



Fundamental field Engineering Sciences
Specialisation Industrial Engineering

HABILITATION THESIS

- ABSTRACT -

**Contributions on product and process design with applications in
industrial and medical robotics**

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- Cluj-Napoca -
2022

The habilitation thesis entitled "*Contributions on product and process design with applications in industrial and medical robotics*" presents my main achievements and scientific, professional, and academic results that followed the obtaining of the doctorate in 2012, as well as my career development plans.

Therefore, the present habilitation thesis was carried out by Assoc.Prof.eng. Bogdan Mocan, PhD from the Technical University of Cluj-Napoca, Department of Design Engineering and Robotics, for obtaining the qualification in accordance with Romanian legislation. The paper is structured in two large sections, to which are added the Introduction, Conclusions and Bibliography.

The first section refers to the scientific, professional, and academic achievements of the author since obtaining his doctorate in March 2012, in the field of Industrial Engineering and Management. The first section is in turn divided into thematically homogeneous chapters and subchapters. The first section highlights the results obtained by the author of this thesis in teaching, science and academic management, results obtained in the two major directions in which the author conducted research: 1. Design of industrial robotic systems to increase business sustainability and 2. Design of mechatronic and medical robotics systems to increase the performance of the medical act.

The second section highlights Career Development and Development Plans. This section is also divided into thematically homogeneous chapters and subchapters: 1. Development of the teaching and professional component; 2. Development of the scientific and research component; 3. Correlation of the research activity with the didactic activity.

Therefore, the habilitation thesis highlights the research activity and the results obtained by the author in the period elapsed since obtaining the title of Doctor of Engineering, March 2012, and the present moment. The results are highlighted and narrated in detail, each subchapter detailing the scientific results obtained.

From a structural point of view, the results obtained during this period are highlighted in the habilitation thesis through case studies, which resulted from the implementation of various research projects carried out as director or project member in various scientific fields, industries, or companies. Also, some of the case studies highlighted were ideas developed as proposals for research projects submitted in various national and international competitions and which so far have not been funded. The various topics and directions of research addressed during this period are interdisciplinary, and points of strong convergence are identified between the directions addressed. The two main directions of research approached during this period are interdisciplinary, identifying many points of convergence between them.

Thus, the *Introduction* chapter presents a short argument of the author regarding the development of the habilitation thesis from the perspective of the accumulated experience and the developed research vision, based on the achievements obtained in the last ten years, since receiving the doctorate.

Chapter 1 of the first section highlights the scientific, professional, and academic achievements of the author in the period of ten years since obtaining the doctorate and until the moment of defending this habilitation thesis.

Chapter 2 presents the research direction "Industrial Robotics - Designing Industrial Robotic Systems to Increase Business Sustainability" and is structured in four sub-chapters that highlight the research topics addressed and the results obtained. Subchapter One presents the author's research on "Intelligent Man-Robot Interfaces for Intuitive Programming of Industrial Robots", the second subchapter highlights approaches to "*Redesign of a gripping device for palletizing in order to reduce its mass*", the third subchapter deals with "Customizing the configuration of robotic systems using the concept of "product-service" and augmented reality",

and the fourth subchapter presents “Design and development of a process management information system to support the development of innovative products within SMEs in the context of new global challenges”.

Chapter 3 presents the research direction "Medical Robotics - Design of mechatronic and robotic medical systems to increase the performance of the medical act" and is structured in two sub-chapters that highlight the research topics addressed and the results obtained. Subchapter One presents the research conducted by the author on the development of a "Laparoscopic compatible sensory device for the accurate detection of small gastric and colorectal tumors", for which a patent was obtained, and the second subchapter highlights stages of “Design, modelling and control of the robotic exoskeleton - CardioVR-ReTone - for the rehabilitation of cardiac patients following open heart surgery”.

Chapter 4, entitled "Prospects for furthering and developing academic, scientific and professional careers", briefly presents the medium and long-term vision of evolution, presenting the niches and directions of research that the author wants to address, with this step towards full academic independence. In the author's vision, the development of the university career implies the development on all three components: scientific, didactic, and professional. Thus, the development plans on all three components are highlighted in a synergistic way that will increase the quality and performance of the university activity. The author's wish is for this plan to be implemented over several years in a future team, together with young PhD researchers.

The *Conclusions* chapter highlights the implications of the issues presented and refers to supporting elements that can facilitate the implementation of the proposed plans, from an institutional perspective, the motivation of team members and international relations that can generate opportunities for collaboration or publication.

The last chapter "List of publications" contains all the articles and results obtained by the author after completing his doctoral thesis.