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Essentials of Fuzzy Modeling and Control
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A man who looks for 'essentials' in some matter would fancy to find at least three things in it: a concise gathering of all the concepts in the field, the state of the art as an up to date survey, and new author's ideas and contribution. If it is our case, the tempted reader of 'Essentials of Fuzzy Modeling and Control' will not be disappointed. To start with the fuzzy concepts, they are briefly exposed in the first chapter (a classical approach) and then it is followed by original authors solutions of aggregation problems (the second chapter) - some results of great work for several years. To mention only ordered weighted aggregating (OWA) operators as a useful generalization as well as some hints for application of fuzzy integrals as an alternative solution. The third chapter deals with approximate reasoning - a basis for the next considerations. From the fourth chapter the essence of essentials commences. It pertains to basic concepts of fuzzy logic control (FLC) - Mamdani type controller, its relationship to PI, PD, and PID control, construction of the knowledge base, tuning problems and some others. The next chapter is dedicated to fuzzy system models: constructive, destructive, Takagi-Sugeno-Kang, quasilinear and quasinonlinear models in the four main fields of consideration: single/multiple input/s - single/multiple output/s. They are briefly, but brilliantly explained by means of simple examples. Developing of fuzzy models is the theme of sixth chapter where the authors consider the problems of fuzzy model learning by observations: template-based modeling, fuzzy neural network techniques and many others. The authors regard the fuzzy versus of both classical (LMS, Kalman filters, etc.) and smart (Dempster-Shafer, mountain-clustering, etc.) methods. A theoretical analysis of FLC is covered by the seventh chapter - an impressive comparative analysis of FLC and classical. The main topics are: FLC as virtual PI (PID) controller, tuning of FLC as a PID controller, FLC as variable structure system, and others. These analyses appear to be an attractive tool for right choice in practical applications and an excellent proof of FLC workability. The eighth chapter treats an extremely significant problem for FLC applications, namely defuzzification problem. The defuzzification is considered as interpretation of controller outputs by means of probability distribution. Several useful methods and their variants are proposed: **B**asic **D**efuzzification **D**istribution, **S**emi **L**inear **D**efuzzification and **R**andom **G**eneration. Except for their names (BADD is not bad, neither SLIDE is slide and RAGE is rage!) we have the following comment. Probabilistic interpretation of the outputs, although convenient, is rather disputable. Accepting time uncertainty instead of spatial we lose the most attractive feature of fuzzy set representation - its parallelism. Besides, although we preserve the shape of transformed sets we change significantly their Σ cardinality. Anyway this is a case with initial normalisation of input fuzzy sets, so are the temporary constraints of actuators as a point-wise instead of parallel structures. The last chapter is the most interesting with it very appealing perspectives. It considers the flexible structures of fuzzy systems. From the theoretical point of view it presents so called soft versus of norms, conorms and aggregating. Here we have the same picture as with say OWA aggregating, where at the expense of gradual varying of some accepted parameter (α , i.e. the level of confidence) we derive a gradual (soft) changing of operator features. But the problem is, that when α is already fixed (in real applications) we obtain some kind of granulation of soft operator features comparable, for example, with the problem of granulation of input/output values in fuzzy set representation. On the basis of soft fuzzy operators, aggregating and implications Parametrized and Compromise Fuzzy Reasoning (PFR, CFR) methods are proposed. In addition to its completeness, state of the art and practical orientation the book shows new unexpected horizons in both theoretical and applicable fields of fuzzy investigations.

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