

# ABSTRACT

This dissertation investigates the use of Particle Swarm Optimization (PSO) to allow automatic modeling of Mamdani fuzzy systems taking as input only the variable definitions, their respective domains and the objective function. This work uses several known techniques to avoid the consideration of invalid fuzzy systems. The main used techniques are the WM method, which is used to generate rules, and the clustering concept, which assists in the generation of the membership functions. The evaluation function proposed considers not only the accuracy of the generated fuzzy system, but also the properties of interpretability and distinguishability. The accuracy of the fuzzy system is measured using the underlying error. The system interpretability is evaluated using a compactness measure, which consists mainly of the number of employed rules and membership functions, while its distinguishability is quantified using the completeness measure, which consists of measuring how the used membership functions are covering the corresponding domain. The main goal of this work is to develop a PSO-based algorithm that uses a fitness function which congregates all these objectives. With well-defined parameters, the algorithm can be used with different kinds of problems without any change, allowing for a fully automatic generation process of an adequate fuzzy system. In this purpose, the proposed algorithm is tested for some benchmark problems, which are classified in two groups, based on the type of function to be modeled by the yield fuzzy system: completely or partially defined function. In the cases for fully-defined functions, three-dimensional functions are used. These functions have two input variables and one output variable. In the cases for partially-defined functions, two classification problems are used, one having four variables and other six input variables. The results obtained by the proposed algorithm are compared to related work.

**Keywords:** Swarm. Particle. Optimization. Fuzzy system.