

In recent years, research has focused more on interactive approaches. The MOEA is run for a few generations, then MCDA techniques are used to elicit some user preferences, which can then be used to guide the next few generations of the MOEA, before the next preference information is elicited. In general, interactive methods have the following main advantages:

- The preference information requested from the DM is usually much simpler than the preference information required by a priori methods.
- They have moderate computational requirements in comparison to a posteriori methods.
- As the DM controls the search process, he/she gets more involved in the process, learns about potential alternatives, and is more confident about the final choice.

Papers in this area include, for example, Branke et al. [2010] and Deb et al. [2010].

Summarizing, the combination of MOEAs and more classical MCDA techniques seems very promising, which is also reflected in the growing number of publications in this area. What we have seen so far is probably only the beginning. There are many interesting avenues to take this further, including many objective problems, handling uncertainty, group decision making, and performance measurement of interactive approaches.

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MCDA Research Groups

MCDA Research Groups — MLO Group, Manchester

MLO (Machine Learning and Optimization) is a research group in the School of Computer Science, The University of Manchester, UK. The group conducts leading-edge research in a wide range of techniques and applications of machine learning, optimization, data mining, probabilistic modelling, pattern recognition and machine perception. The group spans the field from new theoretical developments to large applications, and is currently supported by a number of research bodies, including the UK engineering and physical sciences research council (EPSRC), the UK biotechnology and biosciences research council (BBSRC), and several industry partners.

Currently the group consists of eight full-time academics, five full-time postdoctoral researchers, and around fifteen PhD students. It also supports undergraduate and MSc research projects, summer internships, and hosts many visiting researchers.

At least six members of the group count optimization as a key research interest. Jonathan L. Shapiro (Head of Group) does research in estimation of distribution algorithms, reinforcement learning, and is a leading researcher in the theory of genetic algorithms. Pedro Mendes (Professor in the group, and also a Principal Investigator in the Manchester Interdisciplinary Biocentre) does research on inverse modelling of biochemical systems and networks, including work on the underlying optimization methods. He is the main author of the GEPASI and COPASI modelling systems. Richard Neville works in computational intelligence, and is currently developing hybrids of exact optimizers and evolutionary algorithms. Xiaojun Zeng's research includes work on genetic programming, rough sets, fuzzy sets and decision support systems. Gavin Brown has an interest in evolutionary optimisation and speciation techniques, and has also done important work on the balance between bias and variance in classification problems (a bicriterion optimization problem).

In terms of multicriterion optimization, the main researcher in the group is Joshua Knowles. He has been working on multiobjective evolutionary algorithms since about 1998, and is known for developing the PAES and ParEGO algorithms. For more of his, and the group's collaborations, projects and publications relating to MCDA, see the following sections.

Key Collaborators in MCDA-related Work

At University of Manchester

Royston Goodacre, Manchester Interdisciplinary Biocentre
Julia Handl, Decision Sciences Research Group, MBS
Douglas Kell, Manchester Interdisciplinary Biocentre
Ludmil Mikhailov, Manchester Business School

Nationally and internationally

Richard Allmendinger, University College London, UK
David Corne, Heriot-Watt University, UK
Carlos M. Fonseca, University of Coimbra, Portugal
Manuel Lopez-Ibanez, IRIDIA, ULB, Belgium
Marco Laumanns, IBM, Germany
Lothar Thiele, ETH Zurich, Switzerland
Mark Viant, University of Birmingham, UK
Eckart Zitzler, University of Bern, Switzerland

Research Projects Related to MCDA

Current funded projects

MUSCLE This project called Multi-platform Unbiased-optimisation of Spectrometry via Closed Loop Experimenta-tion, is developing multiobjective optimization algorithms for configuring mass spectrometer instruments that are used by drug companies, government labs, and others to analyse complex biochemical samples. Joshua Knowles and Mark Viant are the principal investigators.

Astra Zeneca Drug Safety The MLO group o· ers MSc research projects and bursaries funded by Astra

Zeneca on the broad topic of drug safety. Among the projects o▪ered last year were two involving multiobjective optimization and decision analysis for use in drug safety studies.

Earlier funded projects

CLADE The CLADE (Closed-loop aptameric directed evolution) project pioneered the use of evolutionary compu-tation optimization methods in the design of novel aptamers — DNA molecules with very strong and specific binding to target molecules — with applications in drug design and biomarker development. Douglas Kell was the principal investigator.

HUSERMET The HUSERMET (Human serum metabolome in health and disease) project analysed a large number of human blood serum samples to understand more about the metabolic profiles of patients su▪ering from three common diseases, as well as healthy individuals. Work included the use of (closed-loop) multiobjective optimization to find e▪ective experimental configurations for the mass-spectrometry instruments used in the analysis. Douglas Kell was the principal investigator.

BBSRC David Phillips Fellowship Joshua Knowles was funded for five years to carry out research on the use of multiobjective optimization and evolutionary algorithms in systems and computational biology.

Speculative projects

Multiobjective optimization in machine learning In work with Julia Handl, a multiobjective optimization approach to unsupervised learning was developed. This included the MOCK multiobjective data clustering algorithm (see publications), and related techniques in multiobjective unsupervised feature selection. Work in this area continues.

ParEGO Knowles developed a multiobjective optimization variant of the E▪cient Global Optimization approach to expensive optimization / sequential experimental design problems. The method uses weighted augmented Tchebyche▪ scalarization of the objectives.

Multiobjectivization in PSP In work with Julia Handl, the protein structure prediction (PSP) problem was considered as a multiobjective optimization problem. Techniques developed were entered into the CASP8 and CASP9 international assessment ‘contests’, and showed promising results including one first place prediction of a protein’s tertiary structure.

Nondominated Solutions Archiving Many optimization algorithms for multiobjective problems store the cur-rent approximation to the Pareto set during operation; it is of interest to consider how to update this set online when a size limit is placed on it. In collaboration with Marco Laumanns and Manuel Lopez-Ibanez, a number of advanced techniques for online archiving were tested, and the methods are available at http://iridia.ulb.ac.be/ manuel/archivers

Performance Assessment of MO optimizers In collaboration work with Carlos M. Fonseca, Lothar Thiele, Eckart Zitzler and others, we have implemented several techniques for assessing the performance of (stochastic) multiobjective optimizers over several runs. The tools are available at http://www.tik.ee.ethz.ch/pisa/

Many-objective Optimization The scalability of multiobjective optimization algorithms (with respect to objec-tive number) is an important current issue. In work with David Corne, a number of recently proposed methods for handling many-objective problems were tested with respect to combinatorial optimization problems with up to 20 objectives.

