Fuzzy Rule Extraction by Bacterial Memetic Algorithms

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Problem of finding optim membershib functions in given FRB system

- How to balance system choosing proper a, b, c, d?
  - Manual tuning
  - Automated tuning

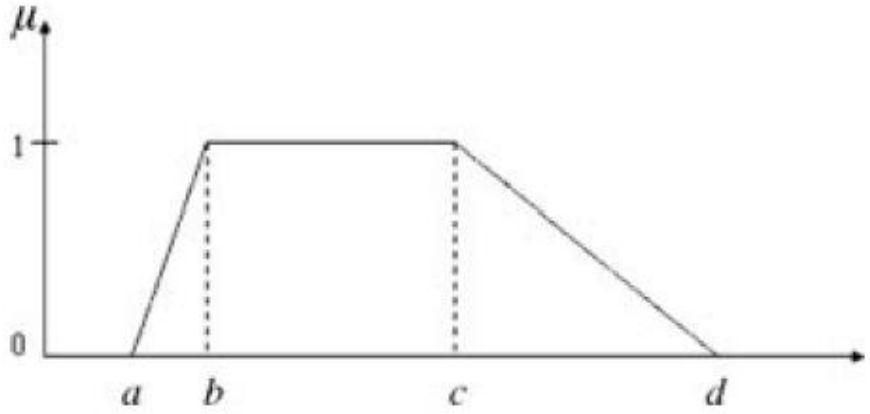


Figure 1. Trapezoidal fuzzy set.

Bacteria structure

- Chromosom – Fuzzy Rule Base
- Gens – Fuzzy Rules

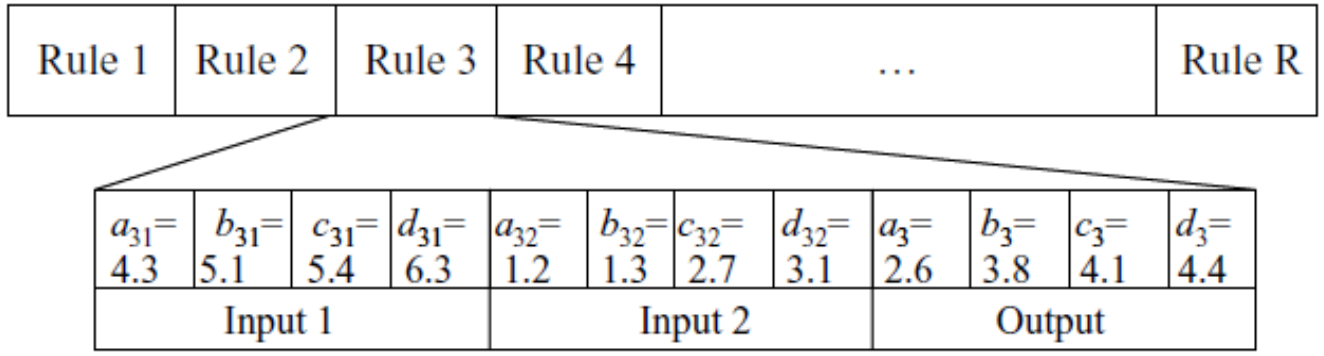


Figure 2. Fuzzy rules encoded in a chromosome.

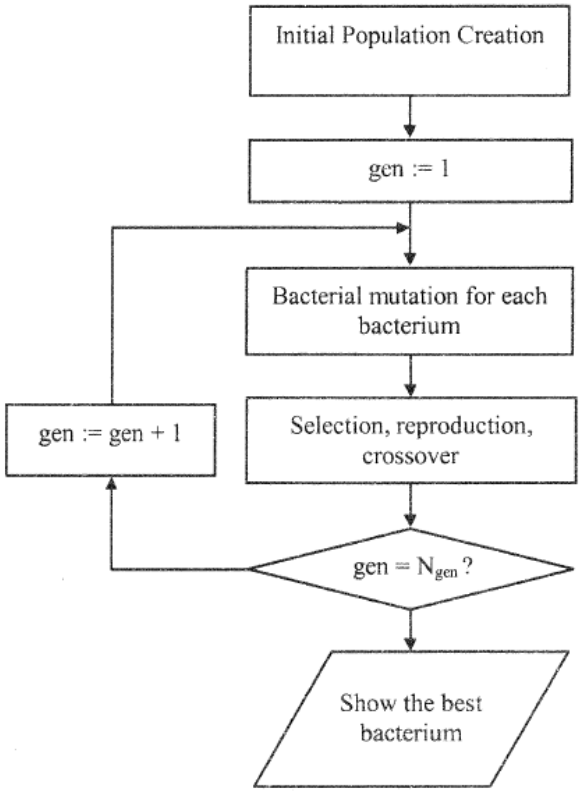
Pseudo-Bacterial Genetic Algorithm (quasi-optimal solution)

