COMPARISON BETWEEN MLP & CMAC

GROUP A

Tianming Qiu, Qiuhai Guo

1 MLP

ADVANTAGES

- **Better prediction** A regression equation will be obtained so that robot can perform much better during the prediction in term of the continuity of movements.

DISADVANTAGES

- **Complex algorithm** MLP algorithm includes both feedforward and backpropagation processes, what results in longer code than CMAC. Since there are lots of subscripts, it tends to be more easily to make mistakes during programing.
- **Converge slowly** It takes more than 6 million iterations and 3 minutes to make the MSE converge into its threshold.

2 CMAC

ADVANTAGES

- **Simple model** The code is much shorter and structure is simpler.
- **Converge fast** Compared with MLP, it takes only hundreds iterations to converge into a even smaller threshold.

DISADVANTAGES

- **Huge demand on training data** Because we adopt a layer 2 with resolution as 50, fast 2500 parameters need to be calculated, unless we cannot cover enough states. For example, in figure 1 on the following page, it shows the coverage area of receptive fields on the layer 2 with 250 samples. The grid board describes the 50 x 50 layer 2 and each square means a neuron. The darker the area is, the more times it has been selected to be activated. When we collected those 250 samples, we just 'scanned' the red object subtly in order to cover possible more neurons on the layer 2, which the trajectory could even be observed clearly in the figure 1 on the next page. Unfortunately, it still remains lots of blank areas.

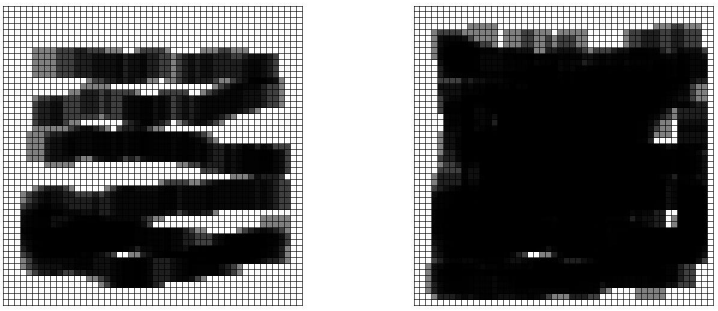

Figure 1: Coverage area (left: 250 samples right: 850 samples)

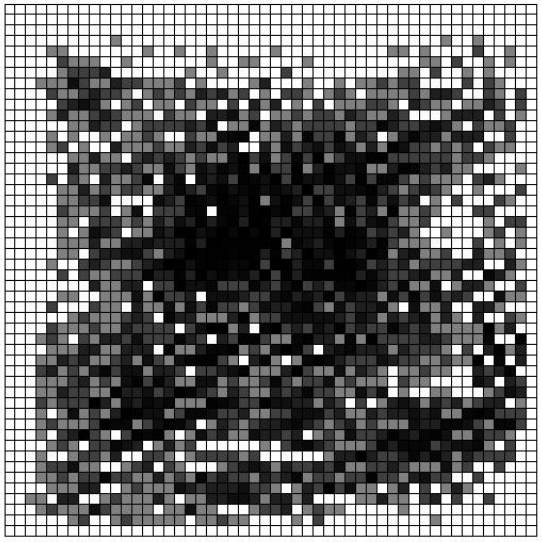

Figure 2: Activated neurons (850 samples)

Next, we try to collect more data up to more than 850 samples. This time layer 2 seems to be totally black, which is shown in figure 1. However, from neuron level, the situation is still not be optimistic. Apart from the area near boundary, many 'empty neurons' can be observed obviously from figure 2. That means, during the prediction process, if a new data from layer 1 was going to activate a set of neurons that have never been trained before, the robot arm was not able to give a correct response and even ran into a not safe position.

- **Lack of continuity & weak robustness** Since the neurons on layer 2 are discrete and the resolution has a limit of only 50, robot cannot trace a red object continuously, more stiff than how it perform by MLP. And sometimes go into wrong positions because of lack of training data in some specific areas.