3.2 Flow Chart of GA

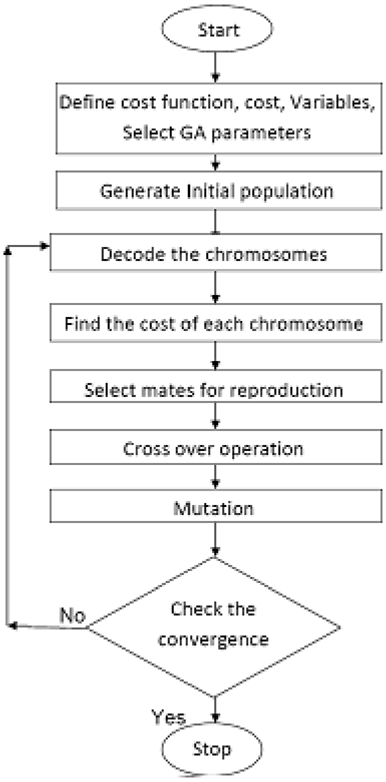

Figure 4: Flow chart of GA

3.3 Particle Swarm Optimization

PSO simulates the behaviors of bird flocking. Suppose the following scenario: a group of birds are randomly searching food in an area. There is only one piece of food in the area being searched. All the birds do not know where the food is. But they know how far the food is in each iteration. So what's the best strategy to find the food? The effective one is to follow the bird, which is nearest to the food. PSO learned from the scenario and used it to solve the optimization problems. In PSO, each single solution is a "bird" in the search space. We call it "particle". All of particles have fitness values, which are evaluated by the fitness function to be optimized, and have velocities, which direct the flying of the particles. The particles fly through the problem space by following the current optimum particles.

When a particle takes part of the population as its topological neighbors, the best value is a local best and is called p-best. After finding the two best values, the particle updates its velocity and positions with following equation given below:

$$V_i^{(u+1)} = W * V_i^{u} + C_1 * rand(\ ) * (pbest_i - p_i^{u}) + C_2 * rand(\ ) * (gbest_i - p_i^{u})$$

$$P_i^{(u+1)} = P_i^{u} + V_i^{(u+1)}$$

In the above equation,
The term rand ( )*(pbest i -Pi(u)) is called particle memory influence.The term rand ( )*(gbesti -Pi(u)) is called swarm influence.
Vi(u) which is the velocity of ith particle at iteration 'u' must lie in the range Vmin ≤ Vi(u) ≤ Vmaxs

$$W = W_{max} - \left[\frac{W_{max} - W_{min}}{ITER_{max}}\right] * ITER$$

Where w -is the inertia weighting factor
Wmax - maximum value of weighting factor
Wmin - minimum value of weighting factor

3.4 Flow Chart

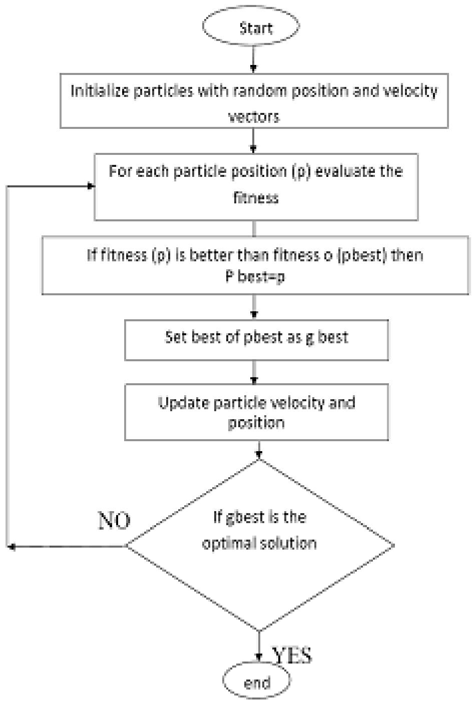

Figure 5: Flow Chart

3.5 Bacterial Foraging Optimization Technique:

Natural selection tends to eliminate animals with poor foraging strategies and favor the propagation of genes of those animals that have successful foraging strategies since they are more likely to enjoy reproductive success. After many generations, poor foraging strategies are either eliminated or shaped into good ones. This activity of foraging is successfully incorporated as an optimization tool in power system harmonic estimation. The *E. coli* bacteria that are present in our intestines also undergo a foraging strategy. The control system of these bacteria that dictates how foraging should proceed can be subdivided into four sections, namely Chemotaxis, Swarming, Reproduction, and Elimination and Dispersal.
a) Chemotaxis:
b) Swarming
c) Reproduction
d) Elimination and Dispersal

4. Matlab/Simulink and Hardware Results

4.1 Simulation Results Obtained With Traditional Method

The step response is first analyzed and it is shown in fig. From the response it can be seen that the rise time, settling time ,peak time are observed. The response is peaky with an overshot of 0.0274.It is desirable to have smooth response for variation in input and output voltages. In order to determine the output and input voltage regulation the input voltage is changed from one value to another value and it is shown in fig. The controller parameters used for the generation of the above step response is Kp =0.35,Ki=25,Kd=0.0017.

