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

Groupe de Travail Européen "Aide Multicritère à la Décision"
Série 3, n°41, Printemps 2020.

European Working Group "Multiple Criteria Decision Aiding"
Series 3, nº 41, Fall 2020.

Dear Members of the EURO Working Group on MCDA,

We wish to share with you a sad news about passing away of Professor Marc Roubens (1940-2020).

Marc Roubens was an expert in Preference Modelling using Fuzzy Logic. He was an active member of our Working Group from its conception to his retirement in 2005.

As indicated in the attached obituary, his funeral has been on Thursday, February 6 at 10:15 a.m. in Court-St-Etienne (Belgium)

We will keep a good memory of him.

With kind regards,
Roman Słowiński, Salvatore Greco and Jose Figueira
The Group Coordinators

Chers membres du groupe de travail EURO sur l'AMCD,

Nous souhaitons partager avec vous une triste nouvelle du décès du professeur Marc Roubens (1940-2020).

Marc Roubens était un expert en modélisation des préférences utilisant la logique floue. Il a été un membre actif de notre groupe de travail depuis sa conception jusqu'à sa retraite en 2005.

Comme indiqué dans l'avis nécrologique joint, ses funérailles ont eu lieu le jeudi 6 février à 10h15 à Court-St-Etienne (Belgique).

Nous garderons un bon souvenir de lui.

Cordialement,
Roman Słowiński, Salvatore Greco et Jose Figueira
Les coordinateurs du groupe

MARC ROUBENS

PROFESSEUR HONORAIRE à la Faculté Polytechnique de l'Université de Mons et à l'Université de Liège

né à Bruxelles le 25 novembre 1940
et décédé à Wavre le 31 janvier 2020

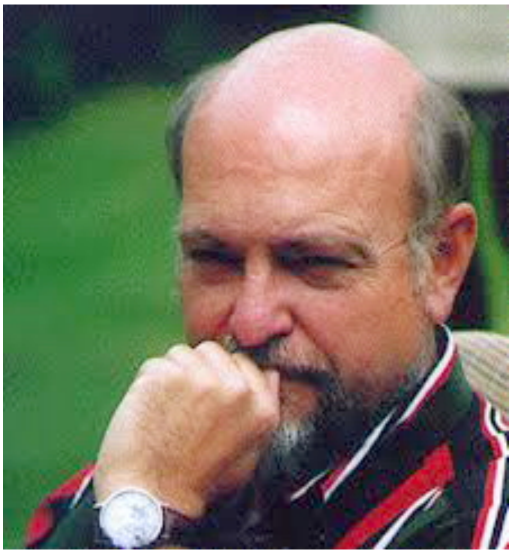
La cérémonie d'adieu aura lieu le jeudi 6 février de10h30 à 11H30

Réunion au crématorium de Champ de Court à 10h15
(1 Drève Goblet d'Alviella à 1490 Court-St-Etienne)

La famille se réunira dans la plus stricte intimité à l'issue de la cérémonie.

Les personnes désirant manifester leur sympathie peuvent verser un don au compte BE28 0882 4636 3120 de Solidarité Logement asbl ou au compte BE70 0016 6430 9125 de la Fondation contre le Cancer, avec la mention «En souvenir de Marc Roubens »

Le présent avis tient lieu de faire-part



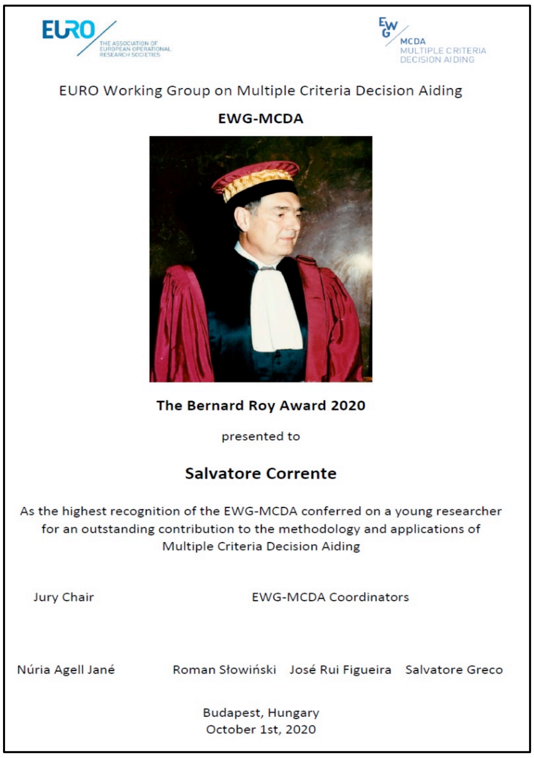
Second Bernard Roy Award of the EURO Working Group on Multiple Criteria Decision Aiding

We are delighted to announce that the jury for the 2020 edition of the Bernard Roy Award of the EURO Working Group on Multiple Criteria Decision Aiding decided, in a process carried out in July, to grant the 2020 award to Professor Salvatore Corrente (University of Catania | UNICT · Department of Economics and Business). The award is a recognition conferred on a researcher under 40 years old for an outstanding contribution to the methodology and/or applications of multiple criteria decision aiding (MCDA). In this second edition two candidates were presented, and after an open discussion the jury, in the current edition composed of Professors Irène Abi-Zeid, Núria Agell (chair), Yannis Siskos, Roman Słowiński and Marc Pirlot, decided to confer the award on Professor Corrente, highlighting the following aspects as outstanding in his career:

- The quality of his publications: His work is published in top tier international journals and falls into the mainstream of the European School of Decision Aiding initiated by Bernard Roy. Moreover, it goes beyond this school, forming a bridge to artificial intelligence, machine learning, and different ways of modelling uncertainty, vagueness and imprecision in decision problems.
- Potential impact of his research: His research is very relevant not only from a theoretical point of view, but also proposing new comprehensive methodologies, and for its applicability to many real-life decision problems.
- Independence and originality of the research: He is the leading author of a great number of journal publications. His independence and originality in MCDA is also attested by several invited talks and visiting professor invitations to numerous European universities.
- Contribution to the research community: He has actively participated in international conferences and has served as a reviewer for 30 important international journals in the field of OR-MS-AI-EMO.

The award will be officially bestowed at the opening session of the next EWG-MCDA meeting, where, following a presentation of the competition by the chair of the jury, the laureate will be invited to give a talk.

Congratulations to Professor Corrente!



EURO Working Group on Multiple Criteria Decision Aiding

EWG-MCDA

The Bernard Roy Award 2020

presented to

Salvatore Corrente

As the highest recognition of the EWG-MCDA conferred on a young researcher for an outstanding contribution to the methodology and applications of Multiple Criteria Decision Aiding

Jury Chair — Núria Agell Jané

EWG-MCDA Coordinators — Roman Słowiński, José Rui Figueira, Salvatore Greco

Budapest, Hungary
October 1st, 2020

Opinion Makers Section

Evolutionary Multiobjective Optimization

Andreia P. Guerreiro[a] and Carlos M. Fonseca[b]

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Introduction

For several decades, evolutionary algorithms (EAs) have been successfully applied to single-objective optimization problems. The flexibility and the ability of EAs to work simultaneously with multiple solutions make them even more suited to the multiobjective case where, due to the usually conflicting nature of objectives, there are typically multiple (Pareto-)optimal solutions, whose image in objective space is known as the Pareto front. When no preference information is known a priori, the goal frequently becomes to determine a representation of the Pareto front, i.e., a bounded-size subset of the Pareto front that is well spread. Thus, the goal of Evolutionary Multiobjective Optimization Algorithms (EMOAs) is typically to search for approximations of such representations, from which a Decision Maker (DM) can select their most preferable point, or learn about the trade-offs in the problem and formulate their preferences.

Evolutionary Algorithms

Evolutionary algorithms are inspired in the principle of natural selection, by which only the fittest individuals in a population survive to reproduce, leading to increasingly fit populations. In evolutionary multiobjective optimization algorithms, each individual represents a solution, and thus a population represents a (multi-)set of solutions. At each generation, such solutions are subject to selection and to variation operators analogous to the recombination and mutation processes that occur in nature.

