MCDA in Catania

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The Group of MCDA of Catania has an important place in the history of MCDA. Effectively one of the most important appointment in the MCDA community is the International Summer School on MCDA. More or less each three years this is an important meeting between young researchers and well known experts which permits to transmit to the former the knowledge of the latter. The first International Summer School on MCDA, held in Catania in 1982, was born upon an idea of Benedetto Matarazzo in collaboration with Jaap Spronk. In 2000 the seventh Summer School was organised by Benedetto Matarazzo and Salvatore Greco again in Catania, which therefore has been the first town to host two editions of this School. This explains how important has been the role of the Group of Catania in the history of MCDA.

Effectively, in 1982 the group of Catania was composed of only one component: Benedetto Matarazzo. In the following years some students of Benedetto Matarazzo reached the group, which is now composed also by Salvatore Greco, Silvestro Lo Cascio, Alfio Giarlotta, Fabio Lamantia and Silvia Angilella. Another researcher who started to work in Catania with Benedetto Matarazzo and now is working in Barcellona is Giuseppe Munda.

The group of MCDA of Catania conducts its researches in some different areas, the most important of which are: Pairwise Criterion Comparison Approach, rough sets approach to MCDA, axiomatic basis of MCDA, fuzzy integral. In most of this research the MCDA group of Catania has some very prestigious cooperations with other very important research groups: Technical University of Poznan, LAMSADE, Technical University of Mons, Graduate School of Engineering of Osaka University.

The Pairwise Criterion Comparison Approach (PCCA) has been proposed by Benedetto Matarazzo. It consists in the possibility to compare feasible actions with respect to all the possible unordered pairs of distinct criteria considered. The partial results thus obtained are then suitably aggregated and used in order to aid the decision maker in a variety of problems. From this viewpoint, therefore, the approach proposed may be considered as an attempt to take explicit the limited capacity of the human mind to make comparisons between numerous and often conflicting evaluations simultaneously; it offers, instead, a series of comparisons easy to execute one at a time. A further work of Salvatore Greco showed that it is interesting also to consider the possibility of not comparing all the possible pairs of criteria. Indeed DM may be interested in comparison only with respect to some pairs of criteria rather than other and moreover because to consider all the possible pairs of criteria is too requiring for the human capabilities. Another interesting feature of PCCA is the high level of flexibility in preference modeling of this methodology, which permits to take into consideration both importance of criteria and intercriteria tradeoff. This characteristic of PCCA is quite interesting because usually importance of criteria and intercriteria tradeoff are used in completely different MCDA approaches (importance in outranking methods and intercriteria tradeoffs in multiattribute utility approach).

Another important subject extensively investigated by the Catania Group of MCDA, in cooperation with Roman Slowinski from the Technical University of Poznan, is the application of rough set approach to the multicriteria decision aid.

The original rough set approach proved to be very useful in dealing with inconsistency problems following from information granulation. It operates on a data table composed of a set U of objects (actions) described by a
set Q of attributes. Its basic notions are: indiscernibility relation on U, lower and upper approximation of either a subset or a partition of U, dependence and reduction of attributes from Q, and decision rules derived from lower approximations and boundaries of subsets identified with decision classes. The original rough set idea is failing, however, when preference-orders of attribute domains (criteria) are to be taken into account. Precisely, it cannot handle inconsistencies following from violation of the dominance principle. This inconsistency is characteristic for preferential information used in MCDA problems, like sorting, choice or ranking. In order to deal with this kind of inconsistency a number of methodological changes to the original rough sets theory have been proposed by Salvatore Greco, Benedetto Matarazzo and Roman Slowinski. The main change proposed is the substitution of the indiscernibility relation by a dominance relation, which permits approximation of ordered sets in multicriteria sorting. To approximate preference relations in multicriteria choice and ranking problems, another modification was necessary: substitution of the data table by a pairwise comparison table, where each row corresponds to a pair of objects described by binary relations on particular criteria. In all those MCDA problems, the new rough set approach proposed by Salvatore Greco, Benedetto Matarazzo and Roman Slowinski ends with a set of decision rules playing the role of a comprehensive preference model. It is more general than the classical functional or relational model and it is more understandable for the users because of its natural syntax. In order to workout a recommendation in one of the MCDA problems, a suitable exploitation procedures of the set of decision rules was proposed. Other recently obtained results have been the following: rough approximations by means of fuzzy similarity relations, rough set handling of missing data, fuzzy set extension of rough set approach based on dominance, results on equivalence of a decision rule preference model and a conjoint measurement model which is neither additive nor transitive. Another recent and quite interesting result of the research of Salvatore Greco, Benedetto Matarazzo and Roman Slowinski is the proof that the decision rule model obtained by rough set approach gives a preference representation more general than Sugeno integral which is considered the most general ordinal aggregation operator of the max-min average type.

Recently the Catania Group of MCDA has started to deal with two new very interesting area in multicriteria decision aid: axiomatic basis of multicriteria aggregations and fuzzy integrals. The researcher about the axiomatic basis of multicriteria aggregation is also conducted in cooperation with the Technical University of Poznan and for some subjects in cooperation with Denis Boyssou (LAMSADE (CNRS - France) and Marc Pirlot Technical University of Mons. The most interesting results in this field can be summarized as follows: axiomatic basis of multicriteria sorting, axiomatization of ELECTRE I methods, axiomatizations of Sugeno integral and its particular cases (max, min, ordered weighted maximum, weighted maximum, order statistics), axiomatization of associative operators of multicriteria aggregation.

With respect to the fuzzy integrals, the Catania Group of MCDA has developed a methodology for inferring the preferential parameters necessary to apply Choquet integral from the DM preferential information. Let us remember that the main interest to use fuzzy integrals in MCDA is to consider the interactions between criteria, that is, in simple words, the case in which the importance of two criteria is different from the sum of the importance of the single criteria, due to their positive or negative sinergy. With respect to this specific aspect the Catania Group of MCDA has developed two specific approaches. The first approach can be considered as an extension of the UTA approach to the case in which the utility functions are represented by a Choquet integral. The advantage of the proposal of the Catania Group of MCDA with respect to other competitive approach is that the methodology proposed by the Catania Group of MCDA permits not only to infer the interactive weights, but allows also the use of a common scale for all the criteria, which permits to compare evaluations of a criterion with evaluations of other criterion. The second approach developed by the Catania Group of MCDA with respect to Choquet integral is an extension of the method of Simos for determining the importance of criteria to the case in which the importance of the considered criteria interacts.

Finally another very interesting subject has recently been introduced by the Salvatore Greco, Benedetto Matarazzo and Roman Slowinski: the bipolar Choquet integral and the Sugeno fuzzy integral. The bipolar Choquet integral was proposed independently also by Christophe Labreuche and Michel Grabisch too. These new type of fuzzy integrals permits to take into account specific kinds of interactions which cannot be considered using classical fuzzy set approach. More precisely, the bipolar fuzzy integrals consider the fact that each evaluation with respect to considered criteria can be positive or negative with respect to a neutral level. The bipolar integral permits to model the interaction between positive values, with respect to a given set of criteria, and the opposite negative values, with respect to another set of criteria.

The most important references

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