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Tuning of PID controller for Positive Output Elementary Super-Lift Luo-Converters using AI Techniques.

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Abstract— **DC-DC conversion techniques have developed very quickly and are undergoing dramatic changes as a result of two major trends in electronic industry as high voltage and high power density. Luo converter is a recently developed DC-DC converter. Positive output Luo converter performs the conversion from positive source voltage of one level to positive load voltage of another required level. Luo series Elementary, Re-lift and Super- lift converters introduces a novel approach – Super Lift technique that implements the output voltage increasing in geometric progression. It effectively enhances the voltage transfer gain in power series. This paper presents the positive output elementary super lift Luo converter performs the voltage conversion from positive source voltage to positive load voltage. The main objective is to develop PID controller for positive output elementary super lift luo converter (POSLLC) to obtain the constant load voltage using the simulation.**

Keywords- Luo converter, Super- lift ,re- lift, POSLLC, PID conrtroller.

I. INTRODUCTION

Voltage Lift (VL) Technique is a popular method widely used in electronic circuit design. It has been successfully employed in DC/DC converter applications in recent years and opened a way to design high voltage gain converters. Converters are the examples of VL technique implementations. However, the output voltage increases in stage by stage just along the arithmetic progression[1]. DC-DC converters are widely used in computer peripheral equipments and industrial applications.

Super lift converters [1] are a series of new DC-DC converters which were developed from prototypes using the voltage- lift technique. This converter implements the output voltage increasing in stage by stage along the geometric progression. It effectively enhances the voltage transfer gain in power series. They are different from any other existing DC-DC converters and possess many advantages including a high output voltage with small ripples[2].

II. OPERATION OF THE CONVERTER

For the purpose of optimize the stability of positive output elementary super lift Luo converter dynamics, while ensuring correct operation in any working condition, a PI control is a more feasible approach.

The PI control has been presented as a good alternative to the control of switching power converters. The main advantage PI control schemes is its insusceptibility to plant/system parameter variations that leads to invariant dynamics and static response in the ideal case.

A. Circuit Description and Operation

The positive output elementary super lift Luo converter is shown in Fig. 1. It includes dc supply voltage V_{in}, capacitors C_1 and C_2 , inductor L_1, power switch (n-channel MOSFET) S, freewheeling diodes D_1 and D_2 and load resistance R.

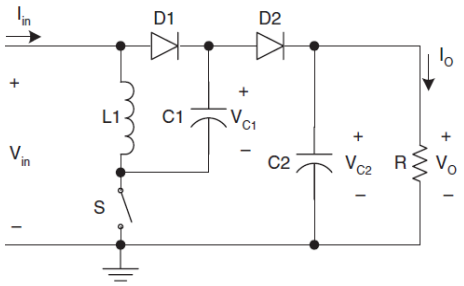


Fig. 1 The positive output elementary super lift Luo converter

when the switch S is closed, voltage across capacitor C_1 is charged to V_{in}. The current i_{L1} flowing through inductor L_1 increases with voltage V_{in}. when the switch S is closed, decreases with voltage.

III. PID CONTROLLER TUNING

A.Conventional tuning

Ziegler Nichols Method

The control system performs poor in characteristics and even it becomes unstable, if improper values of the controller tuning constants are used. So it becomes necessary to tune the controller parameters to achieve good control performance with the proper choice of tuning constants.

Controller	Kp	Ti	Td
P	Ku/2		
PI	Ku/2.2	Pu/1.2	
PID	Ku/1.7	Pu/2	Pu/8

B. AI Techniques

***B(i) Genetic algorithm*:**

GAs were introduced as a computational analogy of adaptive systems. They are modelled on the principles of the evolution via natural selection, employing a population of individuals that undergo selection in the presence of variation inducing operators such as mutation and recombination (crossover). A fitness function is used to evaluate individuals, and reproductive success varies with fitness.

