CHAPTER 6

VALIDATION OF MODIFIED ANN APPROACHES

6.1 COMPARISON OF MODIFIED ANN APPROACHES

The CF using the three modified ANN approaches is compared in this section. For analyzing the MPIM data, ten benchmark datasets were taken from Boctor (1991) for the comparative study. The problem solved by Boctor (1991), involves an incidence matrix with 16 machines and 30 parts. Boctor (1991) tested the datasets by using the SAA and the results are compared with optimum results. Boctor (1991) considered the number of cells and maximum machines permitted to each cell as constraints. Boctor (1991) objective function is to minimize the number of exceptional elements.

The same set of problems are solved by using modified ANN approaches and the results are compared with Boctor (1991) results. The results of the modified BP networks, modified KSOM and modified ART1 are shown in the Table 3.8, 4.5, 5.8 and Table 5.9.

As far as the modified BP is concerned, the modified BP with hybrid algorithm performs well when compared to the modified BP with GA and the modified SA. As per one of the Boctor (1991) constraints maximum numbers of machines in each cell is considered in the modified BP networks. Multi objective and number of constraints can be imposed in this modified BP networks only.

In the problems tested with the modified KSOM networks ten problem results are identical to Boctor (1991) optimal results, but in modified KSOM approach the maximum number of machines permitted to each cell constraint is not considered. But the modified KSOM networks results satisfy the constraint. Objective function (E) is also computed in the modified KSOM algorithm itself. The proper assignment of machines and parts are taken care of in this modified algorithm itself. The modified KSOM computational time is
very less when compared to the modified BP networks. The modified KSOM is simple when compared to the modified BP networks.

The modified ART1 is also tested with the same set of problems and the results are shown in the Table 5.8 and Table 5.9. Here also the maximum number of machines permitted to each cell constraint is not considered. But the modified ART1 networks results satisfy the constraint. Objective function (E) calculations and the proper assignment of machines and parts are also taken care of in this modified algorithm itself. The modified ART1 computational time is equal when compared to the modified KSOM and the computational time is very less when compared to the modified BP networks.

The modified BP gives 50 results for 10 problems with five different $M_n$ values and the maximum number of cell is 2. But the modified KSOM and modified ART1 will give only 10 results. Only one constraint can be considered in the modified KSOM and modified ART1, which is maximum number of cells.

But for each and every run the modified BP and modified KSOM network give different results. But over and above the modified ART1 network results are identical to optimal results for all the ten problems and it will give the same result for all the runs.

The results of the experimentation have proved that the developed ART1 approach is consistent in their performance. Hence modified ART1 approach will produce satisfactory results with any size of the problem for CF.

6.2 TESTED DATASETS

The modified ANN approaches tested with benchmark problems which are found in the literature. Overall two hundred and twelve datasets were tested with the modified ANN approaches. The approaches tested for number of datasets are shown in the Table 6.1. The results were compared with literature results. If the same problem is tested with different number of cells, then that is considered as different dataset.
### Table 6.1 Total number of datasets tested in the modified ANN

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the modified ANN approach</th>
<th>Application</th>
<th>Nature of dataset</th>
<th>Total number of datasets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Modified BP networks</td>
<td>MPIM CF</td>
<td>MPIM</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Multi-objective CF</td>
<td>OSIM</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Modified KSOM networks</td>
<td>MPIM CF</td>
<td>MPIM</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fractional CF</td>
<td>MPIM</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>Modified ART1 networks</td>
<td>MPIM CF</td>
<td>MPIM</td>
<td>131</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Fractional CF</td>
<td>MPIM</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>CF with production factors</td>
<td>NBIM</td>
<td>9</td>
</tr>
</tbody>
</table>

The modified BP network is tested with 30 datasets. For the single objective the first ten datasets were taken from Docter (1991) with two numbers of cells. The next ten set of problems are taken from Sofianopoulu(1997) and tested for multiple objectives with two and three number of cells.

The modified KSOM is tested with 64 datasets for CF and 40 dataset for FCF. In the modified KSOM CF, out of 64 results 40 results are equal and 24 results are superior when compared to the literature results. The modified KSOM FCF results are equal in eight datasets, superior in 28 datasets and three dataset constraints are not satisfied and two problems result is inferior when compared to the literature results. And all other 11 results are equal to literature results.

The modified ART1 network is tested by using 131 benchmark datasets (shown in Table 2.2) for CF. The results are compared with the literature results. The effectiveness of CF is measured with various literature performance measures. Out of 131 datasets the modified ART1 network are superior or equal to 127 problems, inferior in two problems and two problems constraints are not satisfied when compared to the literature results. The modified ART1 FCF results are equal in 7 datasets, superior in 35 datasets when compared to the literature results except 8 datasets in which the literature constraints are not satisfied. The computational consistency is also very high in this modified ART1 when compared to the all literature heuristics/algorithms.
The nine literature datasets were tested for CF with production factors by using the modified ART1 networks. The results are equal to the literature results.

6.3 SOFTWARE DEVELOPMENT

Using MATLAB 6.5

MATLAB is a software package for high-performance numerical computation and visualization. It provides an interactive environment with hundreds of built-in functions for technical computation, graphics, and animation. It provides easy extensibility with own high-level programming languages. The name MATLAB stands for matrix laboratory. The proposed modified ANN approaches have been coded in MATLAB 6.5 package and executed in Pentium IV, 900MHz system.

MATLAB works through three windows such as command window, graphics window and edit window. Command window is the main window. All commands, including those for running user-written programs, are typed in this window at the MATLAB prompt. The programming results are displayed in this window. The output of all graphics commands typed in the command window is flushed in the graphics window. The user can create as many graphics window as the system memory will allow. Edit window is used to write, edit and save the programs.

The result graph using MATLAB is shown in Figure 6.1. Axis x is denoted by parts and axis y is denoted by machines. The parts are represented by square blocks. This graph contains three cells, seven voids and two exceptional elements (E).

Figure 6.1 Result graph using MATLAB