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Optimal Design of Engineering Problems and Radial Basis Function Kernel Application

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Abstract—The aim of this paper is the application of Geometric programming (GP), and Lingo software for optimization of practical engineering problems and sensitivity analysis of such problems. The first part of the study is the basic definitions of the GP method and some rules for changing engineering problems to the standard form of GP. Sensitivity analysis was performed and to do this, the coefficients of the objective function and constraints were changed percent and the optimal response and optimal design parameters to these changes were evaluated. In the sensitivity, analysis for a series of changes in the coefficients, the optimal response to these changes will remain constant is very important. For validation and more evaluation, the results of the GP and Lingo software were compared with Lagrangian multipliers method (LMM). The result of this comparison shows the GP to be an efficient, powerful, and reliable method for optimizing linear and nonlinear problems and Lingo to be an easy and suitable program for finding optimal values and analyzing the solutions to engineering problems. The support vector machine (SVM) was used to predict vertical height (h), mean diameter and minimum weight of truss. After successful trials, the method predicted the abovementioned outputs with high precision.

I. INTRODUCTION

Many very practical design opportunities and engineering problems can be formulated as optimization issues in the form of linear and non-linear programs. The high percentage of these linear and nonlinear programming can create an algebraic form .Geometric Programming is a relatively new optimization technique to optimally solve nonlinear programming problems, which invented by Richard Duffin, Peterson and Clarence Zener [١, ٢]. The method is one of the powerful and relatively easy methods for solving nonlinear problems in the form of of exponential or power function [٣]. This approach emerged in the 1960s and has seen remarkable progress in recent years. A major application of GP involves solving engineering problems, while its major disadvantages that it requires an objective function and constraints in the form of posynomials. The first step to optimizing and solved the problems by the GP method is to determine its degree of difficulty and then solve it [٤, ٥]. It should be noted that the degree of difficulty of the problem is high; in this case, its solution is relatively difficult. GP method is different from other optimization methods in emphasis on the relative values in terms of the objective function rather than the variables. First, instead of finding optimal values for design variables, GP initially determines the desired value of the target function. This feature is especially useful in situations where the desired value of the target function may be of interested. In this section, we will