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A NOVEL APPROACH FOR SOLVING GEAR TRAIN OPTIMIZATION PROBLEM

ABSTRACT: Gear train optimization is a constant subject of research with the goals of its adequate and justified use. One of the more important segments of optimization is the criteria of gear train volume. This paper is oriented on the analysis of the problem of decreasing gear train volume from a gear shaft axis position aspect. A heuristic approach has been developed for positioning shaft axes along a golden spiral contour, and the methodology for this alternative solution of optimization problems was defined. This approach represents an imitation of natural occurrences and development processes in nature. Nature itself achieves optimal processes, therefore this research started under the assumption of convergence towards optima. The process is verified on examples as functional, and results were compared to optimal solutions from literature. Achieved results of volume decrease are directly linked to savings, not only on space, but on housing material for the gear train, costs, speed of forming construction documentation, etc.

KEYWORDS: gear train, optimization, golden spiral, heuristic, novel method

INTERDUCTION

From a research and practical aspect, there is a need for constant improvement in theoretical and practical segments in order to justify the use of gear trains. As a basic problem is achieving better working characteristics, performances, in terms of mass, volume costs, etc. Chonget al.[1] presented a general methodology for optimizing gear ratios, sizes and housing volume for multi-stage gear trains in preliminary design phases. Marjanovic et al. [2] developed a practical approach to optimizing gear trains with spur gears based on a selection matrix of optimal materials, gear ratios and shaft axes positions.Golabi et. al [3] presented gear train volume/weight minimization optimizing single and multistage gear trains' gear ratios. Mendi et al. [4] aimed to optimize gear train component dimensions to achieve minimal volume comparing GA (genetic algoritam) results to analytic method parameter volume. Savsani et al. [5] described gear train weight optimization comparing various optimization methods to genetic algoritam (GA) result values. Gologlu and Zeyveli [6] performed preliminary design automation through optimization of gear parameters and properties using a GA based approach. Pomrehn and Papalambros, [7]optimized gear train volume varying gear thicknesses, distances between centers, pitch diameters, number of teeth, ratios, etc. for a specific four stage setup. Deb and Jain[8] used similar principles for optimizing multi-speed gearboxes using multi-objective evolutionary algorithm optimizing volume in relation to power.

In order to facilitate improvement in this field, a great deal of experience and use of novel and alternative methods is required. Optimization presents a way of effectively achieving desired characteristics of gear trains. This paper is concentrated only on gear trains with parallel shaft axes. Aside from knowing reducer construction, the processes

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