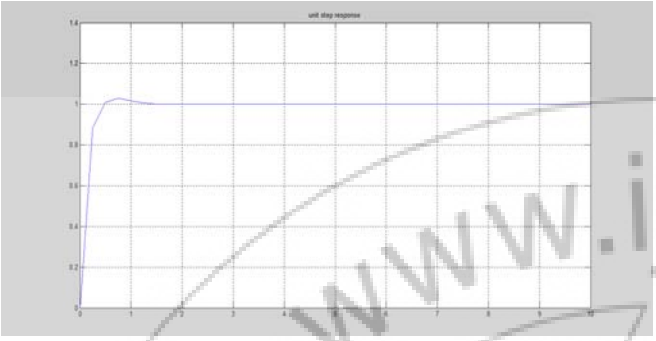

Figure 6: step response with traditionally designed controller

The boost converter with the traditionally designed controller is now simulated in MATLAB/SIMULINK with step change in input voltage from 36v to 26v,and the output voltage observed is shown in the below figure

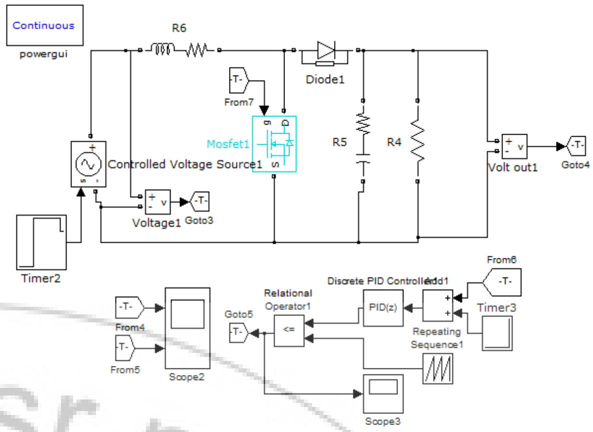

Figure 7: simulink model for step change in i/p voltage

Figure 8: output waveform for step change in i/p voltage

4.2.2 Circuit for Step Change in Load Resistance

The simulink circuit for the boost converter when a step change in load resistance from 100 ohms to 200 ohms is applied the output voltage variation is shown in the below figure.

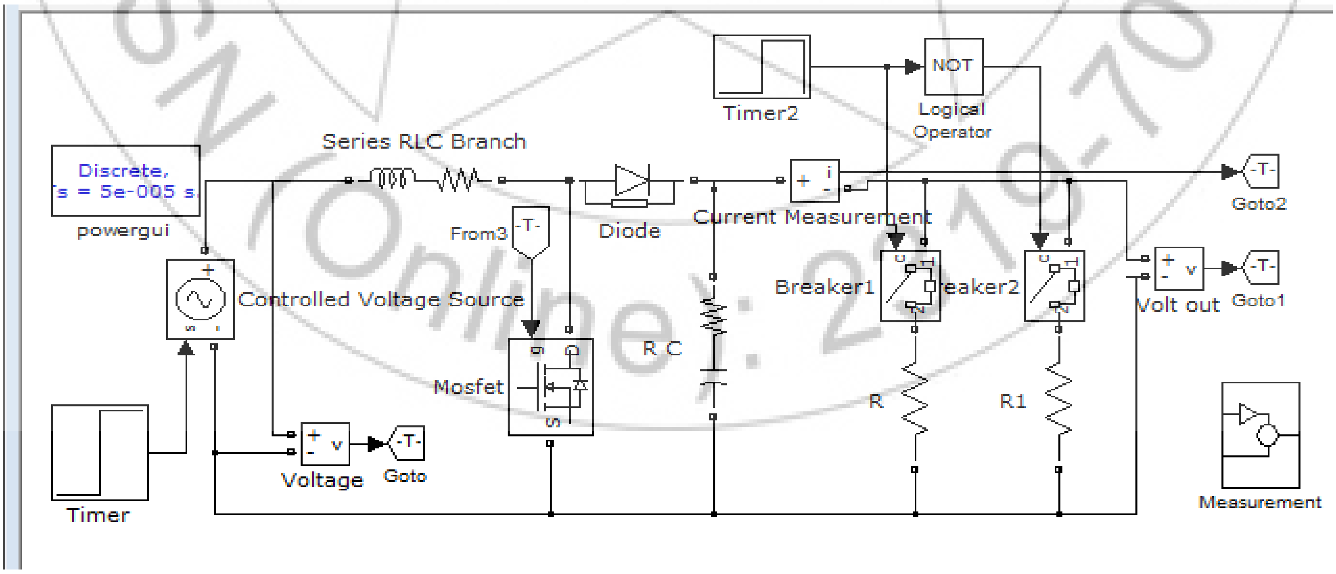

Figure 9: Simulink circuit for step change in load resistance.