Multiobjective Optimization of Experiment Design The typical approach to multivariate experiment design in the presence of limited resources is the fractional factorial design. We have developed the use of multiobjective evolutionary algorithms (MOEAs) in this context to optimize the choice of experiment sequentially. In research done in collaboration with the Goodacre Group in MIB, we found e▪ectiveness improvements over factorial designs in a laboratory study related to optimizing experimental conditions in Raman spectroscopy.

Selected Publications

J. Handl and J. Knowles. Clustering Criteria in Multiobjective Clustering. (Under submission to PPSN 2012).

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Recent and Forthcoming Activities

MBSW Julia Handl, Yaochu Jin and Joshua Knowles are organizing a forthcoming PPSN workshop on modelling biosystems with scope to include optimisation and decision analysis techniques. http://mlo.cs.man.ac.uk/events/mbsw/

Dagstuhl 12041 Seminar A seminar entitled Learning in Multiobjective Optimization was convened in January 2012 at Dagstuhl. Joshua Knowles was a co-organizer along with Salvatore Greco, Kaisa Miettinen and Eckart Zitzler. Other attendees from Manchester included Simon French (Professor, recently retired from Manchester Business School) and Theo Steward (Professor, Manchester Business School).

EMO Joshua Knowles is on the Evolutionary Multi-Criterion Optimization (EMO) Conference Steering Committee. Next year's conference is in Sheffield. See http://www.shef.ac.uk/emo2013

DASIG The Operations Research Society has a Decision Analysis special interest group (DASIG). Joshua presented at their annual workshop in June 2011 on 'Current trends in evolutionary multiobjective optimization'.

To contact Joshua Knowles about any of the projects or activities above, please email j.knowles@manchester.ac.uk

Forum
Learning at Dagstuhl

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http://www.mit.jyu.fi/optgroup/

Since 2004, seminars on multiobjective optimization have been organized in Dagstuhl, Germany (www.dagstuhl.de/) every two or three years. The first two seminars (www.dagstuhl.de/de/04461 and www.dagstuhl.de/06501) concentrated on practical approaches to multiobjective optimization and the main objective was to bring researchers in the fields of multiple criteria decision making (MCDM) and evolutionary multiobjective optimization together. After the second seminar, a book [1] *Multiobjective Optimization: Interactive and Evolutionary Approaches* (edited by J. Branke, K. Deb, K. Miettinen and R. Slowinski) was published by Springer in 2008. The topic of the third seminar (www.dagstuhl.de/09041) was hybrid and robust approaches to multiobjective optimization. The latest seminar in the series (www.dagstuhl.de/12041) was organized in January 2012 and the theme was learning in multiobjective optimization.

As far as the topic of the 2012 seminar is concerned, it originates partly from the above-mentioned book and in particular a chapter in it entitled "Interactive multiobjective optimization from a learning perspective" [2]. As multiobjective optimization can be characterized as the study of optimization under competing criteria, it concerns the search for nondominated or Pareto optimal solutions each representing different trade-offs and involves methods for choosing the final solution among alternative solutions by incorporating preferences of decision makers. Because of the nature of multiobjective optimization, learning plays an important role from several perspectives, e.g., exploration of trade-offs and a consideration of decision maker's preferences. Because we can identify different types of learning, like the decision maker learning about the problem and the optimization process itself learning about the decision maker's preferences (to enable directing the search toward a preferred solution), it was time to pay attention to learning in connection with multiobjective optimization.

As expressed in the motivation of the seminar [3], learning is an important subject in multiobjective optimization because it aims at guiding the decision maker, in an efficient and effective manner, to a preferred solution that is Pareto optimal. The expectation is that an effective learning process would lead to increased satisfaction with and confidence in a decision, as well as a better understanding of the underlying rationale. Therefore, on the one hand, a multiobjective optimization method should aim at permitting the decision maker to learn about the optimization problem, while, on the other hand it should aim at permitting a formal model to be found, to include information about preferences of the decision maker, which can be interpreted as a learning process from the point of view of the formal model. Therefore, we can say that the quality of a multiobjective optimization process is related to what the decision maker and the model learn. Consequently, a fundamental aspect of a multiobjective optimization method is the set of procedures that permit both the decision maker, and the model, to learn. From this perspective, many questions arise, like:

- How can individual learning be characterized?
- How can individual learning be supported?
- How can different types of models learn about the preferences of the decision maker?
- What type of interdependence is there between the decision maker's learning and the model's learning?

With this background and motivation, learning as the main theme of the seminar was originally characterized with the following three topics:

1. **Decision maker's preferences** to be seen mainly from the perspective of the optimization process that interacts with the decision maker and tries to infer formal information to guide the search and adapt the model. The key questions here are "What can and should be learnt from decision maker interactions and how can decision maker's preferences be inferred?" Under the term preferences, all additional information related to the underlying optimization problem can be understood. This information is usually implicitly reflected by the choices of the decision maker. How to extract and exploit this information is the main question here. Besides, a good multiobjective optimization method should enable a decision maker to learn about one's own preferences, which in general are not well established at the beginning of the solution

process. From this point of view, paying attention to behavioural issues is necessary.

2. **Problem understanding** can cover all aspects that aim at gaining insight about the underlying optimization problem. The consideration is related to the decision maker who wants to obtain some information about the problem, in particular, about the Pareto optimal set (but not necessarily restricted to it). For instance, one may be interested in identifying structurally similar regions in the decision space close to the Pareto optimal set in the objective space. Therefore, this topic raises the question "What can be learnt about the problem structure and how can information that is useful for the decision maker be extracted?"
3. **The problem solving process** is driven by the application side where the entire process from the optimization model to the final solution is in the center. Clearly, the two first topics are essential, but here the process as such is in the focus. Therefore, questions related to the topic include "In what respect is the problem solving process a learning process?", "What does a decision maker learn?", "How do we know if a decision maker has learnt?", "How does a decision maker learn?" and "What factors influence how and what a decision maker learns?" One should point out that in all this, human-computer interaction is essential because transferring information from the optimization model to the decision maker and preference information from the decision maker to the multiobjective optimization solution procedure cannot be successful without interfaces that are intuitive and genuinely support the tasks in question.

