Universitatea *Transilvania* din Braşov

HABILITATION THESIS

SUMMARY

MODELS FOR THE STUDY OF MECHANICAL RESPONSE OF THE SOLIDS AND SYSTEMS OF SOLIDS

Domain: MECHANICAL ENGINEERING

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BRASOV, 2015

SUMMARY

Habilitation thesis “Models for the study of mechanical response of the solids and systems solids“ reflects a decade of research conducted by the author in Mechanical Engineering with an emphasis on dynamic analysis methods of mechanical systems and materials.

In the thesis I present briefly the original contributions, disseminated through papers published in indexed ISI Thomson journals, resulting from scientific research conducted at the University "Transilvania" of Brașov, after 2006 when I defended my PhD thesis.

The first chapter covers the researches of the author, in the last five years, in the field of the dynamics of multibody systems with rigid or elastic elements. The research started from practical needs that led to the problems raised by industry. The author tries to give an answer to these problems. One of problem studied was the transmission of the energy in small wind pumps, highly topical theme and with interesting potential practical developments. The study of this problem has led to involvement in the study of mechanical systems with two degrees of freedom and has led to difficult problems of modeling and numerical analysis.

It was made a numerical study of the proposed system and the equations of motion obtained were integrated. The theoretical results were verified by experimental tests using the records of the mechanism in motion. It made a stand on a small scale on which it made necessary records.

Chapter 2 presents in a first step the known results in dynamic analysis of multibody systems with liaisons and researches undertaken by the author in this field. The problem is of great practical interest because the assumption of rigid elements, used frequently in the study of mechanical systems, often does not correspond at high speeds involved and with the considerable forces occurring in operations.

For this study the Finite Element Method is used, but which takes into account the relative movement of the mobile reference systems relating to elements in motion. The first step in analyzing the dynamics of such a system is writing equations of motion. For every type of finite element used the chosen shape functions will determine the final form of the equations.

It is assumed that the small elastic deformations of deformable elements will not affect the general movement, rigid, the whole system. The major difficulty in studying such issues is strong nonlinearity of the equations of motion obtained. To make the integration, the motion is considered “frozen” for short periods of time; the system of equations can be considered a system of differential equations with constant coefficients.

I have shown remarkable properties of the equations of motion, properties that allow a qualitative analysis of systems of equations studied. For writing equations of motion Lagrange equations are used. Coriolis effects causes additional terms in the equations that can lead to instability phenomena of motion.

Chapter 3 of the thesis deals with a new line of research on the study of the mechanical properties of composite materials.Because the composite materials is an interdisciplinary field and more than a stable connection between disciplines such as chemistry, physics or engineering, experience of this is essential for the development of new materials with well-defined applications. Triangle: synthesis and manufacture - composition and structure - properties and performance are essential relationships in composite materials. The properties of a given material composition depend to a large extent on the method by which it was made, which are the consequence of different structures. Conversely, special applications require specific structural

properties and therefore a precise composition, which involves the synthesis and manufacturing processes accordingly.

The idea of using composite materials not only reduces simply replacing metal or other composite materials but also to make constructive use of these materials, taking into account the special properties and possibilities of obtaining to create innovative structures, new forms , to be used for private construction.

Chapter 4 shows a combination of experimental techniques and theoretical methods to understand the radiation effects they have on materials. Basically it will exhibit different composite materials to controlled doses of radiation using IRASM facility within IFIN-HH, achieving high structural performance, static and dynamic, the development of composite materials with enhanced properties

They are able to produce, through interaction with the atoms of the substance traversed (irradiated), the phenomenon of ionization. X-rays with energy greater than 100 keV is strongly absorbed by the substance, while the hard X-rays (energy greater than 200 keV) and gamma radiation can pass through a considerable thickness of the material, when their absorption is much lower.

Under the action of ionizing radiation, chemical and polymer undergoes profound structural transformations, change their chemical composition, structure and all the physicochemical and mechanical properties. Irradiation may affect adversely the characteristics of both materials, in this case we are talking about damage by radiation and, positive, leading to an improvement in certain properties.

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