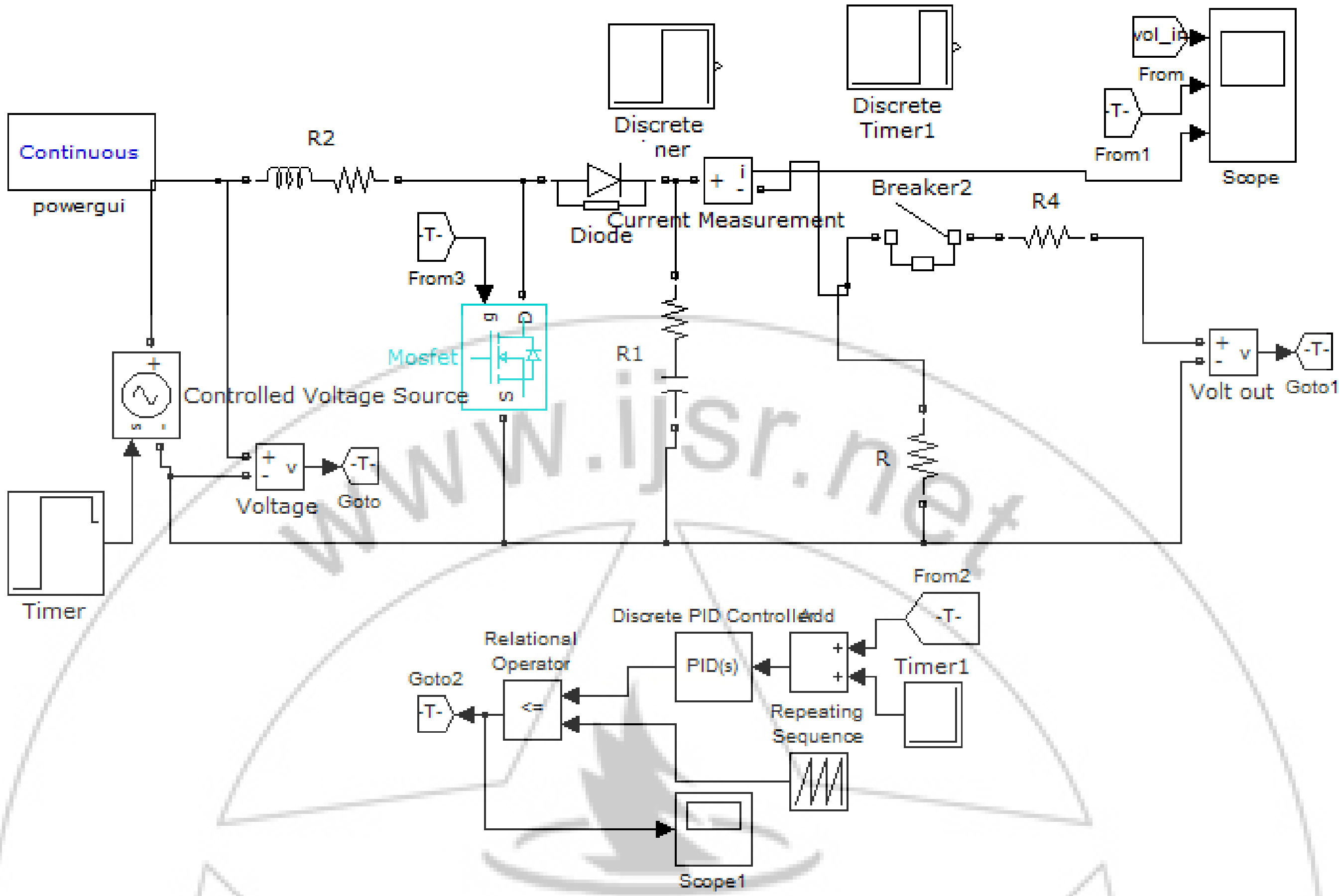

Figure 10: step response obtained with the GA controller

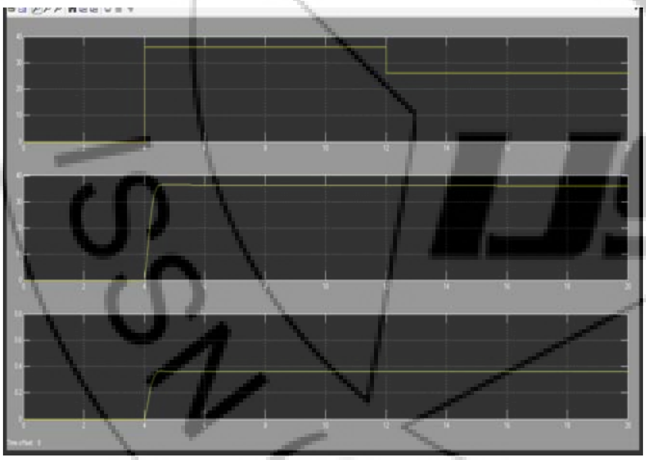

Figure 11: out waveform

5. Conclusion

The design of controller for the boost converter is perceived as an optimization task and the controller constants are estimated through evolutionary search algorithms. Initially the design of PID controller parameters for the boost converter were designed based on the conventional method i.e. ziegler-nicholos method the design of PID controller parameters for the boost converter was finished. By observing the rise time, settling time, peak overshoot from the step response curves .

References

[1] Robert W. Erickson.: "Fundamentals of Power Electronics" (University of Colorado, Boulder).
[2] Jun Zhang, Henry Shu-Hung Chung, *Wai-Lun Lo,S.Y.Ron* Hui, *"Implementation of a Decoupled Optimization Technique for* Design of Switching Regulators Using Genetic Algorithms," *IEEETransactions On Power Electronics, vol. 16, no. 6, November2001*.
[3] J. F. Frenzel, "Genetic Algorithms," *IEEE Potentials, vol. 12, pp.21-24*,Oct. 1993.
[4] The Design of PID Controllers using Ziegler Nichols Tuning Brian R Copeland,March2008
[5] Digital control Engineering by K.ogata.
[6] L. Guo, J. Y. Hung, and R. M. Nelms, "Digital controller design for buck and boost converters using root locus techniques," in *Proc. 29th Annu. Conf. IEEE Ind. Electron. Soc., Roanoke, VA, Nov. 2–6, 2003*,pp. 1864–1869.
[7] H. Matsuo, L. Wenzhong, F. Kurokawa, T. Shigemizu, and N. Watanabe, "Characteristics of the multiple-input DC–DC converter," *IEEE Trans. Ind. Electron.*, vol. 51, no. 3, pp. 625–631, Jun. 2004.