The expectation was to get fresh analysis of existing multiobjective optimization methods with respect to their learning aspects leading to several proposals to improve them. Moreover, new paradigms of learning-oriented multiobjective optimization were expected to be proposed and elaborated forming a basis of a new generation of multiobjective optimization methods.

Before the seminar, participants were given the description of the seminar objectives [3] and the above-mentioned chapter on learning [2] for orientation. Four invited talks were included in the program and participants were also invited to present contributions relevant to the seminar theme. A report summarizing the seminar including abstracts of talks given will be published at the Dagstuhl website later this spring.

Besides the talks, time was devoted to working groups. Participants identified topics and worked in six groups. According to [4], the groups concentrated on the following topics.

The discussion in the first group focused on what and how we can learn from Pareto optimal sets in the objective space, the optimal points in the decision space, the mapping, and from the constraint function values. The group came up with a broad collection of properties of Pareto optimal sets and how to interpret them in a decision context. Moreover, visualization methods that can be used to study properties of the Pareto optimal sets were put into a structured view. It was noted that in many cases features of the Pareto optimal set can be explained by underlying phenomena, such as discrete choices giving rise to cusp points or gaps in mixed-integer problems or mode changes and bifurcations causing knees, dents and gaps in continuous problems. A particular challenge was pointed out as learning from the mapping when the decision space consists of structures (e.g. bridges, car systems or molecules).

The second group focused on the interaction between the decision maker and the analyst or the decision support system (DSS), particularly considering the exploitation of the results obtained through procedures based on the preference information provided by the decision maker. The fundamental idea was that the decision maker does not consider the analyst or the DSS as an oracle giving the “correct” result of the decision problem at hand, but (s)he would like to understand the reasons for which a given recommendation is supplied in order to explain it to (her)himself and to other people involved in the decision (e.g., stakeholders). Different decision models can be used to represent the preference information provided by the decision maker (e.g. weighted functions, additive value functions, Choquet integrals), so different methods should be used to provide the decision maker with an explanation in a clear and natural language (e.g., even-swap, decision rules).

The third group started by considering how we can measure the extent to which decision makers have learnt from the use of interactive MCDM methods and noticed that this is related to what can be learnt. The latter was seen to include information on what outcomes are or are not achievable, on the structure of the objective space and on the decision makers' own preferences. A wealth of information is potentially available to assess such learning varying from quantitative performance measures of the algorithmic implementation to subjective assessments of the extent of learning experienced. Thereafter, the group examined two separate issues. One subgroup looked at monitoring the decision maker's learning through the solutions inspected and the decision maker's response time while using an interactive method. It was concluded that these rules should be discovered through data mining, by comparing the behaviour of decision makers who learned and those who did not learn. The other subgroup looked at an opposite question, namely what can an algorithm learn from the decision maker, through use of explicit decision

models, in order reliably to guide the search for a most preferred solution across the Pareto optimal set.

The fourth group worked on navigation and on a first approach towards a common understanding of search and decision making approaches to identify the most-preferred solution among the Pareto optimal set for a multiobjective optimization problem, subsumed under the term of navigation. In such procedures, the decision maker interactively learns about the problem, while the DSS learns about the preferences of the decision maker. The group introduced a detailed view on navigation, leading to the identification of integral components and features. Furthermore, they reviewed and categorized a number of different approaches and made an overview of applications involving navigation.

The fifth working group focused on representation and on the issue of learning about the Pareto optimal set in both decision and objective spaces from a machine perspective. In this context, learning was understood as the process of obtaining a parsimonious representation of the Pareto optimal set either explicitly by storing points or implicitly by building a model, so as to allow relevant information to be produced in response to queries made by a decision maker. A taxonomy of representations was outlined, raising awareness of the distinct requirements of approximate optimization methods, such as evolutionary multiobjective optimizers and exact optimization methods.

The sixth group considered both algorithm design methods and algorithm selection. It was noted that the automatic selection of an optimization and decision method for MCDM requires not only information about the optimization problem but also about the decision maker. The group first identified questions that the decision maker should be asked before an automatic algorithm selection can be launched. Finally, a model was instantiated with a simple example leading to lower and upper bounds on the number of function evaluations and queries to the decision maker. Some attention was also paid to algorithm design requirements.

One can conclude that learning was regarded as a fruitful topic for discussion and research. As can be seen from the topics of the working groups, it was observed that one can understand learning in the context of multiobjective optimization in various ways and some of them were note pre-seen by the organizers. It appeared that all working group considered their findings as fruitful starting points for further research. Thus, the seminar was productive in many ways and a number of research problems were identified that need careful further consideration.

This seminar was organized by Salvatore Greco, Joshua Knowles, Kaisa Miettinen and Eckart Zitzler. The organizers of the next proposal (resulting hopefully with a seminar in 2,5 or 3 years) will be Salvatore Greco, Kathrin Klamroth Joshua Knowles and Gunter Rudolph. Time will tell what the topic of the next seminar will be. In the meanwhile, we have time to further mature ideas raised in the 2012 seminar.

Warm thanks to all participants and, in particular, to co-organizers of all four seminars in the series. It is now time for new energetic people to take over the organizing responsibility and I wish best of success to the future Dagstuhl seminars.

References

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[3] S. Greco, J. Knowles, K. Miettinen, E. Zitzler: Motivation of Dagstuhl Seminar 12041:
Learning in Multiobjective Optimization, 2012, www.dagstuhl.de/12041.

[4] S. Corrente: Dagstuhl Seminar on Learning in Multiobjective Optimization, in: J. Siebert (ed.), E-News of International Society on Multiple Criteria Decision Making, Issue 1, pp. 22-25, 2012.

Consultancy Companies

Reactive Search Srl is the *Learning and Intelligent OptimizatioN* company.
We realize software and services for **Adaptive Business Analytics**, **Learning and Intelligent OptimizatioN** (LION) and **Reactive Business Intelligence**.
Our competitive edge is caused by a unique integration of **machine learning and optimization**, to facilitate the interaction between domain experts, decision makers, and "reactive" software, capable of self-improvement and rapid adaptation to new business needs.
The founders, the advisory board members, and the collaborators have a track record of successful applications in widely different scientific and business areas (including citations in about 50 patents, and thousands of scientific and technical publications).

Reactive Search vision: software with on-the-job Learning

The term ***Reactive*** Search hints at a ready response to events while searching for optimal solutions. Its strength lies in the introduction of **skills often associated to the human brain**, such as learning from the past experience, learning on the job, ability to cope with incomplete information, quick adaptation to new situations.

