17 - 27

Behavior of Fatigable SOM with Fatigue Level

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1. Introduction

The Self-Organizing Map (SOM) is popular algorithm for unsupervised learning and visualization introduced by Teuvo Kohonen. One of the most attractive applications of SOM is clustering and several algorithms for various kinds of clustering problems have been reported and investigated. In this study, we propose a new type of SOM algorithm, which is called Fatigable SOM (FSOM) algorithm. The important feature of FSOM is that the neurons of FSOM are fatigable. We investigate the behavior of FSOM and apply FSOM to clustering problems. Further, we introduce the fatigue level to FSOM to increase its flexibility for various kinds of clustering problems. The efficiencies of FSOM and the fatigue level are confirmed by several simulation results.

2. Fatigable SOM (FSOM)

In the FSOM algorithm, the neurons which have become a winner can not become a winner during a certain period of time. We call the neuron which has become a winner the fatigued neuron. We have very little difficulty in understanding why neurons are fatigued with becoming a winner. Because human-beings are fatigued with doing something, neurons also are fatigued.

(FSOM1) The initial values of all the weight vectors are given between 0 and 1 at random.

(FSOM2) An input data is inputted to all the neurons at the same time in parallel.

(FSOM3) We find the winner neuron among all the neurons except the neurons which have become winners (namely, the fatigued neurons) by calculating the distance between the input data and the weight vector of the neuron.

(FSOM4) The weight vectors of all the neurons are updated.

(FSOM5) The winner neuron is labeled as a fatigued neuron.

(FSOM6) If FSOM has n_f fatigued neurons, all the fatigued neurons are recovered and turn to be normal neurons.

(FSOM7) The steps from (FSOM2) to (FSOM6) are repeated for all the input data.

3. FSOM with Fatigue Level

We introduce a fatigue level to FSOM in order to increase the flexibility of FSOM. The basic algorithm is the same as the FSOM learning algorithm and we add an additional index controlling update of the weight vectors.

We assign a variable p_i indicating the fatigue level to each neuron of FSOM. This fatigue level p_i is updated according to the following rule. We set the initial value of p_i as 3.0. If a neuron becomes a winner, p_i decreases 0.5. Further, p_i of all the neurons decrease according to the update of the weight vector. The value of p_i is reset to 3.0 when the fatigued neurons are recovered by (FSOM6).

The fatigue level influences the update of the weight vectors. This rule is added to realize the movement such that the neurons with lower fatigue levels move slower.

4. Simulation results

Input data is 2-dimensional random data of 800 points whose distribution is non-uniform as Fig. 1(a). We consider the conventional SOM and the proposed FSOM with 100 neurons (10×10). From the results, we can say that the conventional SOM tends to self-organize all the input data including a lot of noises and FSOM self-organizes some of the clusters. On the other hand, FSOM with the fatigue level self-organizes only one cluster and is not influenced by noises.

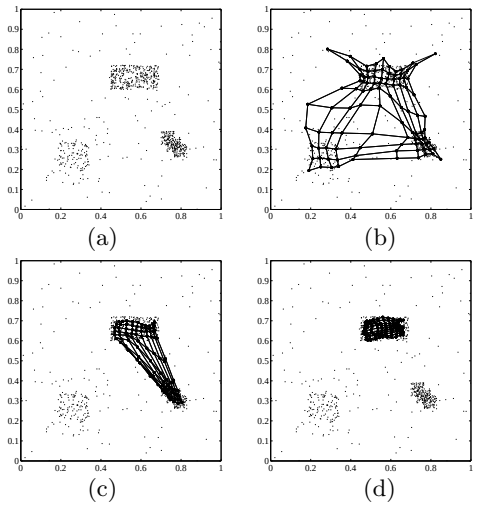

Figure 1: Learning results. (a) Input data. (b) The conventional SOM. (c) FSOM. (d) FSOM with the fatigue level.

5. Conclusions

In this study, we have proposed the Fatigable SOM (FSOM). We have explained the differences between SOM and FSOM and FSOM with the fatigue level with learning algorithm and have investigated its behavior. Furthermore, we have applied the proposed FSOM to extract only one of some clusters including a lot of noises and have confirmed its efficiency.

In the future, we try to discover new applications of FSOM in diverse fields such as sound data processing.

References

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