Evolutionary Algorithm(EA) for Multi-Criterion Optimization:A Literature Survey

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Abstract -

The system level design methodology and synthesis is an important issue of concern among the researchers. Optimization of recourse constraints of system design is performed by various evolutionary algorithms and techniques. Evolutionary techniques have been used for the purpose of single-objective optimization for more than four decades. But gradually people discovered that many real world problems are naturally posed as multi-objective . Now a day's multi-objective optimization is no doubt a very popular area for both researchers and engineers. Since multi-criterion optimization requires simultaneous optimization of multiple often competing or conflicting criteria of objectives, the solution to such problems is usually computed by combining them into a single criterion optimization problem. But the resulting solution to the single objective optimization problem is usually subjective to parameter setting chosen by the user. Since for classical optimization method mostly pareto-optimal solution is found, So in order to find multiple pareto optimal solution, evolutionary algorithm is best choice, because it deals with a population of solutions. Choosing the parameters of our real world problem and finding the relation of these parameters with standard evolutionary techniques to find optimal solution of problem in multi objective scenario is concern of this survey paper. Creation of multi objective evolutionary algorithm is key to deal with finding optimal solution to problems having multiple objective. So in this type of problems the user is never satisfied by finding one solution that is optimum with respect to a single criterion.

Index Terms - Evolutionary Algorithm, Multi Objective Optimization, Pareto-Optimal solution, System level-design, single-criteria.

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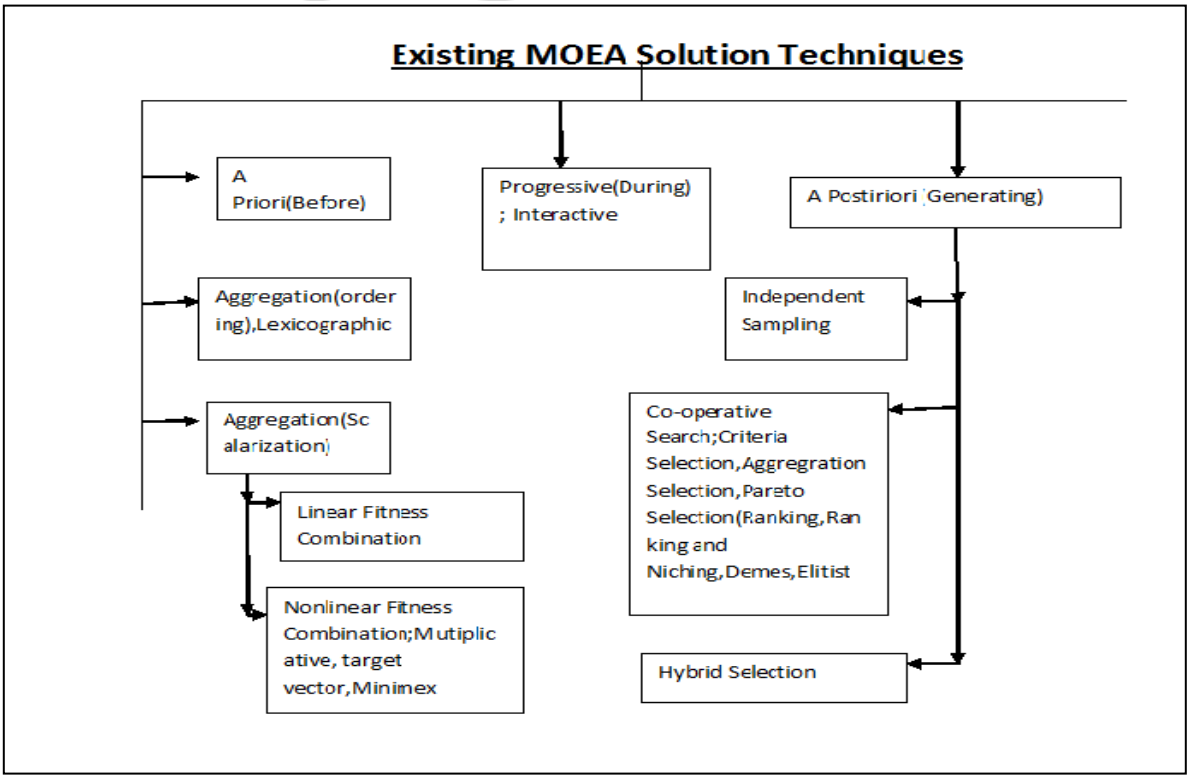
1 SALIENT FEATURE OF LITERATURE SURVEY

