

# Lessons learned from fuzzy logic applications in complex systems

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## Abstract

In recent years there has been a growing interest in the need for designing intelligent systems to address complex engineering problems. One of the most challenging issues for the intelligent system is to effectively handle real-world uncertainties that cannot be eliminated. These uncertainties include sensor imprecision, instrumentation and process noise and disturbances, unpredictable environmental factors, to name a few. These uncertainties result in a lack of the full and precise knowledge of the system including its state, dynamics, and interaction with the environment.

Fuzzy logic (FL) and soft computing (SC) techniques, as complimentary to the existing traditional techniques, have shown great potential to solve these demanding, real-world problems that exist in uncertain and unpredictable environments. These technologies have formed the foundation for intelligent systems. An overview on FL and SC in control and decision making for complex systems will be given over the last four decades.

Some real-world cases on power plant operation, informationdriven safeguards, cost estimation under uncertainty for a large engineering project, and decision support for long-term options of energy policy will be illustrated for the potential use of FL related techniques in complex systems. Essential steps on implementing FL related techniques in industry will be presented via R & D, demonstration, and commercialization. Challenges and future research directions will be concluded in this talk.

## Da Ruan's bio

Da Ruan (PhD in Math, Ghent U, Belgium 1990) is a scientific staff member at the Belgian Nuclear Research Centre (SCK•CEN). He was a Post-Doctoral Researcher from 1991-93 and since 1994 has been a senior researcher and FLINS Project Leader at SCK•CEN.

He is the principal investigator for the research project on intelligent control for nuclear reactors, cost-estimation for large nuclear projects under uncertainty, and computerized decision making systems for society and policy support at SCK•CEN. He was a guest research scientist at the OECD Halden Reactor Project (HRP), Norway from April 2001 to September 2002 as a principal investigator for the research project on computational intelligent systems for feedwater flow measurements at HRP.

His major research interests lie in the areas of mathematical modelling, computational intelligence methods, uncertainty analysis and information/sensor fusion, decision support systems to information management, cost/benefit analysis, and safety and security related fields.

Dr Ruan currently serves as Scientific advisor at the National Institute for Nuclear Research of Mexico for the project “*Adaptive fuzzy control and its applications in nuclear systems*” (Mexico), Regional editor for Europe of *Int. J. of Intelligent Automation and Soft Computing* (TSI Press, Albuquerque, NM), co-editor-in-chief of *Int. J. of Nuclear Knowledge Management* (Interscience Publishers, Geneva), and Guest Professor at the Dept. of Applied Math. and CS in Ghent University and Adjunct Professor in the Faculty of Information Technology at University of Technology, Sydney, Australia.