CHAPTER 6

CONCLUSION

6.1 INTRODUCTION

The present work deals with optimization of parameters of MEMS accelerometer. The optimization of parameters of a MEMS accelerometer using Genetic Algorithm (GA), Artificial Bee Colony (ABC) algorithm, and Artificial Bee Colony (ABC) algorithm with Particle Swarm Optimization (PSO) has been carried out in MATLAB 7.12 environment. Optimized parameters $L_1$, $L_2$, $L_3$, $y_m$ and Fitness function (F) or Die Area (DA) has been identified. The optimal parameter values of MEMS accelerometer, obtained using Genetic Algorithm (GA), Artificial Bee Colony (ABC) algorithm, and Artificial Bee Colony (ABC) algorithm with Particle Swarm Optimization (PSO) have been compared.

Initially, parameters of MEMS accelerometer have been optimized using Genetic Algorithm. The simulation results of this algorithm shows the Fitness function (F) or Die Area (DA) to be equal to 112297.95 $\mu$m$^2$ and this value is within the constrained range of 90000 to 160000 $\mu$m$^2$.

In order to overcome the issues of Genetic Algorithm (GA), Artificial Bee Colony (ABC) algorithm has been introduced. The optimized parameter values $L_1 = 2.364 \times 10^{-5} = 23.64 \, \mu$m, $L_2 = 5.356 \times 10^{-5} = 53.56 \, \mu$m, $L_3 = 4.938 \times 10^{-4} = 493.8 \, \mu$m, $y_m = 1.015 \times 10^{-4} = 101.5 \, \mu$m and Fitness function (F) or Die Area (DA) = 110969.16 $\mu$m$^2$ obtained using Artificial Bee Colony algorithm (ABC) method is better than Genetic Algorithm method. The time taken by the Artificial Bee Colony (ABC) algorithm to compute the number of iterations is very much less compared to Genetic Algorithm (GA) method.
To reduce the Fitness function (F) or Die Area (DA) still further a new algorithm (combination of ABC with PSO) has been introduced. Here force was introduced along with Die Area (DA) as a Fitness function (F).

The optimized parameter values $L_1 = 2.114 \times 10^{-05} = 21.14 \, \mu m$, $L_2 = 4.995 \times 10^{-05} = 49.95 \, \mu m$, $L_3 = 4.854 \times 10^{-04} = 485.4 \, \mu m$, $y_m = 1.013 \times 10^{-04} = 101.3 \, \mu m$ and Fitness function (F) or Die Area (DA) $= 110409.09 \, \mu m^2$ are obtained from simulation. By comparing these parameters $L_1$, $L_2$, $L_3$, $y_m$ and Fitness function (F) or Die Area (DA) values with the parameter values obtained using Artificial Bee Colony (ABC) algorithm, Genetic Algorithm (GA), we conclude that the parameter values obtained using Artificial Bee Colony (ABC) algorithm with Particle Swarm Optimization (PSO) algorithm method is better than that the parameter values obtained using Genetic Algorithm (GA) and Artificial Bee Colony (ABC) algorithm method.

6.2 RESEARCH CONTRIBUTION

Based on the simulation results obtained the optimized parameter values of a MEMS accelerometer are $L_1 = 2.114 \times 10^{-05} = 21.14 \, \mu m$, $L_2 = 4.995 \times 10^{-05} = 49.95 \, \mu m$, $L_3 = 4.854 \times 10^{-04} = 485.4 \, \mu m$, $y_m = 1.013 \times 10^{-04} = 101.3 \, \mu m$ and Fitness function (F) or Die Area (DA) $= 110409.09 \, \mu m^2$. The reasons are: Beam length ($L_1$, $L_2$ ) values obtained using ABC with PSO algorithm method is better than that of GA, ABC method. Beam Length ($L_3$) was not optimized when compared with the values obtained using GA, ABC but it helps to find an optimized Fitness function (F) $= 110409.09 \, \mu m^2$ using ABC with PSO algorithm method. Time taken for the iteration process by ABC with PSO algorithm method was very low compared to GA, ABC method. In ABC with PSO algorithm method there was no overlapping and mutation. At ABC with PSO algorithm method the calculation is very simple and it allows faster convergence.

For the aimed Fitness function (F) or Die Area (DA), Artificial Bee Colony (ABC) algorithm with Particle Swarm Optimization (PSO) algorithm
method provides Fitness function \( F \) or Die Area \( DA = 110409.09 \, \mu m^2 \) is suggested for the MEMS accelerometer design.

### 6.3 SUGGESTIONS FOR FUTURE WORK

This work can be extended further as follows:

Optimization of MEMS accelerometer parameters can be extended to other evolutionary algorithms. Using the optimized parameters, a double folded beam MEMS accelerometer can be designed in any of the MEMS CAD tool and thereafter analyzed.

On completion of design, analysis and validation, the MEMS accelerometer can be fabricated, which can be used for airbag deployment in an automobile industry.