Crucial decisions depend on factors and priorities which are not always easy to describe before starting the solution process. Reactive Search technology allows **feedback** from the user in the preliminary exploration phase to be incorporated so that a better tuning of the final solutions can take the decision maker preferences into account.

Reactive Search Optimization (RSO) techniques are at the basis of RS products and have been proposed by the founders of the company.

The curriculum includes now more than 5000 citations in technical and scientific literature (source: Google scholar) and about 50 citations in international patents (source: Google patents). The scientific quality has been recognized also by an IEEE fellowship for contributions to machine learning techniques for intelligent optimization and neural networks.

Examples of real-world applications developed in the last twenty years according to RSO principles include:

- Neural networks training
- Power distribution networks
- Industrial production and delivery
- Telecommunication networks
- Vehicle routing and dispatching
- Industrial and architectural design
- Biology
- VLSI – circuit partitioning
- Clustering in graphs
- …

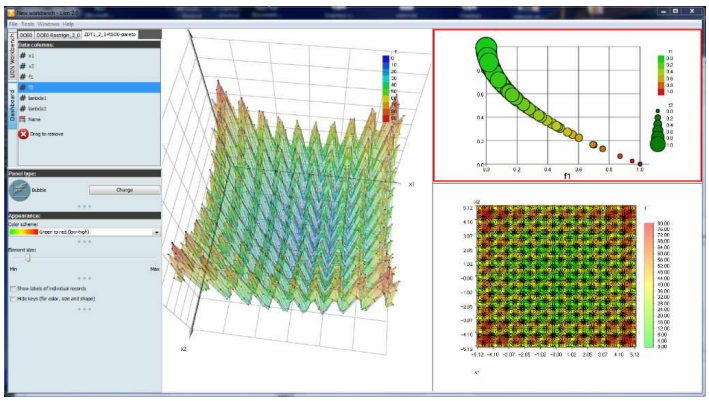
More details about the RSO technology, together with links to original papers and documents, can be found in the following web page **reactive-search.com/learning.php**

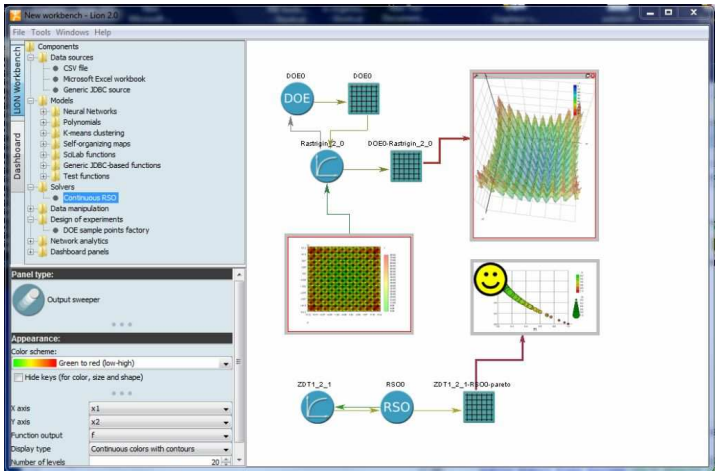
LIONsolver (LION for short) is the flagship product by Reactive Search. LION is a smart software environment for **Adaptive Business Analytics**. It embodies the full-fledged Reactive Search technology into a suite of tools to build models, visualize them, and optimize business and engineering processes.

LION is a uniquely integrated and powerful tool for business intelligence, data mining, modeling, problem solving and decision making.

LION means "Learning and Intelligent" OptimizatioN: a software capable of learning from its previous attempts and from human feedback.

LION integrates two environments: a **workbench**, for placing active tools and defining connections between databases, models, optimizers following the business logic, and a **dashboard** for visualizing data and monitoring measurements.





Updated information about LIONsolver, including a selected number of usage cases, can be obtained at the product web site **LIONsolver.com**. A quick summary of the main characteristics and motivations for adopting the LION approach follows.

What is Adaptive Business Analytics?

Every business has two fundamental needs:

1. **Understanding** the current business processes and the related performance
2. **Improving** the business profitability by making **informed and rational decisions**, based on models of the business, on predictions about the effects of decisions, and on monitoring the effects of decisions.

Business analytics aims at understanding business operations and planning future improvements by using systematic, quantitative and data-driven processes linking data about the business to models, analysis, predictions, and optimal decisions. Related terms are **business intelligence**, **data mining** (exploring business data to discover relevant relationships or "patterns", and insight).

Adaptive Business Analytics emphasizes the capability of rapid **reaction** to external events caused by changes in the business environment or in the decision maker priorities.

Why is Adaptive Business Analytics needed?

Entrepreneurs, managers and decision makers had limited access to data and measurements until the advent of computers, of massive storage systems, and of semi-automated processes.
Decisions based on partial knowledge and **gut feelings** used to be the norm. Big companies were born and prospered with this approach, but big companies collapsed and died because they had wrong assumptions about their business models, poor knowledge of the organization, and they could not *react rapidly* to changes in the market and missed new opportunities.

Systematic approaches based on computer-supported measurements and models give a competitive edge because:

- many **"what if" scenarios** based on models and predictions can be tested before deciding
- the manager's intuition can be confronted with updated business data so that **corrective actions** can be taken very rapidly, before wrong decisions ruin the business
- a **consistent quality** of products or services is obtained by immediately identifying problems and defects

Rational and reproducible processes based on measurements and on the detailed registration of all relevant data about a business are at the base of every business aiming at a consistent and improving quality.
Furthermore, thanks to the rapid adaptation caused by **Reactive Search Optimization (RSO)** technology, there in no contradiction between gut feelings and rational decisions: the software progressively *learns* from the decision maker about his preferences and gut feelings.

Why is Adaptive Business Analytics possible now?

Adaptive BA is possible now, and affordable by most businesses because of the growing amounts of storage and computational power available at cheap prices. This technological development makes it possible to analyze huge amount of data with advanced data mining and machine learning software in acceptable times and with limited software investments.

Which competences and steps are required?

Until some years ago the design and development of BA processes in a business required top-level consultancy or the availability of personnel trained in statistics, analysis, machine learning, databases. This meant that different layers in the business hierarchy had to be traversed for obtaining answers to various business questions, even for summarizing recent data about the business. Top managers had to interact with technical people with high expertise. Experts had to design data extraction and manipulation processes and pass them to programmers for the actual execution. The chain was costly and slow, in some cases so slow that some questions were not even asked because action was needed immediately and waiting for the computed answer could not be afforded.

