DETERMINATION OF OPTIMUM PRESSURE ANGLE OF A CAM DESIGN AND ANALYSIS OF PROGRESSIVE TOOLS

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ABSTRACT- Cam size minimization is the process of selecting geometric parameters of a cam follower mechanism for the smallest possible size. If the pressure angle is exceeding its limits it may cause the following deleterious effects due to friction, crossover shock and track changing, follower jump, chatter and even to jam. To minimize these effects, the presser angle has to be optimized to obtain the suitable values. Numbers of optimization techniques are available to predict the optimum values of the given problem. In this work it has been proposed to use a non- traditional optimization techniques such as Genetic Algorithm (GA) to optimize the pressure angle of the cam. GA starts with a population of points rather than a single point and it is also advantageous in solving problems with multiple optima without repeating the method by number of times. In this present study, radius of cam, roller follower radius, stroke length of a follower and speed of the cam are considered as parameters. The "OOPS" concept is used to generate the optimized pressure angle of a roller- follower type cam (using C++ programming language). The result obtained from the GA has been compared with the analytical results and it has shown the more accurate value.

INTRODUCTION

A cam is a mechanism element that drives another element, known as the follower, through a specified motion by higher-pair contact, as the cam rotates the point of contact changes and consequently, so does the effective force transmitted to the follower. The common practice in the design of cam mechanisms is to find the optimum cam geometry that will enable operation within performance constraints moreover, since a large cam size implies large inertia forces that may result in high contact forces and stresses between the cam and the follower. It is an objective in cam design to include minimization of cam mass by reduction its size.

CAM NOMENCLATURE

Reproduction

Reproduction is usually the first operator applied on a population. It selects the good string in a population and forms a mating pool.

$$Pi = \frac{Fi}{\sum_{j=1}^{n} Fi}$$

Where F_i is the fitness of the i^{th}string and n is the population size.

The reproduction operator may be implemented in algorithmic from in a number of ways. The easiest way is to create a biased roulette wheel slot sized in proportion to its fitness. Let there be four strings in a population, their fitness and

Percentage of total fitness are as shown in the table

Table - Populations, Their Fitness And Percentage of Total Fitness

S.NO	STRING	FITNESS	% OF TOTAL FITNESS
1	01101	169	14.1
2	11000	576	49.2

APPLICATIONS OF GA

ENGINEERING&OPTIMUM RESEARCH	IMAGE PROCESSING &GA	HYPER TECHNIQUES
Mass-Spring-dashpot system identification with simple GA	Selection of detectors for known image classification	Traveling sales man problem via genetic-like operators
VLSI circuit comparison with GA	Search for image feature detectors via GA	TSP via knowledge-augmented genetic operators
VLSI circuit comparison with GA	String-encoded adaptive cross-over trial	Proposal to use GA to learn connectionist network topology
Structural optimization(plane truss) via GA	GA controlled by medieval GA	Knowledge-based genetic operators in the TSP
Blunt knapsack problem with simple GA	Application of progeny testing to GA selection	Globally modified adaptive representation technique(ARGOT)
Aircraft landing strut weight optimization with GA	Publication of ANAS	Connectionist algorithm with GA-like properties claimed.

UNCONSTRAINED OPTIMIZATION

Genetic Algorithms is ideally applied to unconstrained optimization problems, whereas our problem of minimizing the maximum pressure angle of the cam is a constrained optimization problem. So that problem is first converted to an unconstrained problem and the generations are carried out. The final result does not vary much between constrained and unconstrained problems. An unconstrained, two variable function are considered to discuss the traditional steepest descent methods and Non- traditional Genetic Algorithms

Minimize $f(X1, X2) = (X_1^2+X_2-11)^2+(X_1+X_2^2-7)^2$. Inthe interval $0 \le X_1, X_2 \le 6$

The function is modal with an optimum point as (3, 2). The optimum function value is equal to zero.

DESCRIPTION ABOUT THE PROBLEM

This problem consists of two major phases,

PHASE 1:

Roller follower cams in SHM without follower offset, and find the max-pressure angle.

PHASE 2:

Design optimization of roller-follower cam using genetic algorithm.

STEPS INVOLVED IN THE FIRST PHASE

Design parameter Input.