The general structure of an EMOA is as follows. The first step is the *initialization of the population* of a given number, μ, of solutions (or individuals), which is usually performed at random. Then, the μ solutions are evaluated according to the d objective functions of the multiobjective optimization problem. The resulting d-objective vector represents the evaluation of the solution in objective space. The next step is *fitness assignment*, whereby a real value is assigned to each solution in the population. Such a fitness value typically reflects the quality of the solution according to some problem-dependent notion of quality involving the objective values, but may also reflect other aspects such as how much the solution differs from others in the population, or even more general preference information.

A *parental selection* step follows whereby the solutions that will be subject to variation are selected. This selection step, where the fittest individuals have greater chances of being selected, may be performed in a probabilistic or a deterministic way. Common probabilistic methods are, for example, tournament selection and stochastic universal sampling (SUS). The *selection pressure*, which depends on the fitness assignment and parental selection mechanisms, is related to how much likely it is to select the fittest individuals in comparison to the population average. The higher the selection pressure is, the more likely it is that the best individuals are selected multiple times, which may lead to premature convergence. However, with a very low selection pressure, the population may not converge at all.

From the solutions selected, $\lambda > 1$ new solutions are generated using two types of (problem-dependent) variation operators known as *recombination* and *mutation*. There are usually parameters that control the probability of applying each of the operators. It is common to have a high probability of applying recombination and a low probability of applying mutation but there are also evolutionary algorithms where recombination is not used at all. In recombination, a few (usually two) of the selected solutions, are recombined to generate one or more new solutions, the *offspring*. For example, when two solutions represented by binary vectors are recombined using single-point crossover, two new solutions are generated, each of which having the first $t \in \mathbb{N}$ bits from one parent and the remaining bits from the other parent. Mutation usually introduces small changes to (the newly generated) solutions. In the previous example, this might consist of flipping one bit at random. There are different views of the role of mutation. Mutation can be viewed as a complementary operator to recombination, or as a powerful mechanism by itself that can be used alone.

After applying the variation operators, the new λ offspring solutions are evaluated. Then an *environmental selection* mechanism decides which solutions from the original and offspring populations to keep and which ones to discard. There are two main environmental selection strategies. One, represented as (μ,λ), requires that $\lambda > \mu$ and selects μ solutions only from the λ offspring solutions, while the other, represented by $(\mu+\lambda)$, selects μ solutions from the combination of the $\mu + \lambda$ solutions. If the best solutions found are guaranteed to be preserved throughout the generations, then selection is called *elitist*. After this step, the algorithm goes back to fitness assignment and the following steps, and this cycle continues until a *stopping criterion* is met, such as reaching a limit on the number of generations or on the number of functions evaluations, i.e., the number of generated (and evaluated) solutions.

There are several aspects that influence the success of an evolutionary algorithm. One is the balance between exploitation and exploration, i.e., between focusing the search on finding better solutions and focusing on the diversity of solutions in the population. The neighborhood structure implicitly explored by the variation operators is key to the algorithm’s performance. On the one hand, every point in the search space must be reachable from any other point by a sequence of variation steps. On the other hand, small changes to solutions should ideally be expected to cause small changes to their quality. Also very important are the characteristics of environmental selection, for example, its ability to retain the best solutions. In Evolutionary Multiobjective Optimization (EMO), this translates into maintaining a population closer and closer to the Pareto front.

The main difference between single-objective EAs and multiobjective EAs concerns selection. Firstly, in the single-objective case, fitness assignment, which directly impacts the choices made by parental selection, does not usually modify the ranking of the solutions as determined by the single objective function. However, in the multiobjective case, different fitness assignment methods may lead to considerably different solution rankings [3] because the objective functions only impose a partial order on the solution space. Secondly, environmental selection becomes more difficult in the multiobjective case, particularly when all solutions in the population are mutually nondominated, i.e., are such that no solution is at least as good in all objectives as some other solution. In that case, no solution can be deemed worse, and consequently discarded, with certainty without additional preference information. Therefore, different environmental selection methods will implicitly reflect different preferences, and be biased towards retaining different (sets of) solutions. The next section explores in more detail the different types of (environmental) selection methods.

Selection in EMO

Multiobjective EAs are usually used to find good approximations to the Pareto front, and thus are developed focusing on two main goals: searching for better solutions (closer to the Pareto front), and searching for diverse sets of solutions. However, just like solution quality, the notion of diversity is subjective, although in the absence of preference information a diverse set of solutions is commonly understood as corresponding to a set of evenly spread points along the Pareto front. To achieve a good approximation set, selection mechanisms must consider both goals simultaneously. Otherwise, there is a chance that the EA converges to a small region of the Pareto front if only dominance is considered, or does not converge at all, if only diversity is considered. Historically, the first EMOAs addressed these goals separately, for example, by first assigning fitness according to some notion of solution quality and then penalizing solutions in crowded regions of the non-dominated front. More recent approaches, such as indicator-based EMOAs [8, 1, 6], focus on the population quality as a whole, taking into account individual quality and diversity. One way or another, there is always implicit (or explicit) preference information in selection methods.

Multiobjective selection methods can be divided into four types depending on how they incorporate preference information, both with respect to individual solutions and to sets of solutions.

Methods focused on solution quality

Methods focused on solution quality are usually based on some measure of quality [9] mapping each objective vector onto a scalar value. A traditional approach consists in using a scalarizing function to aggregate the objective values. Other approaches are based on Pareto dominance, where the evaluation of each solution depends on the other solutions in the population through a ranking procedure. Examples of these measures are *dominance rank* and *dominance strength*, which evaluate the quality of a solution based either on how many solutions in the population dominate it or are dominated by it, respectively. Another very popular measure *is dominance depth*, where the population is partitioned into a set of nested nondomintated fronts by a procedure called *nondominated sorting* [2], and solutions are ranked according to the depth of the front to which they belong.

Such methods are usually followed by diversity preservation techniques [9], which typically use population density information to penalize solutions in more crowded regions in objective space or, possibly, in decision space, or both. The goal is to select solutions evenly across the whole front.

A common selection mechanism of this type consists in first ranking the population using non-dominated sorting, and iteratively selecting the solutions with the lowest ranks. If not all solutions of the last such rank in the population can be selected due to a limit on the size of the new population, the solutions of that last rank are selected based on diversity. This is performed, for example, by iteratively selecting the solution in the least crowded region and then updating the density information [2].

Decomposition methods

Decomposition methods decompose the multiobjective optimization problem into a finite set of single-objective optimization problems, for example, by using a set of aggregating functions. Environmental selection preserves the solutions that minimize each of these functions [7]. Diversity is achieved by adopting appropriate sets of aggregating functions, and decomposition-based EMOAs tend to find good approximations that are reasonably well distributed. Although these methods do focus on the quality of the solution sets in some sense, they do not define how different sets could be compared.

Methods based on set quality

A quality indicator is a function that maps a set of points in objective space (the image of a solution set) into a scalar value that reflects the quality of the set, and thus imposes a total order on the space of solution sets. For example, the hypervolume indicator, which is one of the most commonly used quality indicators in practice, measures the region dominated by a set of points and bounded above by a given reference point. Quality indicators were initially used in the assessment of the performance of EMOAs. Due to their ability to explicitly and simultaneously favor solutions whose image in objective space is closer to the Pareto front as well as diversity, they were subsequently incorporated in EMOA selection methods.

In (μ+λ) environmental selection, indicator-based selection methods can be interpreted as solving, or at least approximating to some extent, a Subset Selection Problem (SSP). Here the goal is to select a set of μ solutions among the μ+λ solutions such that the indicator is maximized or minimized, depending on the indicator (see [1], for example). Other indicator-based selection methods take individual fitness as a function of the loss in quality of the set if that individual is removed from it. Selection is performed based on iteratively discarding the less fit individual followed by updating the fitness [8].

Portfolio selection approach

A more recent approach generalizes the view of selection as a subset selection problem, and combines environmental selection and fitness assignment into a single portfolio selection problem [6]. In finance (e.g., in the stock market), given a set of assets, this problem consists of determining how much to invest in each asset so that the expected return of the portfolio is maximized and the risk (associated with the portfolio's variance) is minimized. In this analogy, solutions are seen as assets, whose expected return relates to their individual quality, and risk is associated with the uncertainty regarding DM preferences. Fitness corresponds to the investment in the solutions, and is determined by solving a mathematical programming problem. Zero investment (or fitness) implies that the asset/solution is not selected.