[8] J. Y. Hung,W. Gao, and J. C. Hung, "Variable structure control: A survey," *IEEE Trans. Ind. Electron.*, vol. 40, no. 1, pp. 2–22, Feb. 1993.
[9] E. Figueres, G. Garcera, J. M. Benavent, M. Pascual, and

[10] J. A. Martinez, "Adaptive two loop voltage mode control of DC–DC switching converters," *IEEE Trans. Ind. Electron.*, vol. 53, no. 1, pp. 239–253, Feb. 2006.
[11] A. G. Perry, G. Feng, Y.-F. Liu, and P. C. Sen, "A design method for PI-like fuzzy logic controllers for DC–DC converter," *IEEE Trans. Ind. Electron.*, vol. 54, no. 5, pp. 2688–2695, Oct. 2007.
[12] T.-T. Song and H. S.-H. Chung, "Boundary control of boost converters using state energy plane," *IEEE Trans. Power Electron.*, vol. 23, no. 2, pp. 551–563, Mar. 2008.
[13] S.-C. Tan, Y. M. Lai, and C. K. Tse, "General design issues of sliding mode controllers in DC–DC converters," *IEEE Trans. Ind. Electron.*, vol. 55, no. 3, pp. 1160–1174, Mar. 2008.
[14] C. Sreekumar and V. Agarwal, "A hybrid control algorithm for voltage regulation in DC–DC boost converter," *IEEE Trans. Ind. Electron.*vol. 55, no. 6, pp. 2530–2538, Jun. 2008.
[15] M. L. Winston, *The Biology of Honey Bees*. Cambridge, MA: Hardvard Univ. Press, 1987.
[16] D. E. Goldberg, *Genetic Algorithms in Search, Optimization, and Machine Learning*. Reading, MA: Addison-Wesley, 1989.
[17] C. Kessler, "Das symmetrische optimum," *Regelungstetechnik*, vol. 6, no. 11, pp. 395–400, 1958. n"12, pp. 432–436.
[18] L. Corradini, P. Mattavelli, E. Tedeschi, and D. Trevisan, "High bandwidth multisampled digitally controlled DC-DC converters using ripple compensation," *IEEE Trans. Ind. Electron.*, vol. 55, no. 4, pp. 1501–1508, Apr. 2008.

Author Profile

Rajendra Meena is M.Tech scholar Department of Electrical Engineering Mewar University, Chittorgarh, Rajasthan, India.