# CHAPTER V

# CONCLUSION

## 5.1 Result discussion

According to this research, there are two important topics for discussion. The first one is a new behavior based cost function reducing the training time. The second topic is the input pattern sequence feeding to the training network.

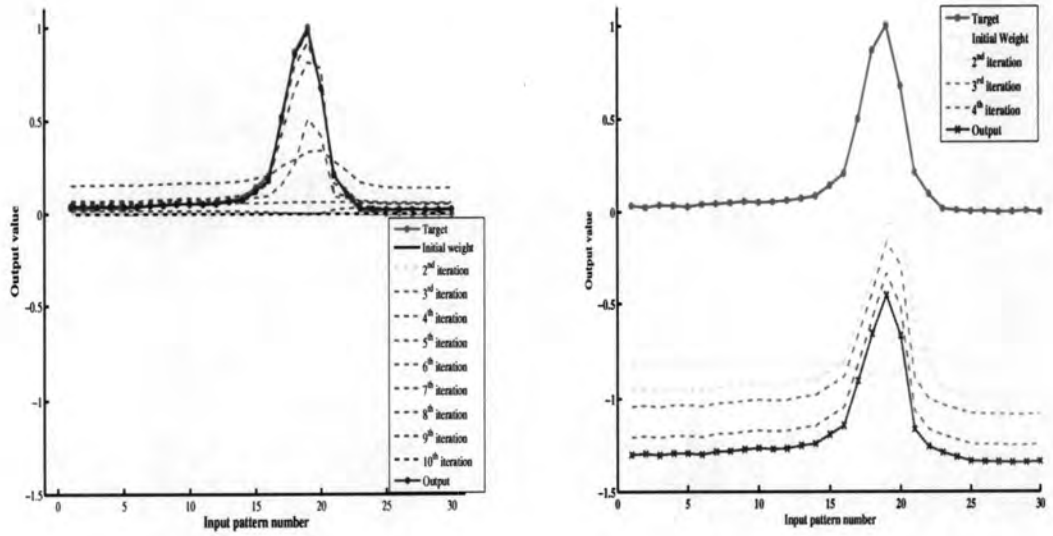
### To reduce number of epochs

To reduce number of epochs, the proposed cost function is created for network to adjust output which parallel with the surface target by comparing it with the first output from the initial weight. Where the initial weight are located, our proposed network adjusts surface output so that the target and the output are parallel. Figure 5.1 shows the mentioned concept.

Figure 5.1(a) shows the adjustment steps of output from each iteration, for Titanium testing set, by using Levenberg-Marquardt learning algorithm. From the initial weight, network adjusts the weight by stretching the output to reach the target within the acceptable error. The figure shows ten steps of weight adjustment. The meaning of each color representations are as follows; red, light green, dotted line, and dark green show the target, the output from initial weight, step of each adjustment, and the output, respectively.

Figure 5.1(b) illustrates the output from our proposed cost function. Our purpose cost function takes four steps for weight adjustment to parallel with output vector. Network does not take time to adjust weight for approach to the target value. Each color has the meaning as mentioned above. With the same initial weight, the objective of the proposed cost function is only to imitate the behavior of the data. Hence, the duration of weight adjustment is shorter.

Therefore, the proposed cost function gives the output that is parallel to the target behavior. It can reduces the amount of oscillation in the learning process. The number of epochs is less than using the standard Levenberg-Marquardt




(a) (b)

Figure 5.1: The weight adjustment comparision. (a) the standard LM training step and (b) the proposed training step.

method. Furthermore, LM algorithm was used to avoid the problem of nonconvergence of backpropagation.

## Input pattern sequence

Form the purpose cost function, we separate the problem in two types which are approximation problem and classification problem. For approximation problem, the input sequence does not matter for the network. The difference of output values crate a different slope. Therefore, our proposed cost function can learn to parallel with the target.

In addition, the proposed cost function is applicable with classification problems. It can separate data by considering the target value as an approximation problem. To learn output interval, input pattern sequence before feeding to the network is very important. Our proposed cost function maybe cannot separate data from any class, so it must be concern about the input sequence. The concept is to crate the different slope between the consecutive input pattern. Therefore, consecutive input pattern comes from the different input class.

## 5.2 Conclusion

For the conclusion, our purpose cost function can forecast output that parallel with target behavior. This technique helps network to reduce the training time (approximately more than 2 times faster). It applies with the approximation problem and also applies with classification problem with the sequence input technique. The performance of this technique is evaluated by measuring the values of cosine correlation between these two vectors, the actual target and the generated output. The accuracy of the proposed methodology is approximately over 90%. The difference of the proposed method and the standard methodology value is also compared by the t-test value.

Furthermore, the application technique of using neural cellular automata incorporates the techniques of digital photography and neural network into a single conceptual framework. The results of study appear to indicate that this approach is feasible. It can be applied to predict color diffusion not only onto clear water surface, but also the one with blocking object. The approach is, in contradistinction to analytic methods, easy to apply and to implement without high computational costs. Above all, we are not restricted to simple geometrical objects with well defined boundary conditions

## 5.3 Further work

1. To implement the proposed cost function to other classification problems.
2. To implement the technique to forecast the behavior with more advanced time steps.