The situation is changing now given the growing availability of **self-service analytics tools**, copying data from complex and hard-to-maintain databases into internal memory (in some cases called *data warehouses*), and allowing rapid exploration, model building, predictions, in some cases at the click of a button, and by using natural and human drag-and-drop actions.

The steps for adopting BA vary depending on the current business state. It is easier and less costly to introduce BA practices if all relevant data about the business are already saved into organized databases and easily accessible by everyone using them. Adopting BA is more costly if many processes are still based on experience in the minds of the business owners and not on formalized processes.

In some cases, the introduction of BA can bring radical changes to the value-creation chain, making **hidden opportunities** visible, and increasing the **speed** by which a business can respond to customer requests, or to changes in the market.

With the RSO technology in LIONsolver the level of automation is raised to new heights.
Powerful data mining and modeling tools **can be used without advanced technical knowledge**, the decision maker is free to concentrate on setting priorities, asking the right questions, building his vision on solid quantitative grounds.

The LIONsolver adaptive business analytics software package includes:

•The capability to **import data from files and from most existing databases**, either local or distributed in different servers (and reachable by the Internet)

•**Exploratory data analysis** tools to rapidly navigate in your data, visualize them and derive the relevant summaries (including Bar charts, Bubble charts, Pie charts, Histograms, Radar charts, Line plots, and simple filtering options like parallel filters, but also advanced capabilities like sweeps in time or across parameters)

•**Model-building** tools, including the standard polynomial fits with least-squares approximations, supervised training tools like neural networks, unsupervised training tools like clustering (top-down and bottom-up), self-organizing maps.

•**Connectors to applications and models which are external** to the BA software. In most cases some models already exist and need to be integrated in a seamless manner into the BA system.

•A suite of **solvers (optimizers)** matched to the business characteristics, for example solvers acting on real-valued parameters, discrete parameters, mixed cases.

•Tools for **manipulating data tables**, like for merging tables together, filtering data, creating data tables by accessing information on the web, etc.

•**Design of experiment** (DOE) methods for creating input data to be used for testing your business (or your system)

•**Network analytics** tools to analyze *relationships* between entities, like relationships between people in social networks or between customers and products.

Software

About the 75th Meeting

University Rovira i Virgili, in Tarragona, hosted the 75th meeting of the European Working Group "Multiple Criteria Decision Aiding", from April 12th to 14th, 2012. The meeting was organized by Dr. Aida Valls, with the help of the research group ITAKA (Intelligent Technologies for Advanced Knowledge Acquisition): Antonio Moreno, Luis del Vasto, Lucas Marín, Sergio Martínez and Carlos Vicient.

The topic of the meeting was "MCDA and Artificial Intelligence: connections and challenges". So, the aim of the meeting was to discuss about the relations and differences between the approaches to decision making in these two research fields.

The meeting was supported by the Catalan Association for Artificial Intelligence (ACIA: www.acia.org) and the EURO association, as well as for the Department of Computer Engineering and Mathematics, the Engineering School, the University Rovira i Virgili and Diputació de Tarragona.

The meeting took place at the buildings of the Engineering School in Campus Sescelades, Tarragona. This is one of the main 4 campus of the University Rovira i Virgili (URV).

The activities started, as usual, on Thursday morning with the "Young Researchers Session". We had an exhibition of 9 posters. Some students of the MCDA course on the URV Master on Intelligent Systems and Information Security prepared 3 posters aimed to illustrate different connections between MCDA and AI. They were devoted to: "MCDA and electronic commerce", "Decision making software tools" and "Ontologies in decision making". The rest of the posters were submitted from students from different countries, covering quite different application topics and methods. EURO gave grants to 4 participants to cover part of their expenses.

Contributed sessions started on Thursday afternoon, after the opening ceremony (by Dr. Aida Valls, general chair of the MCDA75 meeting, Prof. Josep Domingo-Ferrer, head of the Department on Computer Engineering and Mathematics, and Prof. Roman Slowinski, co-coordinador of the EWG-MCDA).

A debate was organized on Thursday with three invited speakers: Prof. Jose Luis García-Lapresta, from University of Valladolid (Spain), expert in social choice using linguistic information, Prof. Vicenç Torra, from the Research Institute on Artificial Intelligence (Bellaterra, Catalonia), expert in aggregation operators mainly with fuzzy data, and Prof. Salvatore Greco, University of

Catania (Sicily, Italy), expert in MCDA methods, mainly for learning from examples. Two questions were proposed to the speakers and to the audience: (1) "Advantages and drawbacks of expressing preferences in a linguistic scale" and (2) "Are the multi-criteria decision aid methods scalable to large sets of data?". A very participatory discussion was done on the topics proposed, focusing mainly on the problems of the different types of evaluation scales: cardinal, ordinal and even linguistic versus numerical.

The submitted papers were organized in 5 sessions during the two days. We had 18 oral presentations and 14 papers submitted for discussion. The abstracts were printed in the proceedings and are available in the web page of the meeting (see below). Full papers and the presentation materials are available to the participants to the meeting in a private web page. The authors of these contributions are invited to a special session organized in the 9th International Conference on Modeling Decision for Artificial Intelligence (MDAI): http://www.mdai.cat/mdai2012/. This will give to these participants the opportunity of presenting the work in an international conference rated as a CORE B by the Computing Research and Education Association of Australasia. Additionally, the papers accepted to MDAI are going to be published in the LNAI/LNCS series of Springer.

In addition, submitted papers will undergo a two-fold blind review to be selected for publication in a special issue of the International Journal of Multicriteria Decision Making **(**IJMCDM**),** published by Inderscience.

The social program included a Saturday guided tour to the medieval village of Montblanc and the Cistercian monastery of Poblet. These are two significant places for the history of the Catalan Kingdom in the 13th -14th century. Montblanc was the 7th most important city in the Catalan Kingdom in the 14th century, having the title of Duke of Montblanc. Some Catalan Courts were celebrated in this village. Poblet Cistercian abbey is one of the largest in Spain. At its center there is a big 12th-century church. The austere, majestic monastery has a fortified royal residence and contains the pantheon of the kings of Catalonia and Aragon (14th-15th centuries). Poblet has a unique blend of architectural styles and mystical spirit. The monastery is still inhabited by monks. After enjoying these treasures that let us to discover a little bit of the history of our territories, we went to a restaurant to enjoy the traditional Catalan meals, served with red wine produced by in the cellar of the restaurant (which we also briefly visit before lunch).

