Behaviors of Lazy Self-Organizing Map Considering Lazy-Neuron Rate

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SUMMARY

In the real world, the amount and the complexity of data increase from year to year. Therefore, it is important to classify various data exactly. In data mining, clustering is one of typical analysis techniques and is studied for many applications, such as a statement, a pattern recognition, an image analysis and so on. Then, the Self-Organizing Map (SOM) [1] has attracted attention for the study on clustering [2] in recent years. The SOM is an unsupervised neural network introduced by Kohonen in 1982 and is a simplified model of the self-organization process of the brain. The SOM can retain topological feature, which is association between neurons, and the SOM can classify similar data.

In the previous study, we have applied the ant world to the conventional SOM. There is a fascinating report that about 20% of worker ants are "lazy" [3], however, its report doesn't be established definite reason and assuredness. Furthermore, researchers reported its report think the lazy ants have some rules. Additionally, in the simulation result, there also is another report that the ants group, which contains the lazy ants at food collections, can collect more foods than the group which contains only the worker ants. From these reports, we have proposed a new type of SOM algorithm, which is called Lazy SOM (LSOM) algorithm [4]. The important feature of the LSOM is that three kinds of neurons exist; $worker\ neurons$, $lazy\ neurons$, which do not work, and $indecisive\ neurons$ which are the neighborhoods of the lazy neurons. The learning rate of the lazy neurons is smaller than that of the worker neurons. The learning rate of the indecisive neurons becomes small due to the lazy neurons. The learning rate of the previous LSOM depends on each neuron's character. For this reason, the previous LSOM can obtain the map reflecting the distribution state of the input data more effectively than the conventional SOM, however, it tends to obtain a strongly twisted map.

Therefore, we proposed an improved LSOM [5], which has the feature of the conventional LSOM and resemble the feature of the conventional SOM. The learning rate of this improved LSOM depends on each neuron's character and lazy-neuron rate, and decreases monotonically with the learning step. We investigated efficacy of the lazy-neuron rate of the improved LSOM and apply it to various input data set. We confirmed that the improved LSOM containing the lazy neurons, which is from 10% to 20% of the total, can obtain the most effective and exact map reflecting the distribution state of the input data than the conventional SOM.

In this study, we investigate the efficacy of the improved LSOM, not for feature extraction but for clustering. We apply the improved LSOM to some input data having multiple clusters and investigate the behaviors of the improved LSOM.

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