

Hierarchical and Distributed Fuzzy Models: New Perspectives in Fuzzy Modeling and Intelligent Systems

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Abstract

Complex phenomena and systems are perceived from different perspectives, diversified conceptual points of view and at various levels of granularity. Symbolic and sub-symbolic processing becomes an inherently visible computing practice. Distributed nature of perception is reflected in topologies of multi-agent systems. All of these faculties challenge the well-established paradigms of system modeling including the existing principles of fuzzy modeling and neurocomputing. In spite of the diversity of the existing architectures and underlying algorithms, a large number of fuzzy models adhere to the surprisingly homogeneous principles of Granular Computing, which are associated with the processing of granular information.

In this lecture, while being fully cognizant of this modeling underpinning, we concentrate on the architectures and fundamentals supporting the reconciliation and characterization of a family of fuzzy models aimed at the representation of the same system (phenomenon) from different cognitive perspectives. The variety of points of view is directly reflected through different levels of granularity (specificity) of fuzzy sets involved in the construction and the usage of individual models as well as different feature (attribute) spaces being used by the models.

We discuss a way in which type-2 fuzzy sets (or higher-order information granules) come to the modeling arena as an immediate result of the overall characterization of the family of the models. An effective way of determining such fuzzy sets is presented. Further studies on the interpretability of fuzzy sets realized at the level of linguistic valuation are presented and with this regard it is shown how those can be carried out in the setting of type-2 fuzzy sets.