Optimization of the link drive mechanism in a sewing machine using imperialist competitive algorithm

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Abstract

Purpose – The purpose of this paper is to present, an optimization problem based on the imperialistic competitive algorithm (ICA) approach for optimizing the needle velocity and variation of needle acceleration in a link drive mechanism of a sewing machine. The optimal geometry of the link drive has been achieved using a non-linear optimization procedure.

Design/methodology/approach – As an important study in this case, the authors might refer to a previous work in which they introduced the possibility of replacing the slider-crank mechanism, that is typically used in sewing machines, with a link drive mechanism. The authors regenerate the optimization problem by modifying the objective function and follow a novel optimization method based on the ICA to overcome the drawbacks of that work. In addition, further modification of the objective function with respect to the variation of needle acceleration is applied to assure smooth movement of the needle during sewing process.

Findings – The results showed a significant improvement with respect to the optimization of needle velocity and variation of needle acceleration in comparison to that previous work. This clearly justifies the efficiency and reliability of the optimization formulation based on the ICA approach.

Originality/value – Needle temperature is considered as an effective parameter on sewing process efficiency and stitch quality. Needle heat generated during sewing process is directly related to needle velocity in penetration zone which in turn depends on the needle driver mechanism of sewing machine. According to literature survey, few researches have focussed to design a driver mechanism of the sewing machine to reduce the generated needle heat. This mechanism has the ability of reducing the penetration velocity of the needle without affecting sewing speed which consequently can reduce the needle heat generated during needle penetration. The work here is novel regarding implementation of optimization algorithm for this mechanism.

Keywords Optimization, ICA, Link drive mechanism, Needle velocity, Sewing machine

Paper type Research paper

Introduction

Textile engineering and its applications to many industrial categories has found a great attention during recent years. This subject has already exceeded traditional applications related to textile production and clothing manufacturing. Nowadays, textile engineering is considered as a multidisciplinary subject which involves several technical fields ranging from mechanical engineering, chemistry, computer modeling, robotics, to electrical engineering. In this context, development of new sewing machines with high level of mechanical performance is of great importance. In many manufacturing processes, sewing is commonly used for joining different parts. Consequently, small improvements in the design and development of sewing machines would result in significant economic gain (Mallet and Ruxu, 1999). However, the basic

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