Universitatea *Transilvania* din Braşov

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HABILITATION THESIS

SUMMARY

Title: RESEARCHES ON THE SOLUTIONS USED TO INCREASE THE EFFICIENCY OF THE MECHANICAL SYSTEMS

Domain: Mechanical Engineering

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SUMMARY

The habilitation thesis presents my own research activities achieved after the public presentation of my PhD thesis, for the period of 2003 – 2019. The research activities are oriented in the field of the solutions used to increase the efficiency of the mechanical systems. Practically, the aim of these solutions is to identify solutions to use and to design mechanical systems with overall and components small dimensions, with small transient periods and with increased efficiency.

By increasing the efficiency of the mechanical systems, it is reduced the materials and the energy consumption and the use period of the mechanical systems is increased (by accomplishing the conditions of functionality and of the mechanical strength).

According to these, the habilitation thesis presents the research activities oriented about two directions:

- the modelling and the functional analysis of the tracking systems;
- researches on the functional – constructive aspects of the mechanical transmissions.

The purpose of the first research direction is to perform the static and the eigen value modelling and analyses, the modelling of the control systems in order to achieve the mechanical strength and the functionality conditions for the tracking systems; the researches are focused on the reducing of the materials consumption and the transient periods.

The second research direction is focused on obtaining small overall dimensions of the mechanical transmissions, on identifying their functioning condition, on identifying the materials of some components in order to gain higher efficiencies and higher functioning periods. According to these, there are performed studies on the friction from the ball bearings, on the constructive aspects of the V-belt and chain drive transmissions and on the friction between the tensioning guide and the chain.

The researches from the habilitation thesis are presented, for each chapter, in the next steps.

The **chapter I.1** presents the modelling and functional analysis of the PV panels tracking systems. First, there are presented some constructive solutions, by indicating the criterias which are on the base of choosing process of the actuators and of the bearings mountings; it is presented the calculus methodology of the loads which are acting on the actuator and on the bearings. After presenting some theoretical aspects of the modelling with the finite elements method, the static and the eigen value analyses are performed. In the next step, the control system is modelled and the dynamic analysis is simulated for a two degrees of freedom tracking system. There are presented conclusions regarding the mechanical strength and the free frequencies of the structure and regarding its transient periods and its positioning errors.

Chapter I.2 presents the functional modelling and analysis of solar collectors tracking systems, by indicating, at the beginning, some constructive solutions. The control system is modelled for a one degree of freedom tracking system. The conclusions are based on the results offered by the dynamic simulation of the tracking system and are focused on the transient periods and on the positioning errors.

Chapter I.3 presents the conclusions.

Chapter II.1 presents the functional analysis of the ball bearings and is focused on identifying the constructive variants and the functioning conditions in order to obtain small friction loses. Comparatively, it is studied the friction in the radial ball bearing, in the two rows radial ball bearing, the sealed radial ball bearing and the angular ball bearing. By performing tests, it is determined for each ball bearing, the variation of the friction torque with the radial load and with the rotation of the inner ring. By using the results from the tests and by using the finite element analysis, is determined the variation of the contact pressure with the radial load and the inner rings rotation. There are presented conclusions which indicate the bearings typology and the functioning conditions with high efficiencies.

The functional and constructive analysis of the V-belt transmissions is presented in the chapter II.2. It is presented the design calculus of these transmissions and the equivalent stresses are determined by using the finite element analysis. There are identified the constructive solutions with small overall dimensions and small equivalent stress at high loadings.

Chapter II.3 presents the functional and constructive analysis of the chain drive transmissions. First, an analytically analysis of the constructive elements for the chain drive transmissions is presented; in the next step is presented the local pressures from the guide/link contacts analysis with the finite elements method. In the next step it is presented the tribological modelling of the pressures distributions on the chain links. The aim of all of these studies is to find out the constructive solutions with small overall dimensions. There are presented tests which are used to find out some material parameters of the guides active part. Finally it is studied, by performing tests, the friction phenomenon in the contact between the tensioning guide and the chain link.

The study of the friction in the steel/polyamides contacts is presented in chapter II.4. In the first part, there are performed tests which are studying the friction in the contacts between the chain link and the PA66 and PA46 polyamides, as materials which are used to design the active part of the tensioning guide. As results, there are presented the studies of the wear and of the friction coefficient under different loadings, speeds, temperatures in lubricated or dry conditions. Finally there are studied new type polyamides (Teflon (PTFE) modified). There are presented the functioning conditions for all the tested materials which assure high efficiencies.

Chapter II.5 presents the conclusions.

Chapter B2 presents the profesional career development plans.