



**Universitatea
Transilvania
din Braşov**

HABILITATION THESIS

SUMMARY

Title:

**Contributions to the Optimization of Vehicle Systems Processes and
Efficiency through Computer Simulation**

Domain: Automotive Engineering

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This habilitation thesis constitutes a synthesis of the scientific, professional, and academic activity undertaken by the author in the field of Automotive Engineering, with a distinct focus on the application of numerical simulation methods as essential tools for optimizing functional processes, increasing energy efficiency, and supporting the transition towards sustainable propulsion systems. The main aim of this thesis is to validate and consolidate the author's original contributions to research, while also presenting a coherent and structured account of the academic and scientific career trajectory in line with current standards in higher education and applied research.

The structure of the thesis follows a logical and thematic progression, beginning with a concise overview of its essential elements in Section (A) Summary, which offers a synthetic perspective on the author's contributions, the pursued research directions, and the prospective development plans. This is followed by Section (B), which contains the core elements of the thesis and is divided into several subsections. Subsection (B-i) includes the presentation of scientific, professional, and academic achievements, aiming to highlight the author's formative path and the activity carried out within specialized research institutions and multidisciplinary collaborations. These accomplishments provide a coherent framework that supports the development of expertise in the field of vehicle engineering with direct applicability to both academic and industrial contexts.

Building on this foundation, the present introduction sets the stage for the content developed across the three main chapters of the thesis. Chapter 1 contextualizes the habilitation thesis in relation to the objectives of the habilitation process, emphasizing the academic and professional criteria it must meet, particularly in terms of independent research capacity and doctoral supervision potential. Chapter 2 details the research directions and competencies acquired through scientific activity, with particular emphasis on the integrated approach to simulating complex engineering processes. This has been achieved through the use of advanced software platforms (such as AVL BOOST, AVL FIRE, MATLAB/Simulink, and Lotus Engine Simulation) and experimental validation performed in dedicated centers such as EMARC and TestEcoCel. Chapter 3 is devoted to the presentation of scientific results obtained in four main research directions: the simulation of functional processes of internal combustion engines, the simulation of vehicle subsystems, the modeling and simulation of electric vehicles, and the integration of hydrogen fuel cell technologies in electric vehicle applications.

Based on these contributions, Subsection (B-ii) outlines the author's career development and future evolution plans. Clear short-term and long-term objectives are formulated, aligned with the dynamic nature of the field, the societal demand for sustainable mobility, and the priorities of European research in the context of energy transition. The author expresses a strong commitment to expanding the research scope, consolidating institutional partnerships, developing international academic networks, and promoting innovative teaching methodologies to support the formation of a new generation of researchers.

Finally, Subsection (B-iii) gathers the relevant bibliography, offering a detailed view of the international visibility and impact of the author's published research. It includes lists of indexed papers in Web of Science and Scopus, highlighting the consistency and quality of the scientific

contributions. The lists of figures and tables complement the final section of the thesis, serving as a useful reference for navigating the technical content.

Overall, this habilitation thesis demonstrates not only the author's scientific and academic maturity but also a strategic vision centered on sustainability, interdisciplinarity, and research excellence. It contributes to the consolidation of a modern, efficient engineering culture aligned with the current and future challenges of the mobility sector.

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