In this approach, probabilistic models are used to describe the uncertainty regarding DM preferences. Returns are seen as random variables and their expected values and variances are calculated based on those probabilistic models. Determining the portfolio that best balances expected return and risk relates to selecting a diverse set of the best (nondominated) solutions, and can be implemented using traditional risk adjusted performance indices such as the Sharpe ratio. Indicators of this type aim at simplifying the integration of preference information, to the extent that it is available, and have been shown to be amenable to analysis and to possess good theoretical properties [4].

Archiving

In elitist EAs using an (μ+λ) environmental selection method, the population may be viewed as a bounded archive that retains the best set of μ solutions found during the search process. In that process it is usually inevitable to, at some point, have to discard nondominated solutions. It is thus important to understand whether the archiving mechanism prevents the deterioration of the quality of the population, and whether it can converge to a (stable) subset of the Pareto front in a limited number of generations. Deterioration can be defined based on Pareto set-dominance, where a set A strictly dominates a set B if every solution in B is weakly dominated by a solution in A, but not the opposite. An archive that does not deteriorate will never retain a set of solutions that is worse than (or dominated by) the set of solutions in any of its previous states [5]. Having an archiving method that does not deteriorate and converges to a stable set means that increasing the number of generations will not lead to a worse archive in terms of set dominance, and that beyond a certain number of generations the archive will not change (it will converge).

Some selection methods are more prone to deterioration, such as those based on individual quality, particularly if the evaluation of a solution is sensitive to the presence of other solutions in the population. One example is the selection mechanism in NSGA-II, which does not prevent deterioration or guarantee convergence to a stable subset [5]. On the other hand, selection methods focused on set quality, particularly those that view archiving as an indicator-based subset or portfolio selection problem, can be made to avoid deterioration provided that the indicator has suitable monotonicity properties, which formalize the agreement of Pareto set-dominance and indicator values. For example, selection based on the hypervolume indicator, such as in SMS-EMOA [1], can prevent deterioration with respect to Pareto set-dominance and also converge to (possibly suboptimal) stable subsets. Indicator-optimal subsets for the subset selection problem can, in some cases, be determined and characterized analytically, providing insight into towards which subsets the selection methods (and the EMOAs using them) are biased to.

Concluding Remarks

The flexibility of evolutionary algorithms allows very different optimization problems, and not just a particular class of problems, to be approached without depending on information such as derivatives or smoothness of objective functions, making them very useful tools. EAs are particularly well-suited for multiobjective optimization, being capable of producing good approximations of the Pareto front. Still, their success highly depends on the particular components of the EMOA. On the one hand, the choice of the variation operators is strongly dependent on the optimization problem and influences how the search space is explored. On the other hand, selection and fitness assignment are largely problem-independent but inevitably introduce preferences that bias the search towards some set of solutions, whether this is explicitly addressed or not.

Although the outcome solutions of EMOAs are not guaranteed to be Pareto-optimal, theoretical studies related to these algorithms help to better understand their behavior. Determining the biases and limitations that fitness assignment and selection methods possess and incorporate into EMOAs is important in order to help explain EMOA behavior. In turn, this will allow better use to be made of current EMOAs and better EMOAs to be developed.

Acknowledgements
Andreia P. Guerreiro acknowledges financial support by national funds through the FCT - Foundation for Science and Technology, I.P., within the scope of the project PTDC/CCI-COM/31198/2017. Carlos M. Fonseca acknowledges financial support by national funds through the FCT - Foundation for Science and Technology, I.P., within the scope of the project CISUC UID/CEC/00326/2020.

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Why do we need MCDA?

Giuseppe Munda

European Commission, Joint Research Centre

1. Introduction

Probably, the readers of this newsletter, as a first reaction, will judge the question I am addressing here as a pleonastic one. We all think that MCDA is the correct approach to decision problems. However, my own experience is that this statement is not taken for granted in many sciences, for example in economics or in ecology where monetary or energy reductionism are still very common. The empirical argument that MCDA deals with complex issues in an effective way is accepted generally, but often it is not a sufficient one for scholars; thus, theoretical arguments have to be put on the table. This is the main reason why along various years, I have explored the theoretical foundations of MCDA by using analytical philosophy and epistemology. Here, I would like to share with you some of the main results briefly.

The starting point is the relationship between comparability and commensurability (Chang, 1997; O'Neill, 1993). From a philosophical perspective, it is possible to distinguish between the concepts of *strong comparability* (there exists a single comparative term by which all different actions can be ranked), implying *strong commensurability* (a common measure of the various consequences of an action based on an interval or ratio scale of measurement, such as money or energy), or *weak commensurability* (a common measure based on an ordinal scale of measurement, such as consumer's utility), and *weak comparability,* which implies incommensurability (Martinez-Alier *et al*., 1998). Incommensurability can be further distinguished into technical and social ones (Munda 2004). *Technical incommensurability* refers to the impossibility of compressing different dimensions into a single metric consistent will all the original dimensions and *social incommensurability* refers to the existence of an irreducible value conflict among social actors, when deciding what common comparative term should be used to rank alternative options.

Two other useful concepts are *set and rod commensurability* (Munda, 2016); these concepts allow a better understanding of the reasons why incommensurability exists. Let us consider the basic example of apples and oranges, we all learn at primary school. Normally we are thought that we cannot sum up them unless we find a common unit of measurement, i.e. their price or the fact that they both belong to the set of fruits. Commensurability, a necessary condition for strong comparability, can then be implemented in two different ways:

1. By looking for a more general category (set) that can contain *all* the characteristics of the objects we wish to compare; these characteristics are described by using adjectives. This can be defined as "*set commensurability" (*e.g. apples and oranges are legitimately lumped together as fruit, along with grapes, bananas, etc.).

2. By finding *one* property common to all objects to be compared and measurable by using one measurement unit, obviously comparison of objects is possible according to the characteristics of this property only. This can be defined as "*rod commensurability",* which can be divided into *"factual"* (e.g. since different types of fruits contain sugar, and this can be significant when their juice is extracted for drinking as a liquid; and for this purpose they can be compared with sugarcane, sugar beet, etc.), and *"potential"* (if one desires to build an ecologically corrected GDP, there is the need to include non-market goods and services, thus their price has, to some extent, to be invented) ones.

2. Set commensurability

Of course, when possible, set commensurability is the most attractive one since apparently no information is lost in the comparison process, while rod commensurability always requires a kind of reductionism. Let us start by considering the famous Aristotle's syllogism: *All human beings are mortal, all philosophers are human beings, Socrates is a philosopher thus Socrates is mortal.* Clearly here, the point is to define an *adjective* that all elements of the set must present as a necessary property; independently on the subsets they may belong (e.g. a human being is mortal if she/he is a philosopher, a politician or a tennis player).

Let us now look at the following statements:

a)*"X is a red-headed basketball player, all basketball players are persons, and therefore X is red-headed person".*

b) *"X is an old basketball player, all basketball players are persons, and therefore X is an old person".*

c) *"X is a small basketball player, all basketball players are persons, and therefore X is a small person".*

d) *"X is a good basketball player, all basketball players are persons, and therefore X is a good person".*

I believe that most readers would agree on the validity of statement a) but very a few would accept statement d) as a correct way of reasoning, although these syllogisms are all formally correct. Here the question is: *when set commensurability is possible and correct?* Geach's (1956) distinction between *attributive and predicative adjectives* can help us in answering this question. In Geach's own words: *"There are familiar examples of what I call attributive adjectives. Big and small are attributive;* x *is a big flea does not split up into* x *is a flea and* x *is big, nor* x *is a small elephant into* x *is an elephant and* x *is small; for if these analyses were legitimate, a simple argument would show that a big flea is a big animal and a small elephant is a small animal. Again, the sort of adjective that the mediaevals called alienans is attributive;* x *is a forged banknote does not split up into* x *is a banknote and* x *is forged, nor* x *is the putative father of* y *into* x *is the father of* y *and* x *is putative. On the other hand, in the phrase a red book, red is a predicative adjective in my sense, although not grammatically so, for is a red book logically splits up into is a book and is red. I can now state my first thesis about good and evil: good and bad are always attributive, not predicative, adjectives"* (Geach, 1956, p. 32).

Although Geach's arguments were developed in the context of moral philosophy, they have an extraordinary explicative power for evaluation problems too. In fact, evaluation is all about an action *a* being declared better, worse or equal than another action *b*. However, although Geach saw the clear difference between predicative and attributive adjectives, he only gave examples of them but no general definition was provided. I tried then to invent one; in my opinion, this way of reasoning can be generalised by defining the new concepts of absolute and relative predicative adjectives. An adjective is *absolute predicative if its meaning does not change in relation to the subsets considered*. It is an intrinsic characteristic of the object considered. The characteristic of being a red-headed person does not change if we consider subsets such as police officers, politicians, scientists or basketball players. In terms of measurement theory, an absolute predicative adjective is always measured on a nominal scale i.e. individual characteristics are grouped into a set of equivalence classes.

