UNIVERSITY OF WEST BOHEMIA

Applied and Computational Mechanics 1 (2007) 461 - 468

Applied and Computational Mechanics

Synthesis of dexterity measure of mechanisms by evolution of dissipative system

M. Grešl [a], Z. Šika [a,*], M. Valášek [a]

[a] *Division of Mechanics and Mechatronics, Department of Mechanics, Biomechanics and Mechatronics, Faculty of Mechanical Engineering, CTU in Prague, Karlovo náměstí 13, 121 35 Praha 2, Czech Republic*

Received 7 September 2007; received in revised form 10 October 2007

Abstract

The paper deals with the new approach of solving traditional kinematical synthesis of mechanisms. The kinematical synthesis is reformulated as nonlinear dynamical problem. All searched parameters of the mechanism are in this dynamical dissipative system introduced as time-varying during motion of mechanism's dimension iteration. The synthesis process is realized as the time evolution of such system. One of the most important objectives of the machine synthesis is the dexterity measure. The new approach is applied to optimization of this property.

Keywords: synthesis, optimization, dexterity, nonlinear dynamic

1. Introduction

Mechanical synthesis is necessary method that is used during design of mechanism. This method gives the optional kinematical parameters of a designed mechanism. Solution of such difficult task usually requires large amount of iterations. The current applied methods are either very specific for simple mechanisms or they are based on iterative solution of kinematical description of mechanism's motion in certain limited number of so called precision points or they are based on more general methods of optimization approaches, recently using evolutionary methods like genetics algorithm (e.g. [3]).

The general synthesis methods seem to be enough powerful and to find the solutions for all problems. They are based on performing mechanism's synthesis rely on an attempt to redefine the dimensions of the system in such a way that a deviation from the desired behaviour is minimized by the use of optimization methods. However, all current methods suffer from two related problems. The first problem is that the proposed dimensions of the mechanism being synthesized do not allow the mechanism assembly in all positions required for the desired motion. The second problem is that if a mechanism's synthesis iteration fails for certain parameter because of constraint and/or assembly violation the whole knowledge from this iteration is lost. Moreover the mechanism's synthesis requires different properties during different motion phases and this selective knowledge from different motion phases is not available from one parameter setting for the whole motion. The solution of the first problem has been proposed by the usage of time-varying dimensions during motion of mechanism's dimension iteration [2]. However, this scheme requires large amount of iterations.

*Corresponding author. Tel.: +420 224 357 452, e-mail: zbynek.sika@fs.cvut.cz.