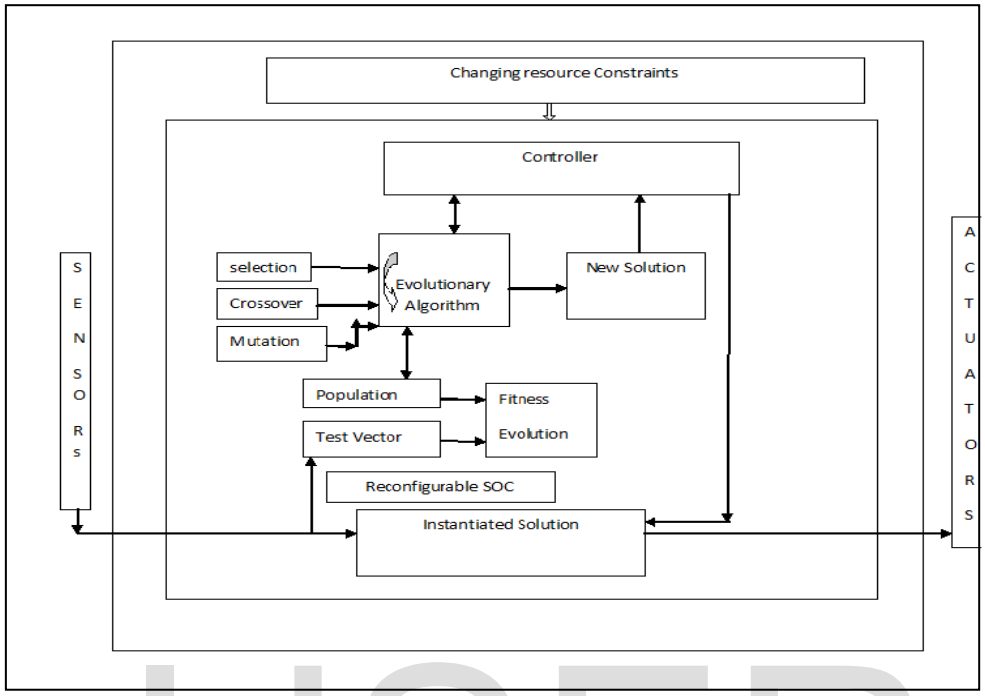
Many real world design task involve complex optimization problem with various

competing design specification and constraints, which are often difficult for real world constraint benefits of cost ,power handling ,memory utilization and speed. Review of popular evolutionary algorithm and their comparison show multi-objective selection criteria for embedded system design level is vary application to application and there is not any universal fitted algorithm for all design and real time problems. Initially Pareto multi-optimization is used to design and optimize embedded system in the design phase. **Figure(1)** shows a overview of existing Multi Objective Evolutionary Algorithm techniques.

Srinivas and Deb's Non-dominated sorting genetic algorithm(NSGA),[2] and some different approaches of evolutionary algorithms are competent upto single objective criteria. An approach to design and optimize embedded system in the design phase based on Pareto multi-optimization, developing code generation technology, how to select best tradeoff configuration of the embedded system architecture , hardware software partitioning embedded industrial application such as coprocessor design for mutual controlling of based on genetic algorithm(genetic algorithm are general purpose optimization and search technique), defining and developing domain specific language used to design architectural model of embedded system, method of system level embedded system optimization based on Pareto Principle, analyze and evaluate performance as well as power consumption to apply the genetic algorithm in optimizing the embedded software are surveyed in proposed work.