More information about the meeting can be found at:
http://deim.urv.cat/~itaka/CMS4

Aida Valls (aida.valls@urv.cat)

The MCDA 75th meeting program is presented below.

PROGRAM
Thursday 12th April / Jeudi 12 avril

Young Researchers Meeting / Jeune Chercheur (Chair: A. Moreno) – Room 1 (ground floor)
11:00 – 13:00
Silva, S., Dias, L., Alçada-Almeida, L., "Sustainability classification of dairy farming explorations in a portuguese region with ELECTRE Tri"
Franco, C., Rodríguez, J.T., Montero, J.,"Decision process under socio-economical viewpoint"
Haddad, M.R., Ben Ghezala, H., Baazaoui, H., "Proposition d'un modèle de recommandation et d'aide à la décision pour les consommateurs sur le Web"
Passuello, A., Cadiach, O., Kumar, V., *Schuhmacher, M.*, "A decision support system based on Bayesian Networks to select the best areas for sewage sludge amendment: a case study"
Bagherikahvarin, M., De Smet, Y., "A quantitative comparison between the Weighted Sum and PROMETHEE II using Data Envelopment Analysis: first investigations"
Griño, M., Soniran, J., *Del Vasto, L., Valls, A.*, Zielniewicz, P., *Slowinski, R.*, "Dealing with a hierarchical family of criteria in ELECTRE-III"
Galindo, J., Soto, S., "MCDA and e-commerce"
Dey, M.K., Muthupandian, S., ***Giovannetti, L.*****, "Decision making software tools"**
Liévano, F., Ortiz, G., "Ontologies in decision support systems"
13:00 – 14:00
Lunch / Diner
14:00 – 14:30
Opening Session / Session d'ouverture – Room A101 (first floor)
14:30 – 16:30
Session 1: Knowledge-based systems and decision making (Chair: V. Torra)
Tervonen, T., Van Valkenhoef, G., Basturk, N., Postmus, D., "Efficient weight generation for simulation-based multiple criteria decision analysis"
Jimenez, A., Suárez-Figueroa, M.C., Mateos, A., Gómez-Pérez, A., Fernández-López, M., "Selecting sports ontologies for reuse: a MCDA approach"
Borràs, J., Valls, A., Moreno, A., Isern, D., "Using MCDA techniques to build personalized and contextualized tourist trip plans"
Lahdelma, R., Wang, H., *Salminen, P.*, "Complementary judgement matrix method with imprecise information"
Papers submitted for discussion
De Vicente, M., Manera, J., González-Blanch, J.M., "Planning with Electre Tri. An application to enterprise incubators in Madrid (Spain)"

Ben Amor, S., Zaras, K., Martel, J.-M., "Additional Information in MCDA with information imperfections: the bayesian model and pre-posterior analysis"
Tremblay, J., *Abi-Zeid, I.,* "Value-based argumentation and multicriteria decision analysis – Methodology and a case study of an environmental project in Québec"
16:30 – 17:00
Coffee Break / Pause café
17:00 – 18:30
Round Table / Table ronde : MCDA and AI (Chair: A. Valls) – Room A101 (first floor)
TOPICS:

- Advantages and drawbacks of expressing preferences in a linguistic scale.
- Are the multicriteria decision aid methods scalable to large sets of data?

Dr. José Luis García Lapresta, University of Valladolid, Valladolid, Spain.
Dr. Vicenç Torra, Research Institute for Artificial Intelligence (CSIC), Barcelona, Catalonia. President of the Catalan Association for AI.
Dr. Salvatore Greco, University of Catania, Sicily, Italy.
20:00 – 21:00
Guided Tour / : Roman time in Tarragona
21:00 – 23:00
Banquet
Friday 13th April / Vendredi 13 avril
09:00 – 10:30
Session 2: Software for MCDA (Chair: V Mousseau) - Room "Sala graus" (ground floor)
Mareschal, B., "Visual PROMETHEE - A New Multicriteria Decision Aid Software"
Corrente, S., Greco, S., Slowinski, R., "Extending ELECTRE and PROMETHEE methods to Hierarchical Structure of Criteria and Imprecise Evaluations"
Bigaret, S., Chiprianov, V., Meyer, P., Simonin, J., "On the Formalization and Executability of the Decision Aid Process with Service Oriented Architecture"
Papers submitted for discussion
Soares de Mello, J.C., Bana, C.A., "Combining DEA with MACBETH"
Boggia, A., *Corrente, S., Greco, S.,* Massei, G., *Slowinski, R.,* "Robust Ordinal Regression in Geographical Information Systems"
10:30 – 11:00
Coffee Break / Pause café
11:00 – 13:00
Session 3: Preferences (Chair: Y. Siskos) - Room "Sala graus" (ground floor)
Angilella, S., Corrente, S., Greco, S., Slowinski, R., "Multicriteria customer satisfaction analysis with interacting criteria"
Argyris, N., *Morton, A., Figueira, J.,* "A polyhedral approach to preference modelling/ Une approche polyhédrale pour la modélisation des préférences"
Fernández, E., Olmedo, R., "An approach to group multi-objective optimization using outranking-based measures of collective satisfaction and dissatisfaction"
Corrente, S., Figueira, J.R., Greco, S., "Dealing with Interaction Between Bi-polar Multiple Criteria Preferences in Outranking Methods"
Papers submitted for discussion
Kadzinski, M., Tervonnen, T., "Stochastic Ordinal Regression for Multiple Criteria Sorting Problems"
Hurson, C., Siskos, Y., "Robustness measures in criteria importance estimation"
Fernandez, E., Navarro, J., Salomon, E., "Automatic enhancement of the reference set for multi-criteria sorting in the frame of the Theseus method"
13:00 – 14:00
Lunch / Diner
14:00 – 14:30
Working group matters and meetings / Vie du group et reunions
Room "Sala graus" (ground floor)
R. Slowinski (EWG-MCDA), *D. Jones* (MCDA76)
14:30 – 16:00
Session 4: Applications (Chair: M.A. de Vicente)
Brauers, W.K., Zavadskas, E.K., "Opposed to Credit Rating Agencies Opinions is a Multi-Objective Quantitative Rating possible? With a test for the European Union Member States"
Masmoudi, L., Yamnahakki, H., El Kadmiri, O., "Application d'une Approche Multicritère pour la Segmentation d'Images Omnidirectionnelles"
Isigonis, P., Zabeo, A., Semenzin, E., Critto, A., Giove, S., Marcomini, A., "Multi Criteria Decision Analysis based scoring of dose response laboratory tests for contaminants in surface water"
Papers submitted for discussion:
García, M.C., *Fernández, G., Escribano, M. del C.,* "The application of new generalized criteria to the electricity prices in the European Union countries"
Valet, L., Cliville, V., "Application of MCDA methods for parameter setting support of an image processing system"
Sarrazin, R., "Méthode d'analyse multicritère appliquée à l'évaluation de la performance de projets routiers en matière de sécurité routière durable"
Angilella, S., Bottero, M., *Corrente, S., Ferreti, V., Greco, S., Lami, I.M.,* "Non Addictive Robust Orginal Regression for Urban and Territorial Planning: an application for siting an urban waste landfill"
16:00 – 16:30
Coffee Break / Pause café
16:30 – 18:30
Session 5: Methods (Chair: M. Kadzinski) - Room "Sala graus" (ground floor)
Caklovic, L., "Measure of inconsistency. AHP & Potential Method. A comparison."
Marin, J.-C., Kazimierz, Z., Boudreau-Trudel, B., "Guiding the decision-making process with the Balanced Scorecard based on rough set theory"
Merigó, J.M., "Decision Making under Subjective and Objective Risk and Complex Uncertainty"
Mousseau, V., Rolland, A., Zheng, J., "Inferring a reference based multicriteria ranking model from pairwise comparisons"