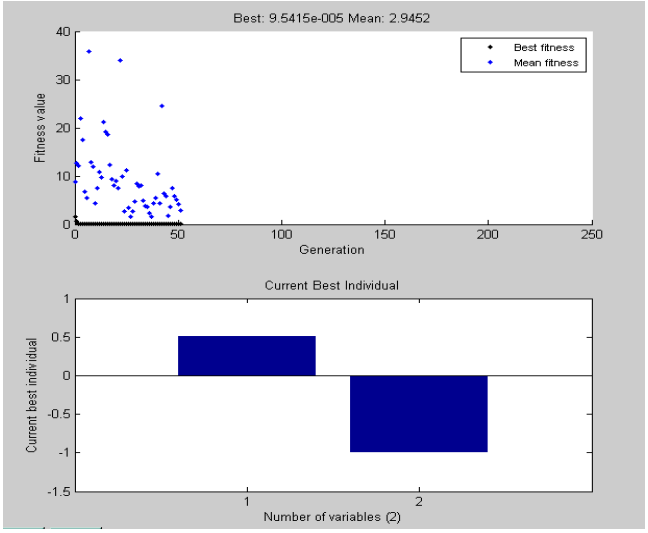
The advantage of the GA approach is the ease with which it can handle arbitrary kinds of constraints and objectives; all such things can be handled as weighted components of the fitness function, making it easy to adapt the GA scheduler to the particular requirements of a very wide range of possible overall objectives.

B(ii) Particle Swarm Optimization:

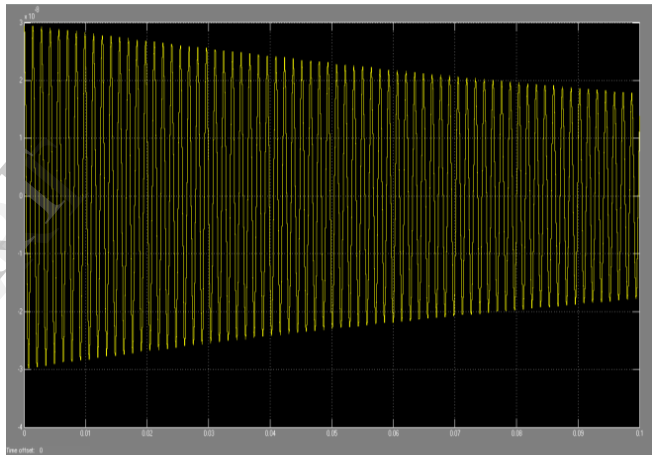
Particle Swarm Optimization (PSO) is a technique used to explore the search space of a given problem to find the settings or parameters required to maximize a particular objective. This technique originates from two separate concepts: the idea of swarm intelligence based off the observation of swarming habits by certain kinds of animals (such as birds and fish); and the field of evolutionary computation.

Getting the best solution from the problem by taking particles and moving them around in the search space. The system is initialized with a population of random solutions and searches for optima by updating generations. The particles fly through the problem space by following the current optimum particles.