- Cam Radius
- Roller Radius
- Stroke Length
- Out-Stroke Angle
- Dwell Period
- Return-Stroke Angle
- Cam Shaft RPM

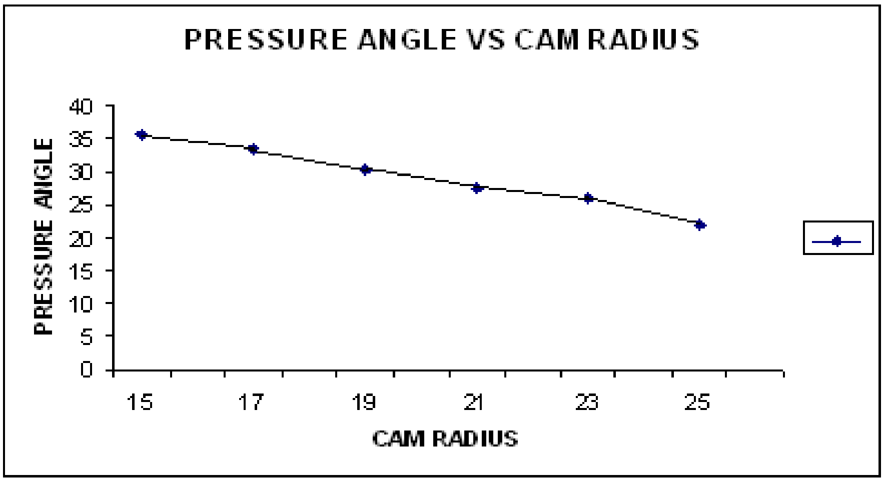
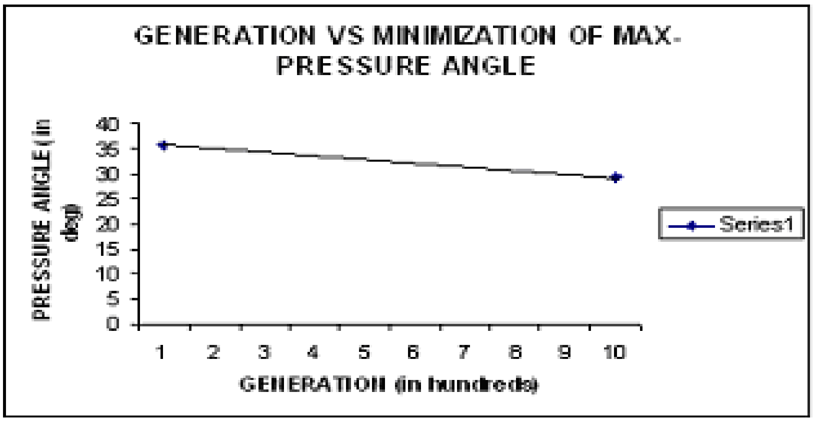


Figure Generation Vs Minimization of max-pressure angle



CONCLUSION

In the present work max-pressure angle of the roller follower cam in simple harmonic motion without offset is optimized by making use of Genetic Algorithm a power full non-traditional optimization tool. It is found that GA gives better result because its search is for global optimum as against the local optimum in traditional search methods. It can be concluded that by applying GA, the optimal design parameters for the motion planning and optimum design of cam mechanism were obtained and the objective is achieved with optimal cam radius and roller radius.

SCOPE FOR FURTHER WORK

The program of this project is designed for only to perform optimization for cam with roller follower in simple harmonic motion and with out follower offset. By adding proper function and required parameters to the program, the software can be made to perform optimization for any type of cams with all type of motions. Many engineering design problems involve simultaneous solution of multiple objective functions. In multiobjective optimization problems there exists a number of solutions which are optimum in some sense. Recently, a number of extensions to simple GAs have been tried to find many of such optimum points simultaneously until recently GAs were perceived as genetic tools use full for optimization of many hard problems. However, the need for the incorporation of the problem specific knowledge in Genetic Algorithms has been recognized. Classical GAs require a modification of an original problem into appropriate (suitable for GAs) form. This is not usually an easy task. So to overcome this problem the GAs are modified accordingly to suit the requirements of the problem to make the task simpler. Such types of modified GAs are called evolutionary problems. Further studies in the above areas would improve the robustness of the Genetic Algorithms.

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