Let us now consider the case of an old person, apparently the adjective *old* seems absolute predicative too, but indeed it is not, because one could argue that old actually is dependent on the noun. If scientists are, on average older than an average middle aged person, then an old scientist is different from an old person. The point becomes clearer if one uses a different profession, e.g. if one refers to "an old basketball player" (statement b) it becomes clear that old in this kind of context can actually have a complete different meaning. The same way of reasoning applies to *small*, which Geach considers an attributive adjective. Clearly, a small elephant is not a small animal and a small basketball player (statement c) is not a small person; the meaning of this adjective changes over different subsets, thus in formal logic terms, the law of the excluded middle is lost (since it is not true that e.g. a person is only young or old). An adjective is *relative predicative if it does not hold its meaning once one switches to a larger or different set of objects*. It describes a characteristic that is dependent on the relative comparisons among the objects considered. In terms of measurement theory, a relative predicative adjective is always measured on an ordinal scale. An adjective is *attributive if it does not have any meaning when referred to a different set or problem framework.* A good person can be a bad basketball player and a good economist can be a bad person. Being good or bad depends also on the notion of quality used, which depends on the use connected to the object to be evaluated. I agree with Geach that evaluative adjectives are always attributive. Given a claim that *"x is better than y"* a proper response is *"x is better what than y?"* Similar points can be made about the adjective *"valuable"* and *"is more valuable than"*.

At this stage, the following conclusion can be derived: *when considering adjectives,* set commensurability is correct only if the adjectives considered are *absolute predicative* ones. An adjective *Z* is absolute predicative if it passes the *ontological* check of the two following logical tests: test (1) implies statements such as *"if x_1 is red and it is a car then x_1 is a red car*" and test (2) *"if x_1 is a red car and all cars are a mean of transport then x_1 is a red mean of transport"*. Adjectives that fail such tests are relative predicative or attributive adjectives, which always imply weak comparability based on incommensurability. For example, the adjective "good" clearly fails (2), statements such as *"x_1 is a good car, all cars are a mean of transport, and therefore x_1 is a good mean of transport"* or *"x_1 is a good scientist, all scientists are human beings, and therefore x_1 is a good human being"* are invalid arguments on the light of a real-world corroboration.

3. Rod Commensurability

Now let us go back to the case of relative predicative adjectives. One could argue that *isn't it true that there can be commensurability even where relative predicative adjectives are involved as long as one sticks to a single measurement unit?* So, going back to the example of big and small as relative predicative adjectives, the relative sizes of elephants and fleas are indeed commensurable as long as one considers a single measurement unit such as kilos, (or pounds), centimetres (or inches) in diameter and so on. The point here is then that *adjectives* are relative predicative but the *property* behind this type of adjective can in principle be measured exactly on a quantitative measurement scale. *Factual rod commensurability is based on this attempt to look for one existing property common to all objects to be compared and measurable by using one measurement unit*; obviously comparison of objects is possible according to the characteristics of this property only.

There is no doubt that rod commensurability is very attractive, in its framework it is possible to make statements ontologically and logically correct on a quantitative scale of measurement and a complete pre-order among objects to be evaluated can always be derived. The classical Adam Smith's example on the value of diamonds versus water is relevant here. No doubt in a city environment everyone would prefer diamond over water, however in a different environment, e.g. a boat in the middle of the ocean, water has definitely a higher value than diamonds. Economic values depend on subjective human preferences, no discussion about this. Attempts to explain economic values through objective, context invariant categories such as energy are an obvious non-sense. On the other side, e.g. Odum’s Emergy[1] measures (Odum, 1996) can be a good proxy of the ecological value of an ecosystem. Galapagos Islands have a higher ecological value than the Dutch Inside Sea surely, but the same does not necessarily apply to economic value (the economic value indeed would favour the Inside Sea, which, since totally eutrophised, offers an important ecosystem service receiving all the nutrients coming from human activity). As a conclusion, we may state that different values, since they are related to different objectives and institutions, cannot be merged into only one metric.

Potential rod commensurability has two distinguishing characteristics:

1) It is based on the search for one plausible common property among the objects to be evaluated, although this property is not necessarily recognizable in the real world.

2) This common property tries to represent many dimensions simultaneously.

One should observe that from a policy point of view, this kind of commensurability is very risky; since a multidimensional concept is compressed into a single dimension only, no consistency between a policy objective and the metric used exists anymore. For example, if sustainability is summarised into the ecological footprint index (where all categories are transformed into land requirements), a possible policy would be to transform the Coliseum into a wooded area since this option decreases the ecological footprint of Rome! Clearly this index is an example of ecological reductionism where e.g. socio-economic and cultural aspects are completely neglected.

In summary, the point is that different metrics are also linked to different social objectives and values; in this context, the statement *"x is better than y"* implies an answer to two questions: 1) according to *what?* 2) According to *whom?* To use only one measurement unit for incorporating a plurality of dimensions, objectives and values, implies reductionism necessarily. If evaluative adjectives like "good" and "valuable" are attributive in standard uses, this does not however preclude the possibility of rational choices between objects, which do not fall into the range of a single comparative. *Weak comparability* based on *incommensurability* is compatible with the existence of such limited ranges; for example, urban well-being is not evaluated as good or bad as such, but rather, as good, bad, beautiful or ugly in relation to different descriptions or indicators. It can be at one and the same time a *"good average income"* and a *"bad social inclusion",* a *"beautiful skyline"* and an *"ugly cultural heritage".* The use of these value terms in such contexts is attributive clearly.

I believe we can accept as true the statement that incommensurability does not imply incomparability; on the contrary, incommensurability is the only rational way to compare various objects under different methodological assumptions than traditional optimisation. It is in terms of weak comparability that evaluation has to take place in practice. This is exactly the basic idea of multi-criteria evaluation; weak comparability can therefore be implemented by using multi-criteria evaluation.

4. Conclusions

1. Commensurability, a necessary condition for strong comparability, can be implemented by means of “set commensurability” and “rod commensurability”. Both of them are not of a general applicability.

2. Different metrics are linked to different objectives and values. To use only one measurement unit for incorporating a plurality of objectives and values, implies reductionism necessarily.

3. Weak comparability can be implemented by using multi-criteria evaluation, which is a formal framework for applied consequentialism under incommensurability.

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[1] *Emergy* is the “available solar energy used up directly and indirectly to make a service or product” (Odum, 1996, p. 8).

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MCDA Research Groups

BONUS — Big Optimization aNd Ultra Scale computing

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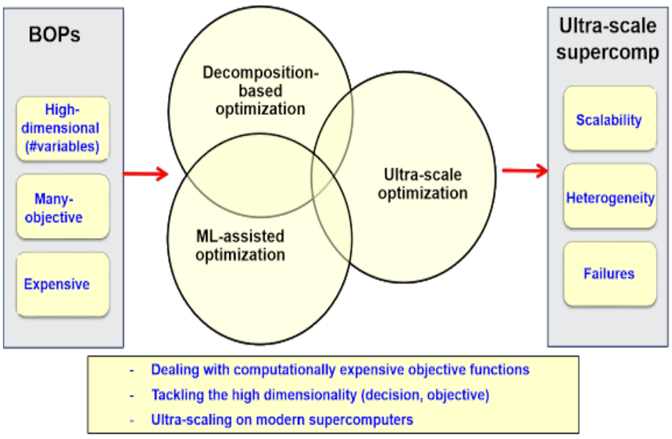
http://sites.google.com/view/bonus-research-group/

BONUS is a joint research group between the University of Lille, CRIStAL (UMR 9189, Univ Lille, CNRS, EC Lille) and Inria Lille - Nord Europe, located in the north of France. The team was established in 2017 as a spin-off of the DOLPHIN research group (2002-2017). It currently consists of five permanent members, all Professors or Associate Professors at the University of Lille, France, three post-doctoral fellows, nine PhD students, as well as technical staff, interns, and visiting scientists.

