



Universitatea
Transilvania
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HABILITATION THESIS

SUMMARY

Title: *Applications of the parametric and non-parametric mathematical models, based on experimental data, in automotive diagnose and design*

Domain: *Automotive Engineering*

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The habilitation thesis entitled *“Applications of the parametric and non-parametric mathematical models, based on experimental data, in automotive diagnose and design”* presents the main achievements within the domain of theoretical, experimental and applied research I have performed after being granted with the PhD degree in the Automotive Engineering. The PhD degree was granted to me on the basis of the PhD degree thesis entitled *“Considerations regarding the loop power flux within the transmissions of multiple-wheel driven vehicles of the MoD”* that I have defended in 1999 at the Military Technical Academy from Bucharest, Romania. According to article 69, paragraph (5), letter a) of the *Law of higher education no. 199 from 2023* and the prescriptions of the *Guide to structure an habilitation thesis* issued by CNACTDU, this thesis is structured as follows:

- Part A: Summary of the habilitation thesis
- Part B: Scientific and professional achievements, further career development perspectives
 - Preliminaries: *Overall view of scientific, didactic and academic activity*
 - Section (B-i): *Highlights of the scientific, didactic and academic activity*
 - Section (B-ii): *Perspectives and planning of the future career*
 - Section (B-iii): *Selected references*

Within the *preliminaries* section, I have presented, based on documents, my personal professional achievements that have been materialized in handbooks, books as well as scientific research projects and publications issued within WoS data base or other data bases as classified and accepted by CNACTDU. It also contains information about the papers and articles that have been published by specialty reviews and magazines, conference and symposiums volumes, probing the originality and the relevance of my academic, scientific and professional work. They are also a vivid prove of my participation in developing educational programs, didactic activity and specific actions in increasing the visibility and impact of the research activity, both at the national and international level. During my whole activity as a tenant of a didactic position within the Military Technical Academy as well as a guest professor in foreign universities, I have mainly taught specialty disciplines: *Wheeled Motor Vehicles Engineering, Tracked Motor Vehicles Engineering, Automotive Manufacturing and Repairing Technology, Automotive Testing, Vibration Mode Diagnosis* (to the undergraduate level) as well as *Modern Concepts in Automotive Engineering, Traffic Accidents Reconstruction, Transportation Management and Automotive Technical Regulations* (to the master level).

The scientific activity has been guided towards the following main directions: *research with respect to the vibration dynamics an supplemental loads of the automotive transmissions; testing transducers signal analysis an processing; research concerning the dynamics, analyzing transitory behavior of the automotive braking systems and issuing mathematical models to diagnose their technical status; mathematically modeling the multiple-flow transmissions of the tracked vehicle (fast tracked vehicles); experimental confirmation of the mathematical models; functional analysis of the internal combustion engines and analyzing the influence of altering different parameters upon their running conditions; vibration analysis of the military automotive structures; assessing the dynamic capabilities of the vehicles during their*

design stage (testing and assessing the vehicles that are subject to the MoD acquisition process).

Section (B-i) concerns the scientific, professional and academic achievements. It presents, in its first chapter, the activities I have been developing with respect to the vibration analysis of the military vehicles transmissions. I aimed at pointing out the importance of a proper instrumentation, collecting and preliminarily processing of the acquired data (mainly torque and angular speed). This chapter deals with frequency and time-frequency analysis as well as with digitally filtering the signals. The quality of various parametric mathematical models (based on experimental data, using system identification procedures) is pointed out.

Chapter 2 deals with pressure measuring, mainly with respect with pressures within a braking system of a military vehicle. Enhancing de measurement accuracy and performing a high-quality data processing, the content of the chapter leads to the idea that malfunctioning components could be tracked down this way.

Chapter 3 underlines the utility of the mathematical models in further development of a system research, providing effective references to mathematical models that I have developed along various research contracts for certain vehicles of the MoD

The fourth chapter deals with the specific features of the non-parametric models. Starting with some of my previous work aspects that dealt with analyzing functional data of an internal combustion engine using non-parametric models, I decided this could be an interesting approach for other structures as well. It is rather suitable in analyzing the vibrations affecting vehicle chassis or military vehicle hulls. In this chapter, I presented the data acquisition structures as well as the conclusions drawn as a result of using the non-parametric models. I strongly believe that a further use of these models could lead to some interesting conclusions, especially when dealing with the influence of the vibrations upon the driving performance (within the combat area) of the military vehicle drivers.

Chapter 5, 6 and 7 of this section are destined to designing activities of some systems or components for military vehicles, starting from their functional analysis and based on their need for updating or upgrading in order to face the challenges of the modern battle field. Thus, chapter 5 approaches an upgrading procedure of a military truck braking system. Chapter 6 discusses over the possibilities to militarize *Dacia Duster 4WD SUV* and their implications over the dynamics and stability of the vehicle. Eventually, chapter 7 offers some non-conformist solutions to provide a highly increased visibility of the battlefield from the driver's seat of an amphibious personnel carrier (i.e. *Piranha III c*).

Section (B-ii) deals with my personal future projection over my teaching and scientific research career. The main research directions are, as follows: keeping on dealing testing contracts for the vehicles that are subject to become property goods of the MoD and/or other defensive structures, as a result of the national acquisition program; increasing the weight of modeling-simulating activities of different organs or assemblies of the vehicle structure; opening of a new research direction (that I've tried to perform some years ago and I had to postpone due to the pandemic context), which involves a research with respect to quantifying the fatigue level of the military drivers

due to the vibrations, that lead to a decrease in their driving capacity; studying, both from theoretical and practical point of view, the military suspension behavior when travelling of road, in combat conditions.

I also present some of my main objectives in developing relations with national and international universities and research institutes or companies.

The last section (B-iii) is designated to listing the most relevant references the habilitation thesis is based on.