

The rise of several major seminal theories proposed in early 60's including fuzzy logic, genetic algorithms, evolutionary computation, neural networks and their combination (the soft-computing paradigm in brief) allows to incorporate imprecision and incomplete information, and to model very complex systems, making them a useful tool in many scientific areas. These new methods may become more effective and powerful in real-world applications and can offer viable and effective solutions to some of the most difficult problems in image and pattern analysis.

The research activity concerns the design of a computational model that takes advantage of the notion of rough fuzzy sets and learning to realize a system capable to efficiently cluster data coming from computer vision tasks. The hybrid notion of rough fuzzy sets comes from the combination of two models of uncertainty like vagueness by handling rough sets (Pawlak, 1985) and coarseness by handling fuzzy sets (Zadeh, 1975). Rough sets embody the idea of indiscernibility between objects in a set, while fuzzy sets model the ill-definition of the boundary of a sub-class of this set. Marrying both notions lead to consider, as instance, approximation of sets by means of similarity relations or fuzzy partitions. The proposed multiscale mechanism, based on a model of rough fuzzy sets is adopted to spread out local into more global information. The local features extracted by the consecutive layers are combined in the output layer in order to cluster the output neurons by minimizing the fuzziness of the output layer. This constitutes a fast algorithm for computing scale spaces, and apply them to image processing. We report results for region-based image segmentation and edge detection by minimizing measures of fuzziness, while texture segmentation is realized by optimizing parabolic-evolutive partial differential equations with edge preserving smoothing properties. An efficient block coding scheme is also designed upon the rough-fuzzy model, together with the adoption of machine learning techniques for vector quantization, as compared against Fuzzy Transform and Fuzzy Relational techniques.

The rough-fuzzy synergy is also adopted to better represent the uncertainty in colour image representation and histogram based indexing mechanisms.