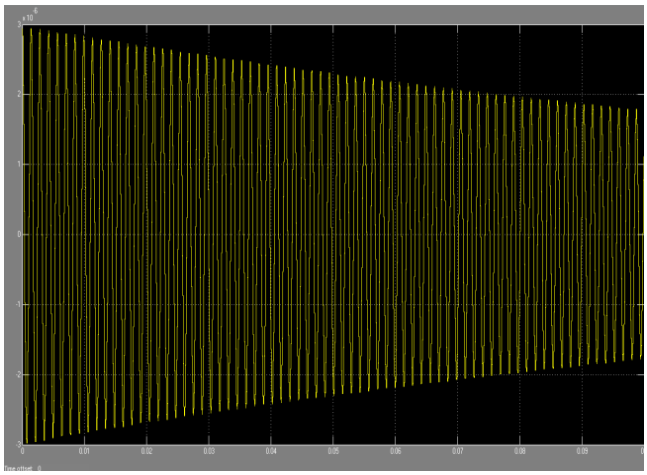
IV. SIMULATION RESULTS



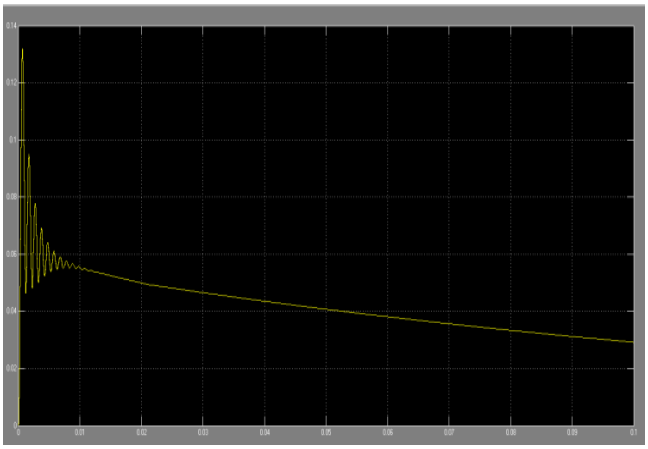
Output of GA



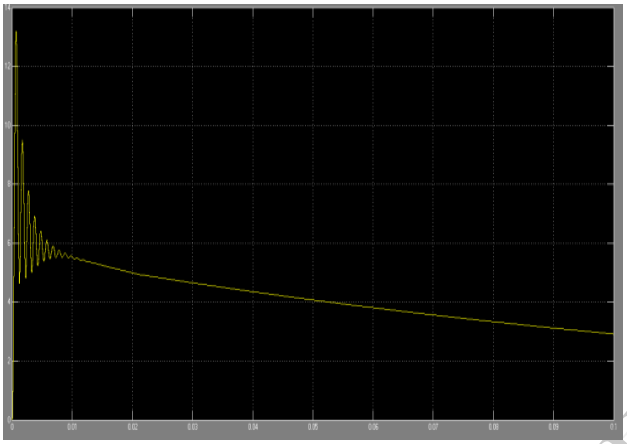
Output current waveform of GA



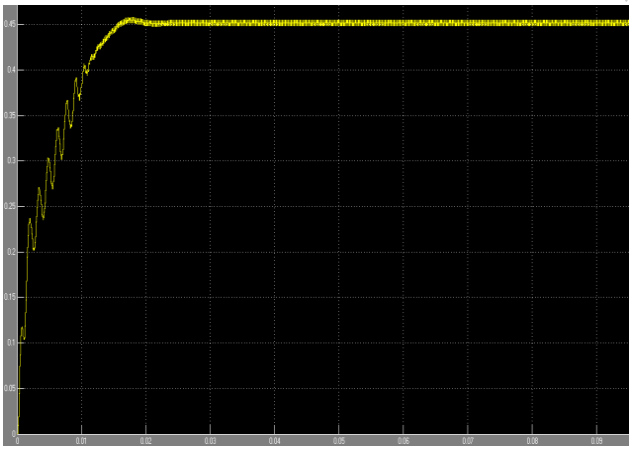
Output voltage waveform of GA



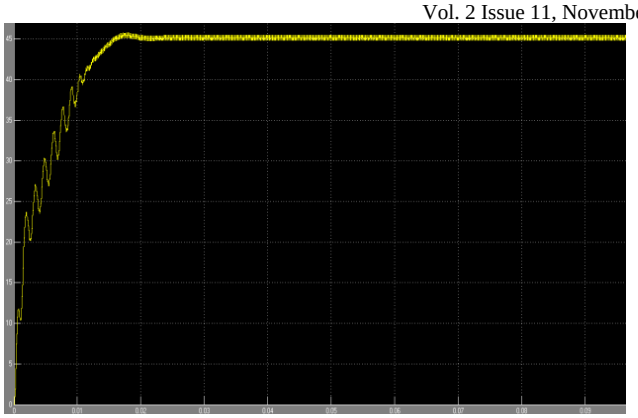
Output current waveform for PSO



Output voltage waveform for PSO



Output current waveform for Luo converter



Output current waveform for Luo converter

V. COMPARISON OF GA AND PSO

In both the techniques population based stochastic optimization. The algorithms start with a group of a randomly generated population have fitness values to evaluate the population. They update the population and search for the optimium with random techniques. GA employing a population of individuals that undergo selection in the presence of variation inducing operators such as mutation and recombination (crossover). A fitness function is used to evaluate individuals, and reproductive success varies with fitness. PSO does not have genetic operators like crossover and mutation. Particles update themselves with the internal velocity. They also have memory, which is important to the algorithm. Particles do not die and the information sharing mechanism in PSO is significantly different.

VI. CONCLUSION

A new series of DC/DC converters – Positive Output Super-Lift Luo Converters have been successfully created. After the comparison of AI techniques used the Luo converter provides the better efficiency and it effectively increases the voltage transfer gain in the power series was analysed and simulated.

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