BONUS addresses big optimization problems (BOPs), defined by a large number of parameters, decision variables, and/or objective functions. The team designs effective solving techniques from computational intelligence (multiobjective optimization, stochastic local search, evolutionary computation) and exact combinatorial search (branch-and-bound) for solving complex BOPs. As such, the main challenges are as follows: (1) gaining a more fundamental understanding of what makes a problem difficult to solve, (2) accommodating the broad range of complex problems with respect to the range of specialized solving techniques in an abstract, flexible and efficient manner, (3) cross-fertilizing the knowledge from other disciplines, such as high-performance computing, operations research and decision making for an increased accuracy and efficiency, (4) dealing with large-scale and computationally expensive problems, (5) incorporating the multi-objective nature of many practical tasks/problems, and (6) scaling on (ultra-scale) modern supercomputers. The BONUS research lines are structured as follows:

1. Decomposition-based optimization: Given the particularly large scale of big optimization problems in terms of variables and objectives, BONUS develops new decomposition techniques by breaking up the original target problem into smaller subproblems that are easier to solve, and loosely coupled or independent. Solving these subproblems simultaneously and cooperatively is essential to address the curse of dimensionality.
2. Machine learning-assisted optimization: When dealing with high-dimensional problems and objective(s) coming from simulations or other black-box systems, BONUS is coupling computational intelligence techniques with surrogate meta-models and other machine learning algorithms in order to speed-up the convergence of the optimization process and to cope with the computationally expensive nature of big optimization problems.
3. Ultra-scale optimization: In order to benefit from the massive parallelism offered by modern supercomputers, BONUS relies on ultra-scale computing for the effective resolution of big optimization problems, such as handling the large amount of subproblems generated by decomposition, or the parallel evaluation of simulation-based objectives and meta-models.



BONUS closely collaborates with international researchers from the University of Mons in Belgium (Joint supervision of 4 PhD students), the Universities of Coimbra and Lisbon in Portugal (CNRS/FCT MOCO-Search project), Shinshu University in Japan (MODŌ international associated lab), City University in Hong Kong (ANR/RGC BigMO project), Monash University in Australia (PHC FASIC 2020), and the University of Luxembourg, in an effort to reflect the strong synergy between optimization, multicriteria decision making and parallel computing. Moreover, team members have recently been involved in the organization of international scientific events, such as EvoCOP’2018, EvoCOP’2019, GECCO’2018, GECCO’2019, HPCS/PaCOS’2018, HPCS/PaCOS’2019, META'2020, MOPGP'2019, OLA'2020, and SYNERGY Summer School 2018. In addition, the next edition of the Genetic and Evolutionary Computation Conference (GECCO’2021) will be held in Lille, and co-organized by the BONUS research group.

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Software

DESDEO – Open Source Software Framework for INTERACTIVE MULTIOBJECTIVE OPTIMIZATION METHODS

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OVERVIEW

DESDEO is a free and open-source Python-based framework for developing, using and experimenting with interactive multiobjective optimization methods [1], and it is developed in the Multiobjective Optimization Group at the University of Jyväskylä. The mission of DESDEO is to increase awareness of the benefits of interactive methods and to make interactive methods easily available and applicable. Thanks to its open-source nature, interactive methods are easier to be utilized and further developed. The framework consists of reusable components that can be utilized for implementing new methods or modifying the existing methods. The framework is released under a permissive open-source license.

Solving both simulation-based and data-driven problems is enabled. DESDEO contains different surrogate models and is currently being extended for various needs of data-driven decision making including uncertainty considerations. Among others, machine learning tools are utilized in different phases of solution processes. In addition, elements of graphical user interfaces and visualizations are currently under construction.

DESDEO covers various types of interactive methods: both scalarization (multiple criteria decision making (MCDM)) based and evolutionary multiobjective optimization (EMO) methods are included. DESDEO v1.0 covering several MCDM type methods was released in the spring 2020 followed by DESDEO v1.1 in the autumn 2020 including implementations of EMO algorithms RVEA and NSGA-III and their interactive versions. Data-driven optimization and constrained optimization are also supported when using EMO algorithms. The latest version can be found at https://github.com/industrial-optimization-group/DESDEO.

Interactive methods are useful tools for decision support in finding the most preferred balance among conflicting objectives. They support the decision maker in gaining insight in the trade-offs among the conflicting objectives. The decision maker can also conveniently learn about the feasibility of one's preferences and update them, if needed. DESDEO has a modular structure and the modules can be conveniently utilized to implement further methods.

DESDEO brings interactive methods closer to researchers and practitioners worldwide. Various application fields like health and well-being, industry and forest treatment planning provide inspiration and feedback for the development. The core concept is a seamless chain from data to decisions as shown in Figure 1.

OPEN-SOURCE SOFTWARE FRAMEWORK

The DESDEO framework is divided into modular Python and R packages with well-defined purposes. The modularity makes it easy to add new methods, while ensuring cross-compatibility between the methods. The modular structure of the framework is shown in Figure 2.

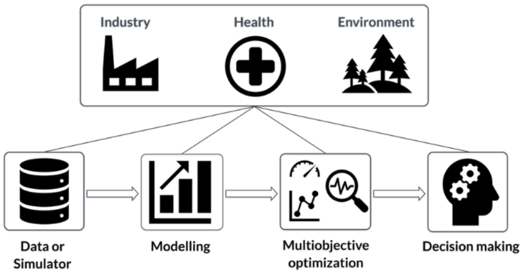

Figure 1. Schematic of the seamless chain from data to decision support behind the DESDEO framework

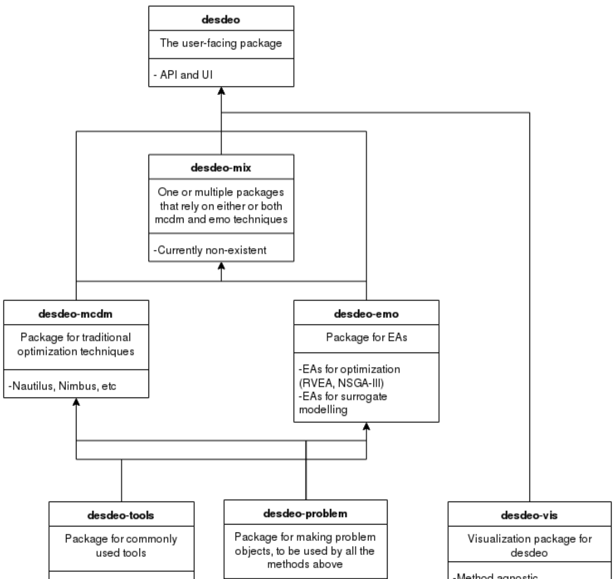

Figure 2. Modular structure of the DESDEO framework

The packages currently under development within the DESDEO framework are:

-desdeo: user-facing package provides user interface support and enables easy cross-compatibility between methods. This is the only package that needs to be installed manually if a user only wants to use the framework for solving optimization problems.

-desdeo-tools contains general purpose tools used by one or more of the other packages in the framework. Examples include scalarization functions, single objective optimizers, non-dominated sorting and metrics for multiobjective optimization.

-desdeo-problem contains methods which are used to define the multiobjective optimization problem to be solved. The objects created by this package can be used by all the packages above it in the figure. Hence, a user only needs to formulate the problem once. It can then be solved using any of the methods in DESDEO. This package also supports surrogate modelling and uncertainty handling.

-desdeo-mcdm contains interactive MCDM methods.

-desdeo-emo contains interactive EMO methods (and their non-interactive variants).

-desdeo-mix contains optimization methods that use aspects of both MDCM and EMO methods.

-desdeo-vis contains visualization packages with support for two- and multidimensional visualizations.

INSTALLATION

USING DESDEO AS A SOFTWARE LIBRARY

The DESDEO package can be found on PyPI, and can be installed by invoking pip:

```
pip install desdeo
```

FOR DEVELOPMENT (ON *NIX SYSTEMS)

Requires poetry. See pyproject.toml for Python package requirements.

```
1. git clone
   https://github.com/industrial-
   optimization-group/DESDEO
2. cd DESDEO
3. poetry install
```

THE INTERACTIVE METHODS CURRENTLY IMPLEMENTED IN DESDEO

- The synchronous NIMBUS method [2]
- Variants of the NAUTILUS family: NAUTILUS [3], E-NAUTILUS [4] and NAUTILUS Navigator [5]
- EMO algorithms: interactive RVEA [6], [7] and interactive NSGA-III [8]

Some examples can be found in https://desdeo-emo.readthedocs.io/en/latest/examples.html.