Work done on multi objective hardware evolution towards self adaptive embedded system by Paul Kaufmann and Marco Platzner (University of Paderborn) 2010 [35],is also surveyed. Here is a view of an architectural concept for an intrinsically evolvable embedded system**Figure(2).**





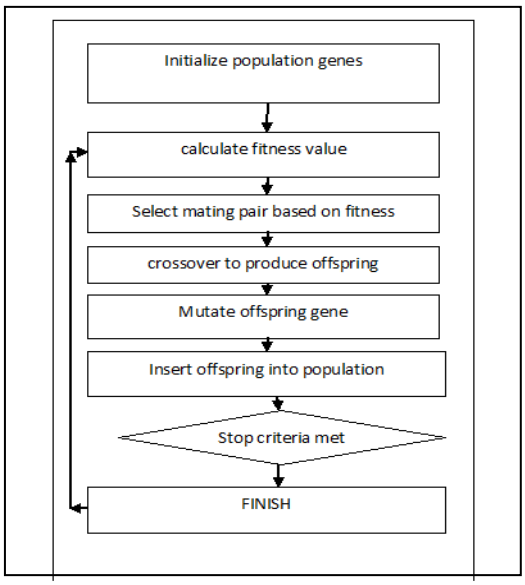
Architecture concept for intrinsic Evolution Figure (2)

This surveyed work has studied optimization problem of high level synthesis process and application of evolutionary algorithm in design space, proposing a framework on multi objective genetic algorithm to perform a design of self adaptive embedded system is proposed under research work. Addressing the problem of the efficient exploration of the architectural design space for parameterized embedded system design is surveyed.

Presentation of design space exploration framework to simulate the target system by Zaccaria , Gianluca Palermo, Cristina Silvan and Vittorio (Polytechnic, Milano ,Italy) 2005 is studied for developing multi objective design space exploration of embedded system design.

2 APPLICATION OF GENETIC ALGORITHM

Genetic Algorithm are one of the Evolutionary algorithm which are frequently using in computing of software engineering problem.



FLow Diagram for Genetic Algorithm Figure (3)

Genetic Algorithm is a very effective way to solve combination optimization problem. We can also use Genetic Algorithm to realize hardware software partitioning. A Multi-Objective Genetic Algorithm for Design Space Exploration in High-Level Synthesis is implemented by Fabrizio Ferrandi ,Pier Luca Lanzi ,Daniele Loiacono ,Christian Pilato (Department of Electronics and Information, Via Ponzio,Milano, Italy) IEEE 2008. In this paper Comparison and Suitability of evolutionary algorithm over already proposed approach in difficult explorations is done.

3 RESEARCH GAP

Although a lot of work has been done in MOEAs theory and application, But most of them has concentrated on application of conventional or ad-hoc techniques to certain difficult problems. Therefore, there are several research issues that still remain to be solved. Some of which are listed below.

1. Applicability of MOEA in more difficult real world problems. Some of those area are parallel evolutionary algorithm, Combination of evolutionary algorithm for complex system-level synthesis.

2. Choosing the best solution from Pareto optimal set.

3. Hybridization of multi-objective Evolutionary Algorithms on large scale test functions.

4. Although a lot of work has been done in this area but the theoretical portion is not so much exploited. So a theory of evolutionary multi-objective optimization is much needed, which will examine different fitness assignment methods in combination with different selection schemes.

5. The stopping criteria of MOGA is not up to the mark, because it is not obvious to understand when the population has reached a point from which no further improvement can be reached.

6. Further in future, there is a large scope to extend the dimension of the objective design space of target device to include timing analysis and scheduling issues. There is also a growing need for raising the level of abstraction in hardware design to simplify the design process and utilization of combining the encoding techniques and extension of methodology to analyze the impact of the control in final design.

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