Universitatea *Transilvania* din Braşov

HABILITATION THESIS

SUMMARY

RESEARCH CONCERNING OPTIMAL ROBUST DESIGN AND PNEUMATIC MUSCLE BASED ACTUATION OF SYSTEMS

Domain: Industrial Engineering

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(A) SUMMARY

The habilitation thesis presents the main research activity conducted by the author after obtaining her PhD in December 2005. The main fields addressed in this period were:
1) Optimisation of surface processing by lapping by means of robust parametric design and
2) Industrial robot and medical recovery equipment actuation systems based on pneumatic muscles. The greater part of research activity was carried out in the *Manufacturing Systems Robust Design Laboratory* and in the *FESTO Fluidic Actuation and Automation Laboratory* of the Department of Industrial Engineering and Management within the Faculty of Technological Engineering and Industrial Management of Transilvania University of Braşov.

Chapter 1, *Justification of the Habilitation Thesis* presents in short the financing modality of the research and of the dissemination of results. Further presented are the professional and transversal competences acquired by the author over the last years, and the wish to tutor young PhD researchers is outlaid and motivated.

Chapter 2 titled *Professional Evolution and Competences of the Candidate* describes the author's professional path since graduation from university to date. Her teaching activity is outlined with an emphasis on the international recognition materialised by participation in numerous teaching assignments in Europe within the Erasmus programme. Further the research activity is presented in short, including the contracts in that the candidate participated as contract director or team member. The national and international recognition of her research is outlined as reference is made to volumes published by collectives authors abroad or at prestigious national publishing houses. Also mentioned are the two applications for invention patents, as well as the activity conducted in parallel as coordinator of a department at central university level.

Chapter 3 of the thesis, titled *Robust Systems Design* consists of an overview of the candidate's involvement with reducing the dispersion of the values of product and manufacturing process characteristics both during the design phase (off-line) and during production (on-line). Robust Design is a method that lends itself for this purpose and offers efficient tools for obtaining 6σ type quality in all stages of product development. The robust design of processes yields consistency of quality, consequently to reducing the scattering of the values of quality characteristics. After presenting the basics of robust design, the author highlights her own contributions in this area of research. The improvements are presented brought to the computer programme developed for the robust optimisation of a part surface lapping system. In the same direction of robust design further presented is an original methodology for the computation of the dynamic signal-to-noise ratio.

The determination of the dynamic signal-to-noise-ratio is useful in the development of new technologies and products, as well as in measurement, when there exists a well-defined relation between the output quantity of a measuring instrument and the assessed quality characteristic. The advantage of determining the dynamic signal-to-noise ratio consists in its allowing the optimisation of the analysed system based on a function, as opposed to a previously set valued. The optimisation of the system is obtained by the generation of a set of output quantities.

Chapter 4 titled *Pneumatic Muscle Based Actuation Systems* represents the largest part of the thesis and highlights the author's scientific concerns over the last years. The presented results were obtained in conceiving new systems for industrial robots and medical recovery equipment, all having pneumatic muscle based actuation as their common denominator. Due to the novelty of pneumatic muscles, their performance and behaviour was the object of many detailed studies and published papers.

The presented examples of achievements in this direction of research, all including pneumatic muscle based actuations are the conceived rotation and translation modules, the rehabilitation equipment for the lower limb bearing joints, as well as a new variant of gripper system. For all these products the constructive diagrams and obtained performance are presented.

The last chapter of the habilitation thesis, *Plans for the Evolution and Development of the Professional, Scientific and Academic Career* presents the future avenues of research and directions of teaching activity. Regarding the future research, the author will continue the studies concerning pneumatic muscle implementation in various products with applicability in the construction of rehabilitation equipment for the upper limbs. Concerning robust optimisation of systems the author envisages the development of a new software application for the computation of the dynamic signal-to-noise ratio.

The teaching activity is planned to pursue its current coordinates, with the intent of developing and introducing a new course module of *Compliant actuation systems* within the *Innovative Manufacturing Engineering* Master Course. Also continued will be the publishing activity of teaching materials for students, as well as participating in teaching activities at European universities.