CHAPTER 7

CONCLUSION AND SCOPE FOR FUTURE RESEARCH

7.1 CONCLUSION

Aluminium metal matrix composites, although slowly gaining their momentum in replacing conventional materials in aerospace and automobile industries, still pose heavy machining problems when machined using conventional methods. In this research work, an investigation is carried out in machining AMC using ECM process. The work material A356/SiC<sub>P</sub> is prepared using stir cast method. Taguchi’s parametric design, which helps to reduce the cost and time involved in gathering meaningful data set, is followed for experimentation. Applied voltage, electrode fee rate, electrolyte concentration and amount of reinforcement were identified as decision variables. Three optimization approaches were attempted to maximize the MRR.

Significance of the parameters was tested with ANOVA. Result showed that, in addition to all the three process parameters, amount of reinforcement also found to influences the variations in MRR. The ranking of these parameters when checked with Pareto ANOVA revealed that the electrode feed rate ranked top, followed by electrolyte concentration and applied voltage. Three optimization approaches namely, Taguchi method, ANN-direct search approach and ANN-GA were employed to find the optimal solution. In Taguchi’s method, signal-to-noise ratio was the key factor in deciding the output values. The results derived from this method
disclose that except for applied voltage and electrode concentration, the optimal values identified for the parameters are closely matching to the values obtained from other two approaches. This happens because Taguchi method works only with all the possible combinations of parameter levels and tries to find the best among them. For the next two approaches, a modeling of equation was done using ANN. The ANN system was developed using feed forward-back propagation network and trained with 2/3 of data. One of the commercially available software, whose reliability was appreciated by many researchers, was chosen for this. The predictions made by this model were found to have very good agreement with experimental data and the model was capable of predicting MRR value for any combinations of parameters within the range. This ANN model was successfully integrated with Direct search algorithm to perform optimization. The maximum MRR given by this approach was better than the value proposed by Taguchi’s method. Finally the ANN was linked with GA and optimized results were obtained. Confirmation experiments were conducted with the optimal combinations estimated by all the three approaches. Upon comparison, it was understood that, the integrated approach using ANN and GA behaved well. The present study implies that the content of reinforcement in the AMC should be less in order to get higher MRR. In ECM process the mechanism of material removal is due to ion displacement of metal ions which are produced due to electrochemical action. It is found that the SiC particle reinforced in the aluminium alloy is inactive during this chemical reaction and so high content of this reduces the effective matrix area exposed to ionization during the electro chemical action. Though tried with first time, the integrated approaches seem to be better than Taguchi method, in this particular case. The results also entail that MRR can be increased by increasing electrolyte concentration and applied voltage, and by reducing electrode feed rate which coincides with the findings reported in past literatures.
There are few limitations observed in the present study and are summarized as follows:

1. The temperatures of electrolyte at the entrance and exit of tool-work gap are an important factor. In the present study, due to machining setup limitations and to limit the temperature rise of electrolyte in the work-tool gap, machining time is chosen as 10 minutes per trial.

2. In the present machining setup the maximum electrolyte flow rate possible is 5 lpm and hence is chosen for the study.

3. The hole diameter of the tool (2 mm), through which electrolyte is flowing during machining, has limited the upper level of electrolyte concentration to 100 gm/l.

4. The inter electrode gap is treated as constant value in this work because of very short range of values permitted by the manufacturer.

7.2 SCOPE FOR FUTURE RESEARCH

The present study is made with considering only rough machining operation where material removal is the only variable of importance. This can be extended to the finish machining where other output responses like overcut, tolerance and surface roughness can be included. In addition to this, the following aspects of electrochemical machining can also be given due considerations:

- The electrolyte flow distribution can be studied with various methods of flow and identification of flow path configuration which may help in enhancing the output quality can be done.

- A generalized neural network prediction model linked with an optimization algorithm can be developed by conducting more number of experiments those include almost all the controllable parameters.