Chapter Five
Conclusions and Recommendations

5.1. Conclusions:

This research investigated optimized V-beam micro electro thermal actuator using particle swarm optimization techniques. The micro device parameters were analyzed in MATLAB from steady state heat equation by developing formula govern heat dissipation (entropy) for various micro structure to optimized using particle swarm optimization techniques.

Numerical simulations data show that V-beam micro electro thermal actuator for generatinglarge angular displacement & output force can be achieved which increase v-beam efficiency, performance and reduce running & manufacturing costs. A model for the entropy, force output and angular displacement of V-beam micro electro thermal actuator is built as indeterminate problem, and an iteration algorithm is set up. The calculated results based on this model agree well with our own MATLAB simulation. Moreover inoptimization process, theoptimal result is better than the original case about 40%.

According to the model, the V beam thickness (h) decrease as the entropy generation rate will decrease and the optimal solution is 50 μm, gap between beam & substrate (g) decrease as the entropy generation rate will decrease and the optimal solution is 1 μm, V beam width (w) increase as the entropy generation rate will decrease and the optimal solution is 20μm, V beam length (L) decrease as the entropy generation rate will decrease and the optimal solution is 500μm and V beam current density (J) decrease as the entropy generation rate will decrease and the optimal solution of J is 0.1 $A/\mu m^2$.

Theresult obtained by the optimization technique adopted in this research has excelled itself when compared with results in the literature in the following:

- The research take five parameter while in other study take three parameters to optimize.
- Thelength (L) of V-beam in current study reduced 84% thatImplies less material is needed and cost compared to Chengkuo Lee.
- the V-beam width (w) is increase by 70% to result obtained by Chengkuo Lee to maintain good thermal necessity and reliability of v-beam with more structure which increase cost.
- V-beam thickness (h) reduced by 37.5% in current work which reduce cost and space for design.
- Finally it is appear that current work more effective because it increase force output(F_t)by 40% ,maintain good thermal characteristics with little structure and cost compared to Chengkuo Lee.

In this research Particle Swarm Optimization has been presented as an alternative method to optimize the structure of V-beam micro electro thermal actuator in order to optimize composite structures and current density. One of the objectives of the research is to introduce the PSO algorithm as a new variant of algorithms in MEMS design optimization.

Moreover implements of method for constraint simple model, results show the ability of proposed methodology to find better optimal solution ingreater accuracy, faster convergence speed and simplicity. The suites of functions included are investigated by Particle Swarm Optimization in researching PSO behavior.

5.2. Recommendations

The PSO algorithms implemented here are computationally intensive and are missing some features that would improve flexibility and work continues on improvement so we recommended to :

- Search for better improvement to PSO specially to solve velocity and stagnation problems.
- To use PSO for complex model as it shown superior feature in solving simple model.
- Effective utilized of model constraints under equation govern performance and reliability.
- To evaluate more factors could increase V-beam performance such as micromachining and fabrication.

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