

CONTACT STATE ANALYSIS BY RST, NFIS, AND SOM SYSTEMS

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1. An overview

This paper reports application of Neuro- fuzzy inference system (NFIS), self organizing feature map- neural networks - (SOM) and rough set theory (RST), on detection of contact state in a block system. In this manner, on a simple system, evolutions of contact states, by parallelization of Discontinuous Deformation Analysis (DDA) method, have been investigated. So, a comparison between NFIS and RST results has been presented. The results show applicability of the proposed methods, by different accuracy, on detection of contact's distribution. Other benefit of our method is how one can insert the role of approximate analysis in the most consuming time part of the discrete mechanics analysis, contact detection.

2. The proposed algorithms

This part of paper, proposes three different flowcharts, which comprises the varying combinations of DDA, NFIS, SOM and RST, upon the information granulation theory and balancing between the successive granules (1, 2). Information granules are collections of entities that are arranged due to their similarity, functional adjacency, or indiscernibility relation. The process of forming information granules (2) is referred to as IG. There are many approaches to construction of IG, for example SOM, Fuzzy C-Means (FCM), and RST. The granulation level depends on the requirements of the project. The smaller IGs come from more detailed processing. On the other hand, because of complex innate feature of information in real world and to deal with vagueness, adopting of fuzzy and rough analysis or the combination form of them is necessary. In this study, the main aim is to develop a hierarchical extraction of IGs using three main steps:

1-Random selection of initial crisp granules: this step can be set as "Close World" Assumption .But in many applications, the assumption of complete information is not feasible (CWA), and only cannot be used. In such cases, an Open World Assumption (OWA), where information not known by an agent is assumed to be unknown, is often accepted.

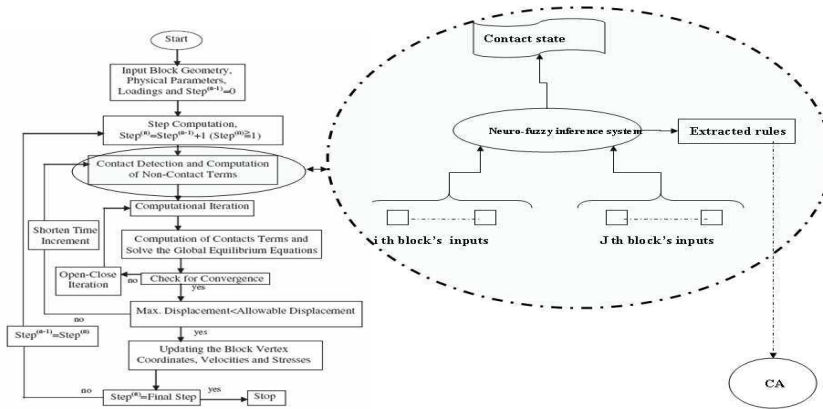
2- Fuzzy granulation of initial granules: sub fuzzy granules inside precise granules and extraction of if-then rules.

3- The close-open iteration: this process is a guideline to balancing of crisp and sub fuzzy granules by some random selection of initial granules or other optimal structures and increment of supporting rules, gradually.

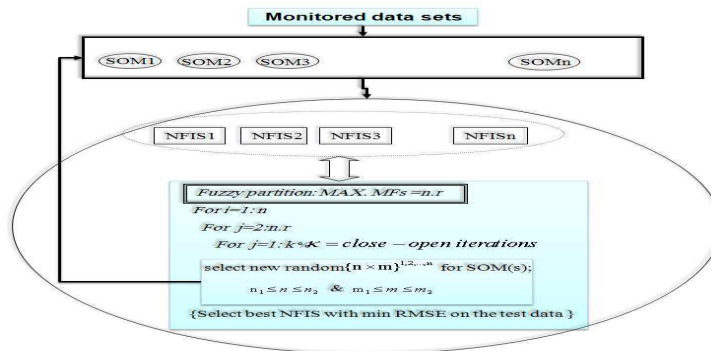
3. Results

The Contact State (C.S) in 2-D on block system has four components:" no contact: 0; V-V: 1; V-E: 2; E-E: 3", where numbers are the attributed codes .All of training and checking data set were 100 and 50, respectively, which were revealed from DDA. Inputs for any block were vertexes positions and area (total inputs: 18). The extraction of rules by NFIS and RST, under eliciting of best granules (rules and clusters) get an acceptable approximation of the distribution of contact's state (so, resulted from SOM), can deployed

in the core of contact detection part of DDA or other discrete element methods (so in some lattice mechanics based methods).



1-Contact state detection by NFIS



2-SOM-NFIS based on two forms: random and regular neuron growth (SONFIS)

4. References

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