

## **IDEIA & FAAD: Two groups at INESC - Porto**

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The groups Research in MCDA began at INESC in the middle 80's, as a natural evolution of people working in planning and operation optimization of Power Systems, mainly Manuel Matos, then a PhD student working in multicriteria models for hidro-electric-agricultural planning, and Vladimiro Miranda, who supervised the thesis.

In the 90's, restructuring of INESC led to the constitution of two groups in the Power Systems area with a strong involvement in MCDA: IDEIA (Information and Decision in Energy) - Vladimiro Miranda FAAD (Tools for Analysis and Decision Aid) - Manuel Matos Presently, the groups are together in the Power Systems Unit of INESC, with a total of 15 researchers (6 PhD), working in several application areas of power systems.

The Power Systems Unit has a WWW page (<http://www.inescn.pt/lproenca/>)

Research activity in MCDA and related areas An important part of the activity of the groups relates with analysis and simulation of power systems, namely distribution systems and isolated systems with dispersed renewable generation. However, the main research interest is the application of fuzzy modeling to planning and operation problems, in order to deal with the great amount of uncertainty in data (consumptions, forecasts in new areas, economic parameters, etc.). Existence of multiple criteria is another permanent characteristic of these problems, which leads to the development of fuzzy multicriteria models and tools in most of the research work.

Application of fuzzy models to the transmission and generation electric system for planning purposes lead to a PhD thesis (João Tomé Saraiva) in which decision support to the reinforcement of the network was one of the main objectives. In the distribution planning area, a fuzzy multicriteria methodology was developed using an e-constrained strategy to generate a representative sampling of the non dominated solutions set. The combinatory optimization sub-problems were solved with simulated annealing. This work conducted to a PhD thesis (Maria Teresa Ponce Leão). Another approach to the same problem, based on the use of genetic algorithms and a tree of fuzzy scenarios is now under development in a PhD project (Miguel Proença).

More basic research in MCDA has been also done since the beginning, mainly for dealing with large lists of non dominated solutions in multiattribute problems and in the post-generation phase of multiobjective problems. A non-prescriptive methodology (SAM -- Successive Amplification Method) was developed to help focusing in the preferred area of the attribute space, without having to consider, in each step, more than a limited number of alternatives. Intermediate steps use fuzzy clustering to represent groups of solutions by their prototypes. Another line of research developed models to translate numerical values of the attributes to qualitative descriptions that permit to construct synthetic natural language sentences, using fuzzy modifiers for intensity of preference. This was the basis for simple conversational applications that help the decision maker navigate in the attribute space, always maintaining a global view of the nondominated alternative set. More recently, a screening method (the "fuzzy conjunctive method") for large lists of solutions was developed, as an extension of the well-known conjunctive method, incorporating different types of scales, soft decisions about rejected alternatives and decision aid about thresholds to use. Modeling of the process of decision in public projects and tenders is a recent interest area, in which a MSc dissertation (João Germano) about the general framework of the problem was already presented.

### Some relevant publications

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Vladimiro Miranda, Manuel A. Matos, J. Tomé Saraiva, "Power System Modelling with Fuzzy Concepts", *Proceedings ERCIM Workshop on Decision Support Methods and Applications*, pg.267-270, Lisboa, 1991.

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Manuel A. Matos, Pedro Borges, "A flexible interface for decision-aid in multicriteria decision problems", XIth International Multiple Criteria Decision Making Conference, Coimbra, 1994.

Manuel A. Matos, M<sup>a</sup> Teresa Ponce de Leão, "Electric Distribution System Planning with Fuzzy Loads", *International Transactions in Operational Research*, Vol.2, No.1, pg.389-394, Elsevier, 1995.

M<sup>a</sup> Teresa Ponce de Leão, Manuel A. Matos, "Multicriteria Distribution Network Planning Using Simulated Annealing", EURO XIV - 20th European Conference on Operational Research, Jerusalem, 1995.

M<sup>a</sup> Teresa Ponce de Leão, Manuel A. Matos, "Fuzzy Modeling of Independent Producers for Multicriteria Electric Distribution Planning", Proceedings IEEE Stockholm Power Tech, Vol. Power Systems, pg.826-831, Stockholm, 1995.

João Paulo Germano, Decision Aid in the Multicriteria Selection of Projects (in portuguese), MSc Dissertation, FEUP, Porto, 1995.

M<sup>a</sup> Teresa Ponce de Leão, Distribution Networks Planning with Independent Generation (in portuguese), PhD Dissertation, FEUP, Porto, 1995.

Vladimiro Miranda, L. M. Proença, "A general methodology for distribution planning under uncertainty, including genetic algorithms and fuzzy models in a multi-criteria environment", Proceedings of IEEE/KTH Stockholm Power Tech Conference, Stockholm, Sweden, June 18-22, pp. 832-837, 1995.