Papers submitted for discussion

Leibak, A., *Sheletski, A., Vaarman, O.,* "On a hierarchical approach to the generation of pareto points for complex systems"

Greco, S., Siskos, Y., Slowinski, R., "Controlling robustness in ordinal regression models"

Veneziano, T., Bisdorff, R., *Meyer, P.,* "Didactic application of the stability of the median-cut outranking digraph"

Saturday 14th April / Samedi 14 avril
09:00 – 16:00
Day dedicated to informal exchanges aiming the participants to know themselves and to organize their cooperation.

Journée consacrée à des échanges informels devant permettre aux participants de mieux se connaître et d'organiser leur coopération.

Guided excursion " DISCOVER THE MEDIEVAL LIFE (POBLET + MONTBLANC)"
(including lunch)

Forthcoming meetings

INFORMS 2012 International Beijing;
June 24-27, 2012; Beijing, China;
http://meetings.informs.org/beijing2012

The 54th Annual conference of the Canadian Operational Research Society and the 12th International Conference on Multiple Objective Programming and Goal Programming;
June 11-13, 2012; **Sheraton on falls, Niagara Falls, Canada; www.cors.ca/cors2012/**

IPMU 2012-14th International Conference on Information Processing and Management of Uncertainty in knowledge based-systems; July 9-13, 2012; Catania, Italy.
http://www.ipmu2012.unict.it

Euro 2012 - 25th European Conference on Operational Research; July 8-11, 2012; Vilnius, Lithuania; http://www.euro-2012.lt

The Sixth Global Conference on Power Control and Optimization PCO 2012, which will be held in Mount Carlo hotel, Las Vegas, Unites States of America , August, 6 – 8, 2012.

ISMP 2012 - 21st International Symposium on Mathematical Programming;
August 19-24, 2012; Berlin, Germany;
http://www.ismp2012.org

76th Meeting of the EWG on MCDA.
September, 2012; Portsmouth, Great Britain;
Organizer: University of Portsmouth - A. Ishizaka;
Topic: "MCDA in maritime, land and air transport management".

OR 2012 - International Annual Conference of the German OR Society;
September 4-7, 2012; Leibniz Universität Hannover, Germany;
http://www.OR2012.de

ANTS 2012 - Eighth International Conference on Swarm Intelligence;
September 12-14, 2012; Brussels, Belgium;
http://iridia.ulb.ac.be/ants2012

Matheuristics'2012;
September 16-21, 2012; Angra dos Reis, Rio de Janeiro, Brazil;
http://www.ic.uff.br/matheuristics2012/

INFORMS Annual Meeting 2012 Phoenix;
October 14-17, 2012; Phoenix, Arizona, USA;
http://www.informs.org/

EURO / INFORMS Joint International Conference 2013;
July 1-4, 2013; Rome, Italy;
http://www.euro2013.org

Announcements and Call for Papers

The new European Journal of Decision Processes founded by EURO is preparing a special issue on risk Management.

CALL FOR PAPERS
Special Issue on Risk Management Guest Editors Simon French (University of Warwick) Alec Morton (London School of Economics) Ortwin Renn (University of Stuttgart)

Motivation
Most decision making involves dealing with uncertain consequences and managing these uncertainties. Thus decision process and risk management are intimately interconnected, although their literatures are based in distinct communities. The purpose of this special issue of the EURO Journal of Decision Processes (EDJP) is to explore that relationship and draw together different disciplinary perspectives on risk management and decision.
EJDP-which has been recently established by the Association of European Operational Research Societies (EURO)-publishes papers that contribute to the understanding and appropriate use of operational research in supporting different phases of decision making processes. More information on EJDP is at http://www.springer.com/40070 and at http://www.euro-online.org/web/pages/1497/euro-journal-on-decision-processes

Schedule

Prospective authors are invited to submit a full paper to the Manuscript
Central editorial system
(https://www.editorialmanager.com/ejdp, article type SI: Risk Management). Alternatively, they may send the Guest Editors a three-page extended abstract describing the proposed contribution (email a.morton@lse.ac.uk) for feedback. The planned schedule is as follows:

June 1st, 2012: Deadline for the submission of extended abstracts September 30th, 2012: Deadline for submission of full papers November 15th, 2013:
Final decision notification 4th quarter of 2013: Publication of the Special Issue

The upcoming **MCDA/M Summer School** which will take place next year in Hamburg, Germany (a fist announcement is attached).

The website (which is still under construction) can be found here
http://logistik.hsu-hh.de/MCDAM-2013
Certainly something for PhD-students, also for the ones starting their studies in the coming 18 months.