A SIMPLE VIEW

A screenshot of a user interface for the interactive E-NAUTILUS method is given in Figure 3. The problem illustrated has four objective functions. This and an interface for the NAUTILUS Navigator method can be utilized through an online interface available at https://desdeo.it.jyu.fi/dash.

WEBSITE AND FUTURE DEVELOPMENT

To learn more about DESDEO and the Multiobjective Optimization Group, please visit the official website https://desdeo.it.jyu.fi/. We warmly invite anyone interested to try out the framework, give feedback and contribute to the development!

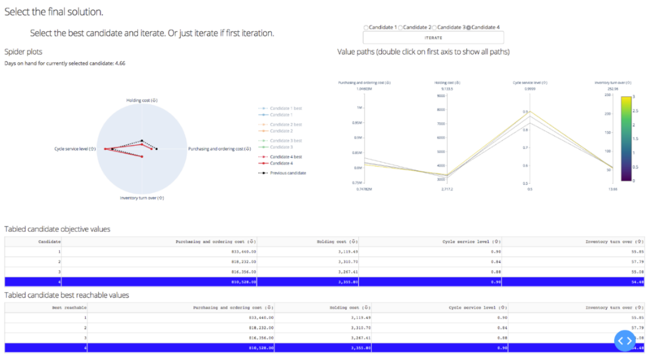

Figure 3. User interface for the interactive E-NAUTILUS method

ACKNOWLEDGEMENTS

DESDEO development is funded by the Academy of Finland (project 322221). DESDEO is related to the thematic research area Decision Analytics utilizing Causal Models and Multiobjective Optimization (DEMO, jyu.fi/demo) at the University of Jyväskylä.

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ESTECO

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ESTECO is an independent software provider, highly specialized in numerical optimization and simulation data management. ESTECO is a supplier of integration, simulation, optimization technology and consulting services for the automotive, aerospace, manufacturing, pharmaceutical, petrochemical, life science, architecture, and other industries.

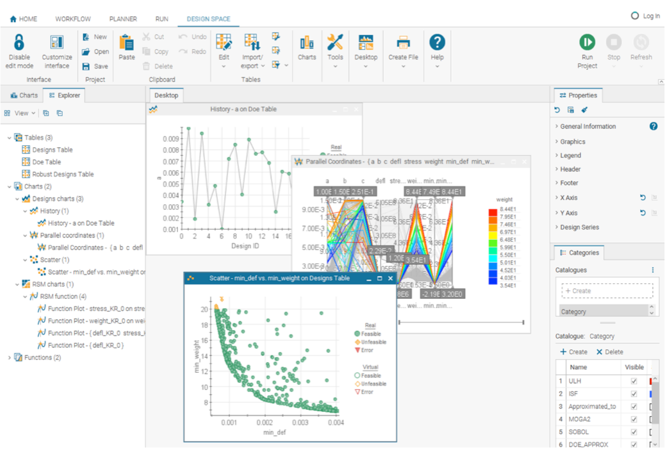
The company was born as a spin-off of a EU-funded Project, thanks to the results of university research in the field of modeling, simulation and multi-objective optimization. At the end of the funded project, the evaluation of the commercial potential of a multi-disciplinary optimization software called "Frontier" gave promising results and led to the decision of creating a new company acquiring the IP of the project. In 1999 ESTECO was founded and the platform called modeFRONTIER was brought to market.

Today ESTECO counts more than 120 employees, mostly software developers, with company headquarters in Italy, offices in USA and India, and distributor offices covering Europe, Asia and the Americas. The company headquarters is located in AREA Science Park, one of the most important multi-sector science parks in Italy with top quality services and extensive relations with academic and research institutes. The entire research and development activity is carried out at this location.

The expansion of the use of ESTECO products around the world has gained momentum since the early 2000s. For this reason, in 2004, the ESTECO North America office was opened in Detroit, in the heart of the US automotive district, to allow us to follow that market more effectively: over the years, and thanks to a growing team of highly skilled professionals, the action scope expanded to many other sectors and organizations across the US, with recent focus on the Aerospace field. Subsequently, pursuing a strategy of decentralization of support activities, in 2012 an office was opened in Pune in India: along with offering qualified local support, the branch now counts on two professional teams which closely cooperate with our headquarters on software testing and development.

ESTECO's internal organization is structured to ensure continuous innovation in product development. The development teams in the company adhere to the philosophy of Lean Manufacturing and AGILE software development, with particular attention to continuous integration and continuous deployment of software products. The mission of the Research Groups on Software Engineering and Numerical Methods guarantees the constant and continuous innovation of the software products proposed to the market. The quality of customer support is also guaranteed by the Professional Services and Engineering, IT, and Marketing and Sales groups.

ESTECO develops **modeFRONTIER** (a comprehensive solution for process automation and optimization of the engineering design process), **VOLTA** (a collaborative web platform for simulation process and data management and design optimization) and **Cardanit** (a web-based collaborative tool for modeling business processes and the decisions driving them, based on BPMN and DMN standards).
The commercial software solutions developed by ESTECO are currently used by many companies all around the world, which leverage their powerful integration capabilities with popular third-party commercial and in-house CAE modeling tools such as CAD, Finite Element Structural Analysis and Computational Fluid Dynamics. Today ESTECO has more than 300 customers in the most diverse industrial sectors and in different geographical areas, including Ford, Volvo, Honda, Audi, Toyota, Fiat, BMW, EADS, Canon, Toshiba, Samsung.

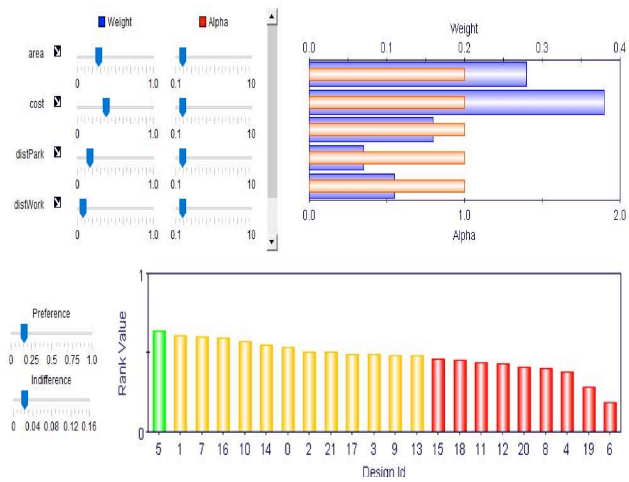


ESTECO works closely with international research institutes and universities: thanks to the ESTECO Academy Program, our technology is used in over 200 universities all over the world, fostering new learning opportunities in STEM education and offering advanced professional skills to future engineers. Furthermore, our qualified team of professors, researchers and PhDs offer courses and lectures in the scientific and educational environment. We also cultivate an ongoing interchange of information and ideas with students, experts and academicians who offer a critical contribution to the advancement of our technology.

ESTECO technologies include Integration and Process Automation, Optimization-Driven Design, Engineering Data Intelligence, Robust Design and Reliability, Distributed Execution, Simulation Data Management, and Multiple Criteria Decision Aiding/Making.

As regards the latter, modeFRONTIER provides a **Multi Criteria Decision Making (MCDM) tool** to make an informed final choice among the optimal design candidates. The MCDM tool performs this job as an iterative and interactive information refinement process: in fact, its wizard-based interface automatically ranks the alternatives based on the priorities of the decision maker, enabling him/her to make better decisions where intuition alone could not hint at a rational order of optimal designs. Six different methods are available to start refining the choice of the best option based on the type of the problem at hand, and on its complexity. Once the default ranking is ready, it is possible to fine-tune the final decision thanks to an interactive slider feature. As the preferences are modified, changes in the ranking can be observed in real time: this way, the decision maker can formulate coherent and informed decisions.

In modeFRONTIER, the design alternatives are arranged into tables containing numerical data that can come from different sources: optimization, Design of Experiments (DOE) tool, post-processing tools, external files and databases. Attributes are quantities (values) used for measuring the performance of an alternative and associated with a certain goal, which can be to minimize or maximize the given value. In the modeFRONTIER MCDM tool, attributes correspond to



variables (inputs, outputs, constraints and objectives).
When making a decision, one tries to choose the best available alternative, which implicitly implies ranking all available alternatives according to their performance or

quality measured in terms of the values of all attributes selected for the multi-objective decision problem.