- Create the initial population: N_{ind} individuals are randonily created and evaluated. (N_{ind} is the number of individuals in the population.) Each individual contains N_{fuzzy_rules} fuzzy rules encoded in the chromosome. (N_{fuzzy_rules} is the number of fuzzy rules of desired model
- Apply bacterial mutation to each individual
- Apply conventional genetic operations
- Repeat procedure until a certain termination criterion is satisfied

Bacterial mutation

- Each individual is selceted one by one.
- N_{clones} copies of the selceted individnal are created ("clones").
- Choose the same part or parts randomly from the clones and mutate it (except original individual)
- Select the best clone and transfer its mutated part or parts to the other clones.
- Repeat the part choosing-mutation-selection-transfer cycle until all the parts are mutated and tested exactly once.
- The best individual is remaining in the population, all other clones are deleted.
- This process is repeated until an the individuals have gone through the bacterial mutation.

Flow chart of the algorithm



Bacterial Memetic Algorithm

- Create the initial population: N_{ind} individuals are randonily created and evaluated. (N_{ind} is the number of individuals in the population.) Each individual contains N_{fuzzy_rules} fuzzy rules encoded in the chromosome. (N_{fuzzy_rules} is the number of fuzzy rules of desired model
- Apply bacterial mutation to each individual
- Levenberg-Marquardt method for each bacterium (finds local minimum)
- Gen transfer in the population
- Repeat procedure until a certain termination criterion is satisfied

Gen transfer in the population

- The gene transfer operation allows the recombination of genetic information between two bacteria.
- Population must be divided into two halves. The better bacteria are called the superior half, whereas the other bacteria are referred to as the inferior half.
- One bacterium is randomly chosen from the superior half.
- One bacterium is randomly chosen from the inferior half.
- A “good” part from the source bacterium is chosen, and this part will overwrite a “not-so-good” part of the destination bacterium.

Flowchart of the algorithm

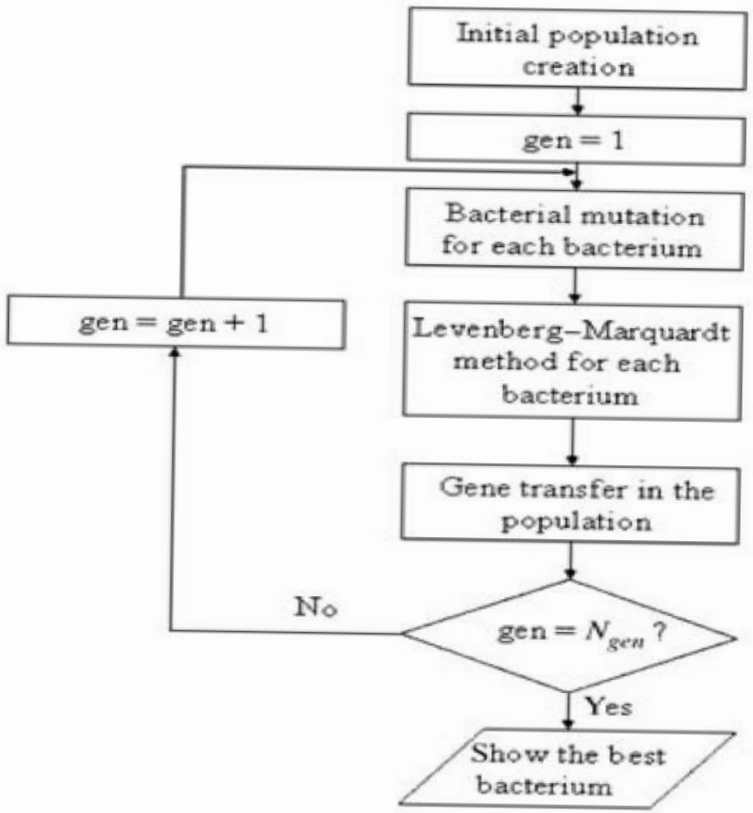


Figure 3. Flowchart of the algorithm.