Web site for Annoucements and Call for Papers:
www.cs.put.poznan.pl/ewgmcda

The link to the new issue of the journal International Journal of Multicriteria Decision Making (IJMCDM) is given below:
http://www.inderscience.com/browse/index.php?journalID=350&year=2012&vol=2&issue=2

Books

Multicriteria Portfolio Management

By Xidonas, P., Mavrotas, G., Krintas, T., Psarras, J., Zopounidis, C.

ISBN: 978-1-4614-3669-0
http://www.springer.com/mathematics/quantitative+finance/book/978-1-4614-3669-0

Presents a strong case for a multicriteria approach to portfolio construction and selection

Develops an integrated and innovative methodological approach within the framework of multiple criteria decision making

Includes suggestions for an innovative methodological approach to traditional portfolio creation
The disastrous impact of the recent worldwide financial crisis in the global economy has shown how vulnerable international markets are. The insufficiency of our models and tools to effectively intercept the overwhelming consequences of the decline has to be the starting point for re-designing and re-engineering existing portfolio management methods and tools.

Mathematical Optimization and Economic Analysis.

Mikulas Luptacik. Springer, New York, 2010.
ISBN 978-0-387-89551-2
The book presents specific examples to demonstrate each technique's advantages and applicability as well as numerous applications of these techniques to industrial economics, regulatory economics, trade policy, economic sustainability, production planning, and environmental policy.

Innovation in Power, Control, and Optimization: Emerging Energy Technologies

Pandian Vasant (University Technology Petronas, Malaysia), Nadar Barsoum (Curtin University, Malaysia) and Jeffrey Webb (Swinburne University of Technology, Malaysia)
ISBN13: 9781613501382
Developing a system that can cope with variations of system or control parameters, measurement uncertainty, and complex, multi-objective optimization criteria is a frequent problem in engineering systems design. The need for a priori knowledge and the inability to learn from past experience make the design of robust, adaptive, and stable systems a difficult task.

Innovation in Power, Control, and Optimization: Emerging Energy Technologies unites research on the development of techniques and methodologies to improve the performance of power systems, energy planning and environments, controllers and robotics, operation research, and modern artificial computational intelligent techniques. Containing research on power engineering, control systems, and methods of optimization, this book is written for professionals who want to improve their understanding of strategic developments in the area of power, control, and optimization.

Handbook on Decision Making
Vol 2: Risk Management in Decision Making

Jie Lu, Lakhmi C. Jain and Guangquan Zhang
INTELLIGENT SYSTEMS REFERENCE LIBRARY
Volume 33, 2012, DOI: 10.1007/978-3-642-25755-1

This book presents innovative theories, methodologies, and techniques in the field of risk management and decision making. It introduces new research developments and provides a comprehensive image of their potential applications to readers interested in the area. The collection includes: computational intelligence applications in decision making, multi-criteria decision making under risk, risk modelling,forecasting and evaluation, public security and community safety, risk management in supply chain and other business decision making, political risk management and disaster response systems. The book is directed to academic and applied researchers working on risk management, decision making, and management information systems.

Financial Decision Making Using Computational Intelligence (Springer Optimization and Its Applications) July 31, 2012 | ISBN-10: 1461437725 , Edition: 2012

Michael Doumpos (Editor), Constantin Zopounidis (Editor), Panos M. Pardalos (Editor)

The increasing complexity of financial problems and the enormous volume of financial data often make it difficult to apply traditional modeling and algorithmic procedures. In this context, the field of computational intelligence provides an arsenal of particularly useful techniques. These techniques include new modeling tools for decision making under risk and uncertainty, data mining techniques for analyzing complex data bases, and powerful algorithms for complex optimization problems. Computational intelligence has also evolved rapidly over the past few years and it is now one of the most active fields in operations research and computer science. This volume presents the recent advances of the use of computation intelligence in financial decision making. The book covers all the major areas of computational intelligence and a wide range of problems in finance, such as portfolio optimization, credit risk analysis, asset valuation, financial forecasting, and trading.

GUIDEBOOK FOR SUPPORTING DECISION MAKING UNDER UNCERTAINTIES
Today's Managers, Tomorrow's Business
by Ettore Piccirillo *(Unilever Supply Chain, UK)* & Massimo G Noro *(Unilever R&D Port Sunlight, UK).* ISBN: 978-981-270-803-8
981-270-803-0

This book provides much-needed guidance in making sound business decisions for the business leader or decision maker, especially investment appraisal practitioners such as strategic planners, business analysts, financial partners, and supply chain experts. By "supply chain", the authors mean the network of retailers, distributors, transporters, storage facilities and suppliers that participate in the sale, delivery and production of a particular product.

The book begins with an introduction to the concept of decision making under uncertainty and the forces driving the business. A gap in the current knowledge is then discovered as it arises from an analysis of the profitability indicators that are currently being used.

With hands-on experience in decision making within the supply chain environment, and coupled with leading-edge mathematical and business formulations, the authors propose how to enrich quantitative and qualitative decision-making measures. This further leads to a decision-making framework and process, supported by a ready-to-use tool (PADOVA).

Articles Harvest

(This section is prepared by Salvatore CORRENTE, salvatore.corrente@unict.it)

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Available at: www.deg.ist.utl.pt/cegist/artigosinternos_en.shtml

Seminars

Announcement:

The "Useful links" section of the group's homepage

(www.cs.put.poznan.pl/ewgmcda)

is being enlarged. Contributions of URL links to societies, research groups and other links of interest are welcome.

A membership directory of the European Working Group on "Multiple Criteria Decision Aiding" is available at the same site. If you would like to be listed in this directory please send us your data (see examples already in the directory).

Contact: José Rui Figueira (figueira@ist.utl.pt)

Web site for the EURO Working Group "Multicriteria Aid for Decisions"

A World Wide Web site for the EURO Working Group on "Multicriteria Aid for Decisions" is already available at the URL:

http://www.cs.put.poznan.pl/ewgmcda/

Web site Editor: Milosz Kadzinski (Milosz.Kadzinski@cs.put.poznan.pl)

This WWW site is aimed not just at making available the most relevant information contained in the Newsletter sections, but it also intends to become an online discussion forum, where other information and opinion articles could appear in order to create a more lively atmosphere within the group.

EWG-MCDA
EURO Working Group on Multicriteria Decision Aiding
Groupe de Travail Européen Aide Multicritère à la Décision
NEWSLETTER
BULLETIN

This newsletter is published twice a year by the "EWG on MCDA", in November/December and April/May , with financial support of the Association of European Operational Research

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