The six algorithms available in the MCDM tool are: Linear MCDM, GA MCDM, Hurwicz MCDM, Savage MCDM, AHP, and Electre TRI. These different methods are described in the following paragraphs.

The Linear MCDM algorithm calculates the utility function, which is used as the basis for the ranking of available alternatives. The utility function takes into account the *weight* and the *alpha* value of the attributes. These parameters can be configured by the user, giving complete control over the definition of the decision-making process. The user can also determine the weight of each attribute, i.e. its relative importance with respect to other attributes, simply by using sliders. The consistency of the preferences is checked by the algorithm, automatically adjusting all weights in the 0-1 range. The user can further refine their decision criteria by specifying the alpha value, which reflects the linearity or non-linearity of the corresponding function. As the sliders are adjusted, all the charts are updated real-time.

The GA MCDM algorithm calculates the utility function with a Genetic Algorithm (GA). As in the case of the Linear MCDM, this function is used as the basis for the ranking of available alternatives and takes into account the weight and the alpha value of the attributes. However, unlike in the case of the Linear MCDM (requiring the user to set those values), the GA MCDM identifies the designs with the best combination of those values calculated according to the preferences of the decision maker.

The Hurwicz criterion, or the criterion of realism, is one of the commonly used methods for making decisions under uncertainty and it represents a compromise between the optimistic and the pessimistic approach. The pessimistic approach, or the maximin criterion, takes a pessimistic view of the environment, assuming that no matter which alternative is selected, the worst situation for that alternative will prevail. Therefore, the aim is to achieve the largest possible payoff or utility by maximizing the minimum value. On the other hand, the optimistic approach, or the maximax criterion, takes an optimistic view of the situation, assuming exactly the opposite and thus trying to maximize the maximum payoff or utility. With the Hurwicz MCDM algorithm, the decision makers express their degree of optimism by setting the Hurwicz weight (also called coefficient of optimism or alpha) in a range from 0 to 1, where 0 indicates total optimism and therefore corresponds to the maximax criterion and 1 indicates total pessimism.

The Savage minimax regret criterion is a variation of the pessimistic approach, where opportunity loss (or regret) is taken into account rather than payoff or utility. It assumes that the maximum possible loss will occur and it therefore focuses on minimizing the maximum opportunity loss in such circumstances. Opportunity loss is defined as the payoff difference between the highest value of a certain attribute in the dataset and the actual value of that attribute for a given alternative. If an attribute is to be minimized, the payoff difference must be as large as possible; on the other hand, if an attribute is to be maximized, the payoff difference must be as low as possible. All attributes' values are normalized.

The AHP MCDM is based on the Analytic Hierarchy Process (AHP) developed in the 1970's by Thomas L. Saaty, allowing the comparison of both qualitative and quantitative criteria (attributes). It breaks down the problem into its constituent parts, which are then structured hierarchically. The decision maker should know the relative importance of all attributes (for example, how important is attribute A relative to attribute B?), which are taken into account by the algorithm to make pairwise comparisons and to create the priority matrix. The weights are computed in order to obtain the average importance of each criterion. The same computation is also done for designs on the basis of their values in each attribute in order to determine their relative ranking for each attribute. The final ranking of designs is computed by AHP considering the average weights of attributes and the relative ranking of designs per attribute.

Electre TRI is a multi-criteria sorting which assigns alternatives (designs) to predefined groups, or categories. It is particularly useful if dealing with hundreds or thousands of good designs to isolate only a small number automatically selected according to the decision maker preferences, which can be subsequently ranked using another MCDM algorithm. The assignment of a design to a group is done on the basis of a pairwise comparison between the given design and a profile. Profiles are values in the range of a variable, delimiting groups to which designs can be assigned. The number of profiles is user-defined. No ranking is performed within each profile, but only among them according to whether the user is interested in the maximum or the minimum values of a given attribute.

Forthcoming meetings

- 4-6/2/2021
  10th International Conference on Operations Research and Enterprise Systems – ICORES 2021
  Vienna, Austria
  http://www.icores.org

- 15-19/3/2021
  ICVNS – 8th International Conference on Variable Neighborhood Search
  Abu Dhabi, UAE
  http://www.icvns2020.info/

- April 2021
  91st Meeting of EURO Working Group on MCDA
  Budapest, Hungary

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

- 5-8/4/2021
META'2021 International Conference on Metaheuristics and Nature Inspired Computing
Marrakech, Morocco
http://meta2020.sciencesconf.org/

- 7-9/4/2021
EvoCOP 2021 – The 21st European Conference on Evolutionary Computation in Combinatorial Optimisation
Seville, Spain
http://www.evostar.org/2021/evocop/

- 10-11/4/2021
5th International Conference on Intelligent Systems, Metaheuristics & Swarm Intelligence (ISMSI 2021)
Victoria, Seychelles
http://www.ismsi.org/

- 11-13/4/2021
2021 INFORM Business Analytics Conference
Hyatt Regency Grand Cypress, Orlando,
http://meetings2.informs.org/wordpress/analytics2021/

- 21-23/4/2021
The 17th International Workshop on Project Management and Scheduling (PMS)
Toulouse, France
https://pms2020.sciencesconf.org/

- 22-23/4/2021
3rd IMA and OR Society Conference on Mathematics of Operational Research Innovating Mathematics for New Industrial Challenges
Aston University, Birmingham, UK
https://ima.org.uk/14347/14347/

- 17-21/5/2021
LAGOS 2021 – The XI Latin and American Algorithms, Graphs and Optimization Symposium
Sao Paulo, Brazil
http://eventos.ufabc.edu.br/lagos2021/

- 19-21/5/2021
Conference on Integer Programming anc Combinatorial Optimization – IPCO XXII
Atlanta, Georgia, USA
https://sites.gatech.edu/ipco-2021/

- 26-28/5/2021
7th International Conference on Decision Support System Technology (ICDSST 2021)
Loughborough, UK
https://icdsst2021.wordpress.com/

- 1-8/6/2021
EURO PhD School – Reinforcement Learning Applied to Operations Research
Marienheide, Germany
http://www.stochmod.eu/EPS/

- 8-11/6/2021
SEIO 2021: 39th Spanish Conference on Statistics and Operational Research
Granada, Spain
www.seio2021.com

- 9-11/6/2021
ECCO XXXIV 2021 – The 34th annual conference of the EURO Working Group European Chapter on Combinatorial Optimization
Madrid, Spain
https://ecco2021.euro-online.org/

- 15-18/6/2021
MESS 2021 - Metaheuristics Summer School ~ Learning & Optimization from Big Data
Catania, Italy
https://www.ants-lab.it/mess2020/

- 21-23/6/2021
OLA'2021 – International Conference on Optimization and Learning: Challenges and Applications
Catania, Italy
http://ola2021.sciencesconf.org/

- 27/6-2/7/2021
MCDM 2021 – 26th International Conference on Multiple Criteria Decision Making
Portsmouth, UK
https://mcdm2021.org

- 28/6 – 7/7/2021
EURO PhD School on Data Driven Decision Making and Optimization
Seville, Spain
https://congreso.us.es/epsdata/

- 28-30/6/2021
15th International Congress on Logistics and SCM Systems
Poznan, Poland
http://icls2020.put.poznan.pl/

- 30/6 – 2/7/2021
2nd International Conference on Applied Mathematics in Engineering (ICAME20)
Burhaniye, Balikesir, Turkey
http://icame.balikesir.edu.tr

- 7-9/7/2021
18th EUROPT Workshop on Advances in Continuous Optimization – EUROPT 2021
Toulouse, France

https://europt2021.recherche.enac.fr/

- 7-9/7/2021
Joint ECSO-CMS 2021 European Conference on Stochastic Optimization Computational Management
Venice, Italy
https://www.unive.it/pag/38159#ecsocms2021

- 10-14/7/2021
2021 Genetic and Evolutionary Computation Conference (GECCO 2021)
Lille, France
https://gecco-2021.sigevo.org/HomePage

- 11-14/7/2021
EURO 2021
Athens, Greece
https://euro2021athens.com/

- 18-22/7/2021
EURO PhD School on Sustainable Supply Chains
Lisbon, Portugal
https://epsinssc.tecnico.ulisboa.pt/

- 19-30/7/2021
EURO PhD School on MCDA/MCDM
Bilkent, Turkey
http://mcdm.metu.edu.tr/

- 22-24/7/2021
3rd Conference on Sustainable Supply Chains (SustSC 2021)
Lisbon, Portugal
http://sustsc2020.tecnico.ulisboa.pt/

