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BOOK OF ABSTRACTS

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4 - How much to decentralize? The impact of interaction pattern and search setting on exploration strategy for a complex system

Mohsen Jafari, Mechanical Engineering, University of Melbourne, *Jens Pfau*, *Shu-Jung Sunny Yang*, *Alan Smith*

Social, organizational and technological systems have been viewed as sets of interdependent elements by scholars. To study them, these scholars have adopted simulation tools from other sciences, such as the biological and physical sciences. This paper examines the influence of interaction patterns among the elements of a complex socio-technological system on the value of search centralization over its landscape. To do so, it compares the number of local optima for different search settings, centralized and decentralized, when the underlying elements have different interaction patterns such as local, random, centralized and small-world. To count the number of local optima, a simple agent-based simulation model is used for landscape generation. The results highlight the important of search setting as well as interaction pattern in determination of exploration search strategy, wide or narrow, for a complex system.

5 - Systems strike back — but how?

Olaf Tietje, FHO-Hochschule Rapperswil

A simple extension of the standard scenario technique can show how a system strikes back. Thus, under certain circumstances a system analyst can foresee what must be done to achieve specific goals in a system. The standard scenario technique uses an impact matrix model to assess the importance of impact factors for the future development. The importance is assessed based on the strength of the mutual impacts between the factors. In the standard approach two impacts on a factor enhance the importance of that factor even if one of these impacts tends to increase and the other tends to decrease the factor. In the new approach such impacts cancel themselves out and thus the new approach called indirect system feedback analysis reveals a much more realistic development of the system. The presentation shows (a) the plausibility of the indirect system feedback analysis, (b) the additional requirement s for the definition of the impact factors and the impacts, and (c) prototypic results for two case studies. When analyzing the production chain of maize and investigating the coexistence of genetically modified plants and non-genetically modified plants the indirect feedback analysis shows that the extent and costs of measures to avoid commingling strongly increase. When analyzing regional touristic development the indirect feedback analysis shows that the touristic value added can at most be increased by the power of the regional touristic organization.

■ TA-12

Thursday, 08:30-10:00, Room E-21

Multiple criteria decision making I

Chair: *Evelina Trutnevyte*, Institute for Environmental Decisions (IED), Natural and Social Science Interface (NSSI), ETH Zurich

1 - Ranking of qualitative decision options using copulas

Biljana Mileva-Boshkoska, Department of Knowledge Technologies, Jozef Stefan Institute, *Marko Bohanec*

We study the ranking of multi-attribute options. Each option is described by multiple qualitative attributes. Each option also belongs to an ordered class. Options that belong to the same class are almost equally appreciated by the decision maker. In this way, decision maker's preferences are defined qualitatively and options are ranked only partially. To model the preferences and obtain a full ranking of options, qualitative preferences are mapped into quantitative ones. Current approaches, such as the Qualitative-Quantitative (QQ) method, transfer the quantitative classification problem into a regression one by using linear regression, thus obtaining linear function for ordering of the preferences. QQ performs well for linear and monotone preferences; however it underperforms in cases of non-linear preferences, especially when the linear approximation is inadequate. To address this problem, we modify the QQ method by introducing copulas as an aggregation utility instead of linear regression. Copulas are functions which manage to capture the non-linear dependences among random variables. To use copulas, we will consider the attributes as random variables. As most of the theory is based on the bivariate copulas, we construct a hierarchical structure of bivariate copulas in order to model the dependences between the attributes and the classes. Such a hierarchical structure allows us to define a copula-based non-linear quantile regression function that we use for ranking of preferences. In this paper we investigate the performance of this method when employing different hierarchical structures of copulas. Our findings show that copulas can be successfully used for modeling of different non-linear preferences with respect to different hierarchical structures.

2 - An approach to handling preferences based on local trade-off information in interactive MCDM methods

Jussi Hakanen, Dept. of Mathematical Information Technology, University of Jyväskylä, *Dmitry Podkopaev*

The trade-off concept in multiple criteria decision making (MCDM) refers to ratios between changes of different outcomes when moving through the set of efficient (e.g. Pareto optimal) outcomes. Decision making techniques usually operate two types of trade-off information: objective trade-offs describe inherent properties of the problem's efficient outcome set, while subjective trade-offs represent decision maker's (DM's) judgment to the relative importance of criteria. We propose an approach to handle preferences based on local trade-offs, to be applied in interactive MCDM methods for continuous problems. Our approach utilizes trade-offs of both types to form a complete learning cycle: the DM is informed about trade-offs for a given efficient outcome (DM learning) and in its turn, presents partial information about preferences in terms of subjective trade-offs (computer learning). The scheme of handling preferences concerns one iteration of the interactive decision making process: In the beginning, an efficient outcome is given. The DM is informed about all local partial trade-offs at the outcome, for any criterion which can be improved. If the DM does not find any changes reasonable, the procedure stops. Otherwise, the DM selects a criterion to be improved and, after analyzing objective trade-off information related to this improvement, presents his/her own preferences in terms of acceptable trade-off ratios. Then the direction of outcome changes is searched in the efficient outcome set such that the local directional trade-offs are proportional to ones presented by the DM. The projection of this direction to the efficient outcome set (a curve in the outcome space) is presented to the DM for interactive exploration and choosing the next efficient outcome.

3 - Integral Indicators and Expert Estimations of Ecological Impact

Mikhail Kuznetsov, Moscow Institute of Physics and Technology, *Vadim Strijov*

To compare objects or alternative decisions one must evaluate a quality of each object. A real-valued scalar, which is corresponded to the object, is called an integral indicator. The integral indicator of the object is a convolution of the object features. Expert estimations of one expert or an expert group could be indicators, too. We consider a problem of indicator construction as following. There is a set of objects, which should be compared according to a certain quality criterion. A set of features describes each object. This two sets are given together with an "object/feature" matrix of measured data. We accept a linear model of the convolution: the integral indicator is the linear combination of features and their weights. To do that we use the expert estimates of both indicators and weights in rank scales. To compute indicators according to the linear model, one can use the expert set of weights. Our goal is to match the estimated and the computed integral indicators by maximizing a rank correlation between them. We consider the set of the estimated indicators and the set of the estimated weights as two cones in spaces of indicators and weights, respectively. Our goal is to find the set of weights such that the distance between this set and the cone of the expert-given weights must be minimum. Using the found weights we compute the set of indicators such that the distance between this computed set and the cone of the expert-given indicators must be minimum, as well. This methodology is used for the Clean Development Mechanism project evaluation. The project partners have to prove that their project can yield emission reductions in developing countries. The proposed integral indicators are intended to evaluate the environmental impact of this projects.