STM JOURNALS

Journal of Materials & Metallurgical Engineering
ISSN: 2231-3818(online), ISSN: 2321-4236(print)
Volume 5, Issue 3
www.stmjournals.com

Optimization of Dynamic Load Carrying Capacity of Rolling Contact Bearing by Using TLBO Technique: A Review

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Abstract

Rolling contact bearings are widely used in machinery. To deliver excellent performance, the rolling contact bearing has to work efficiently with constraints like strength, long life and high reliability. This work is to optimize the dynamic load carrying capacity of rolling contact bearing for efficient performance. Objective function is to maximize dynamic load carrying capacity with given parameters and constrains and Teaching-Learning Based Optimization (TLBO) technique is selected for the optimization. This method works on effect on learner of teacher.

Keywords: *Rolling contact bearing, dynamic load carrying capacity, TLBO*

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INTRODUCTION

Rolling contact bearings are mostly used in machinery and have large range of applications in the mechanical and aerospace engineering. Rolling contact bearing has much lower friction than sliding contact bearings so they were referred to as antifriction bearings. Rolling contact bearings are available in a large variety to support radial and thrust load. In rolling contact bearing the rolling elements can be balls, rollers. Rollers can be cylindrical, spherical and conical.

LITERATURE REVIEW

Very large amount of work has been done to improve performance of rolling contacts bearing but less research has been carried out on optimization of rolling contact bearing. Shantanu Gupta [1] has optimized three basic objectives the dynamic load carrying capacity, static load carrying capacity and elasto-hydrodynamic minimum film thickness for rolling contact bearing. They optimized them separately as well as pair-wise by taking NSGA II algorithm which is an advanced multiobjective optimization algorithm. Rajeswara Rao [2] took maximum fatigue life as objective function and constrains are based on kinematics. Design variables were; number of rolling elements, bearing pitch diameter, diameter of rolling element and inner ring and outer-ring groove curvature radius. Rao [3] have found new efficient optimization method, called "Teaching-Learning-Based Optimization (TLBO)", is proposed by them for the optimization of mechanical design problems. They tested this method on four different general mechanical design problems, five different constrained general test functions having different characteristics and six mechanical design optimization problems which are widely used in real world applications. Rao [4] has proposed an optimization method to find global solutions of optimization problems which are nonlinear called Teaching–Learning-Based Optimization (TLBO).

The effectiveness of the TLBO was tested by taking benchmark problems with various characteristics and then they compared the outcomes with other optimization techniques. They also consider the criteria like mean solution, convergence rate, success rate, average functions evaluations required to make performance effective. They proved that TLBO shows better performance of TLBO. R. Venkata Rao [5] has carried out the parameter optimization of a multipass turning operation using the teaching-learning-based optimization

algorithm. They considered two different examples based on previous research but they used different optimization techniques. The first example taken by them was a multiobjective problem and second example was a single objective, multiconstrained problem with 20 constraints.

The performance of the TLBO algorithm is compared with other optimization methods by considering convergence rate and accuracy of the solution. R. Venkata Rao [6] have considered mathematical models of three important casting processes namely continuous casting, squeeze casting and die casting to optimize parameters of respective processes. With suitable example containing respective process parameters, each process was described by them. Venkata Rao [7] has carried out research on two stage thermoelectric cooler (TEC).

To optimize parameters they considered multiobjective algorithm with two separate arrangements of the thermoelectric cooler. Coefficient of performance and maximization of cooling capacity of the thermoelectric cooler were taken as the objective functions. Venkata Rao [8] has studied different examples of modern machining processes. By using TLBO algorithm they optimized parameters of processes like ultrasonic machining (USM), abrasive jet machining (AJM) and wire electrical discharge machining (WEDM).

Ajinkya Karpe [9] has created a three dimensional model of the roller ball bearing in ANSYS workbench. They did the contact stress analysis between the balls and the races. They fixed the outer race and put the inner race under rotation from the shaft and also gave radial loading. TANG Zhaoping [10] made a 3 Dimensional model of deep groove ball bearing using ANSYS APDL. The simulation results of ANSYS by them have proved that theoretical values and the computational values are consistent.

CONCLUSION

The constrained based optimization problem for rolling contact ball bearing to optimized dynamic load carrying capacity can be solved by using Teaching-Learning Based Optimization Technique. Dynamic load carrying capacity will be taken as objective function and constrains can be generated by considering different design parameters affecting dynamic load carrying capacity. Then results will be compared with other optimization methods.

REFERENCES

1. Shantanu Gupta, Rajiv Tiwari, Shivashankar B. Nair, Multi-objective design optimization of rolling bearings using genetic algorithms, *Science Direct, Mech Mach Theory*. 2007; 42: 1418–1443p.
2. Rajeswara Rao B, Rajiv Tiwari, Optimum design of rolling element bearings using genetic algorithms. *ScienceDirect, Mech Mach Theory*. 2007; 42: 233–250p.
3. Rao RV, Savsani VJ, Vakharia DP, Teaching–learning-based optimization: A novel method for constrained mechanical design optimization problems, *Elsevier, Comput Aided Design.* 2011; 43: 303–315p.
4. Rao RV, Savsani VJ, Vakharia DP, Teaching-learning-based optimization: An optimization method for continuous non-linear large scale problems, *Elsevier, Inform Sciences*. 2012; 183: 1–15p.
5. Venkata Rao R, Kalyankar VD, Multi-pass turning process parameter optimization using teaching– learning-based optimization algorithm, *Science Direct, Scientia Iranica E* 2013; 20 (3): 967–974p.
6. Venkata Rao R, Kalyankar VD, Waghmare G, Parameters optimization of selected casting processes using teaching–learning-based optimization algorithm, *Science Direct*, doi:10.1016/j.apm. 2014. 04.036.
7. Venkata Rao R, Vivek Patel, Multi-objective optimization of two stage thermoelectric cooler using a modified teaching–learning-based optimization algorithm, *Science Direct, Eng Appl Artif Intell.* 2013; 26: 430–445p.
8. Venkata Rao R, Kalyankar VD, Parameter optimization of modern machining processes using teaching–learning based optimization algorithm. *ScienceDirect, Eng Appl Artif Intell*. 2013; 26: 524–531p.

9. Ajinkya Karpe, Sainath Karpe, Ajay kumar Chawrai, Optimization of thicknesses of inner and outer races of a deep groove ball bearing using Fem (Ansys), *IJIRAE*, ISSN: 2349-2163.
10. TANG Zhaoping, SUN Jianping, The contact analysis for deep groove ball bearing based on ANSYS, *ScienceDirect, Procedia Engineering* 2011; 23: 423–428p.

Cite this Article
Pritesh J Thoriya, Biren J Saradava, Prasad S. Puranik. Optimization of dynamic load carrying capacity of rolling contact bearing by using Tlbo technique: A review. *Journal of Materials & Metallurgical Engineering.* 2015; 5(3): 41–43p.