- 2-4/8/2021
Modeling and Optimization: Theory and Applications (MOPTA 2020)
Pennsylvania, USA
http://coral.ie.lehigh.edu/~mopta/

- 15-20/8/2021
ISMP 2021
Bejing, China
http://ismp2021.csp.escience.cn/dct/page/1

- 22-27/8/2021
IFORS 2021
Seoul, South Korea
http://www.ifors2020.kr/

- 30/8-1/9 2021
CLAIO 2021
Madrid, Spain
https://claio2021.com/

- 30/8 – 3/9/2021
29th edition of the IFIP TC7 Conference: System Modelling and Optimization
Quito, Ecuador
https://modemat.epn.edu.ec/ifip_tc7_2020/

- 31/8 – 3/9/2021
OR21 joint conference SVOR/ASRO, ÖGOR and GOR
Bern, Switzerland
https://www.euro-online.org/web/pages/460/calendar

- 13-17/9/2021
12th International Conference on Parametric Optimization and Related Topics (paraoptXII)
Augsburg, Germany
http://uni-a.de/to/paraopt

- September 2021
92nd Meeting of EURO Working Group on MCDA
Cracow, Poland
http://www.cs.put.poznan.pl/ewgmcda/

- 21-23/10/2021
18th International Logistics and Supply Chain Congress (LMSCM2020)
Gaziantep, Turkey
http://lmscm2020.gantep.edu.tr/

- 24-27/10/2021
2021 INFORMS Annual Meeting
Anaheim Convention Center & Anaheim Marriott, California, USA
https://www.informs.org

- 29/11 – 1/12/2021
Joint ALIO/EURO International Conference 2021 on Applied Combinatorial Optimization
Viña del Mar, Chile
https://www.euro-online.org/web/pages/460/calendar

- April 2022
93rd Meeting of EURO Working Group on MCDA
Belgrade, Serbia
http://www.cs.put.poznan.pl/ewgmcda/

- 3-6/7/2022
EURO 2022
Espoo, Finland
https://euro2022.euro-online.org/home/

- 25-29/7/2022
XVI International Conference on Stochastic Programming (ICSP2022)
California, USA

https://gsm.ucdavis.edu/xvi-international-conference-stochastic-programming-2022

- September 2022
  94th Meeting of EURO Working Group on MCDA
  Agios Nikolaos, Greece
  http://www.cs.put.poznan.pl/ewgmcda/

- April 2023
  95th Meeting of EURO Working Group on MCDA
  Jaén, Spain
  http://www.cs.put.poznan.pl/ewgmcda/

Seminars

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

Books

Multicriteria Portfolio Construction with Python

Authors: Sarmas, Elissaios, Xidonas, Panos, Doukas, Haris

This book covers topics in portfolio management and multicriteria decision analysis (MCDA), presenting a transparent and unified methodology for the portfolio construction process. The most important feature of the book includes the proposed methodological framework that integrates two individual subsystems, the portfolio selection subsystem and the portfolio optimization subsystem. An additional highlight of the book includes the detailed, step-by-step implementation of the proposed multicriteria algorithms in Python. The implementation is presented in detail; each step is elaborately described, from the input of the data to the extraction of the results. Algorithms are organized into small cells of code, accompanied by targeted remarks and comments, in order to help the reader to fully understand their mechanics. Readers are provided with a link to access the source code through GitHub.

This Work may also be considered as a reference which presents the state-of-art research on portfolio construction with multiple and complex investment objectives and constraints. The book consists of eight chapters. A brief introduction is provided in Chapter 1. The fundamental issues of modern portfolio theory are discussed in Chapter 2. In Chapter 3, the various multicriteria decision aid methods, either discrete or continuous, are concisely described. In Chapter 4, a comprehensive review of the published literature in the field of multicriteria portfolio management is considered. In Chapter 5, an integrated and original multicriteria portfolio construction methodology is developed. Chapter 6 presents the web-based information system, in which the suggested methodological framework has been implemented. In Chapter 7, the experimental application of the proposed methodology is discussed and in Chapter 8, the authors provide overall conclusions.
The readership of the book aims to be a diverse group, including fund managers, risk managers, investment advisors, bankers, private investors, analytics scientists, operations researchers scientists, and computer engineers, to name just several. Portions of the book may be used as instructional for either advanced undergraduate or post-graduate courses in investment analysis, portfolio engineering, decision science, computer science, or financial engineering.

https://www.springer.com/gp/book/9783030537425

Announcements and Call for Papers

Call for the "Bernard Roy Award of the EURO Working Group on Multiple Criteria Decision Aiding" (Bernard Roy Award of EWG MCDA)

Policy
-The Bernard Roy Award of EWG MCDA is a recognition conferred to a researcher under 40 years old for an outstanding contribution to the methodology and/or applications of Multiple Criteria Decision Aiding (MCDA).
-The award will be officially bestowed at the opening session of the EWG-MCDA 92, September 2021, Warsaw, Poland, if there is a suitable candidate. In this case, following a presentation of the competition by the chair of the Jury, the laureate will be invited to give a talk.
Award
The laureate then will receive the financial award (1000 EUR) and the diploma.
Eligibility
-The Bernard Roy Award of EWG MCDA shall be awarded for a body of work in MCDA, preferably published over the last decade. Although recent work will not be excluded, care shall be taken to allow the contribution to stand the test of time.
-The potential award recipient shall have a recognized stature in the MCDA community. Significance, innovation, depth, and scientific excellence shall be emphasized.
Nominations
-Candidates can be nominated by any three members of the EURO WG on MCDA.
-A candidature for the Bernard Roy Award of EWG MCDA is composed of the nomination letter along with a recent and detailed CV, up to 5 best publications, as well as a self-description of the achievements up to 3 page long in a standard manuscript format. The nominations should be sent to the Jury chair (Irène Abi-Zeid at: irene.abi-zeid@osd.ulaval.ca) by the due date of June, 30th 2021.
Selection process
-Only one award may be assigned on each occasion.
-One person may receive the award at most once in her/his lifetime.

-The jury evaluates the nominees essentially on the basis of their scientific activities (papersin top journals, editorials, relevance of methodological proposals and/or applications...).

Jury

-The jury for the current edition is composed of Professors Irène Abi-Zeid (chair), Maria Franca Norese, Yannis Siskos, Roman Słowiński, and Daniel Vanderpooten.

Timing

-Deadline for nominations: June, 30th 2021.

-The Jury chair informs the EWG coordinators who invite the laureate to the meeting: July, 31st 2021.

-Preparation of the diploma by the EWG coordinators. Presentation of the laureate and her/his talk during the EURO WG on MCDA Autumn meeting. An electronic copy of the laureate's presentation handed over to the EWG coordinators will be made available on the EWG on MCDA Web Site.

Articles Harvest

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

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Announcement 1:

The next issue of the EWG-MCDA Newsletter will include a new section enriching the articles harvest and called

"Recent contributions in brief".

Authors who recently published a paper on MCDA and related topics are invited to submit a brief description of their contribution, using no more than 2000 characters including spaces (1 standard page if figures would be included). In addition to the bibliometric information, the description is expected to include a clear motivation and features of the research reported, as well as highlights of its contribution to the theory or methodology or innovative applications of MCDA.

We believe that the publication of these short descriptions will facilitate the promotion of new research results in our field for the benefit of readers and authors.

Contributions should be sent to Salvatore Corrente (salvatore.corrente@unict.it)

Announcement 2:

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.

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.

Acknowledgment

This issue of the EWG-MCDA Newsletter is the last one edited by José Rui Figueira who ends his service as the editor of the Newsletter after 20 years of his excellent service for the MCDA community. We wish to thank José very warmly for the 40 issues of the Newsletter he edited with a great commitment over these years. The newsletter edited by José has become a recognized showcase of the EURO WG on MCDA and a means of communication with a broad international community of MCDA and beyond.

At the same time we are happy to welcome Salvatore Corrente who kindly accepted to replace José in his editorial duty. We wish Salvatore a happy follow-up and a growth of the Newsletter's role in the international promotion of the MCDA methodology elaborated by members of our Working Group.

Roman Słowiński and Salvatore Greco - Co-ordinators of the EWG on MCDA

Groupe de Travail Européen “Aide Multicritère à la Décision” /
European Working Group “Multiple Criteria Decision Aiding”

Founded by Bernard Roy in 1975

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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