

Abstract of Habilitation Thesis
“Research on Tyres for Road Vehicles”
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The first part of the habilitation thesis presents the main personal scientific, professional and academic achievements after receiving the PhD title in 1999.

Chapter 1 specifies the main research field of the thesis, the importance of the research in the automotive field, which has brought international appreciation to the research team. Furthermore, a brief history of the research developed in this field at the Automotive Engineering Department, University POLITEHNICA of Bucharest, is presented.

Chapter 2 presents the most important research on the stresses distributions in the tyre-road contact patch. The upgrade of the flat bed movable rig through integration of modern measuring equipment is presented. Some experimental results are presented, in addition to the approaches of disseminating the results.

The thesis provides information on the initial research performed for measuring the distributions of stresses in the tyre-road contact patch, in real rolling conditions. This has represented the groundwork for developing the second generation rig, capable of measuring the tri-axial distributions of stresses in the tyre-road contact patch, in real rolling conditions. The construction of the complex transducer rig, which is unique worldwide, has been based on two national patents and has benefited from founding through the Ideas Program of the National Research Development and Innovation Plan. The rig allows measuring the distributions of stresses for truck tyres, in all the specific conditions, in real rolling circumstances, on tri-orthogonal directions simultaneously, all across the contact patch width. The complex measuring equipment includes a fixed data acquisition system with 90 strain measuring channels, and two mobile systems. The analyses of experimental results show relative slip occurring at the trailing edge of the contact patch, in all specific rolling conditions. The results have been disseminated in articles published in Web-of-Science indexed journals and proceedings, and have been cited repeatedly around the world.

Furthermore, I have presented two other experimental methods of investigating contact patch forces, using force transducers and accelerometers.

Chapter 3 presents the main finite element models developed for research on tyres and on their interaction with the road. Thus, a passenger car tyre and several truck tyres have been modelled. The models have been used for simulating inflation, modal behaviour, radial stiffness and tyre-road contact. The distributions of stresses in the contact patch have been modelled. Although not proprietary models, I have contributed to all the stages of their development.

Chapter 4 presents an experimental study on the modification of tyre dynamic radius in rolling conditions on the chassis dynamometer. Thus, an increment of rolling speed has led to a very small increase of dynamic radius. The increment of inflation pressure has produced a more significant increase of dynamic radius.

Chapter 5 presents some research concerning the influence of tyre sealant on the passenger cars vibration behaviour. It has been ascertained that the addition of tyre sealant leads to increasing the magnitude of vibrations transmitted to the vehicle and that noticeable resonances occur in the steering system at higher speeds.

Throughout the presentation of the scientific achievements, I have clearly stated the personal contributions, as well as the collaborations with numerous specialists in view of pursuing the proposed objectives.

In chapter 6 I have presented briefly some other research fields approached after receiving the PhD title, for example: research in the field of internal combustion rotary engines, research in the field of classic and hybrid vehicles, etc.

Chapter 7 presents a quantitative synthesis of the scientific, professional and academic achievements after receiving the PhD title.

In the second part of the habilitation thesis I have presented the plans for evolution and development of my own scientific, professional and academic career. From the scientific point of view, I will continue the research on distributions of stresses in the tyre-road contact patch, as the research team activities are recognized and appreciated worldwide. Experimental research in laboratory conditions will be performed, using the complex transducer capable of measuring the tri-axial distributions of stresses in the tyre-road contact patch. A new rig will be designed and manufactured for slick tyre rolling on the complex transducer. Experiments will be performed by changing some tyre functional parameters. Experimental research on distributions of stresses in the tyre-road contact patch in real rolling conditions will be continued at higher speed, including free rolling, traction and braking conditions. The manufacturing of equipment that can be industrialized and marketed to potential beneficiaries is envisaged.

In the near future, I intend resuming studies in the field of “intelligent tyres”, alongside the research team. To this end, I will instrument a special tyre with strain gauges or accelerometers. The data from the “intelligent tyre” will be related to contact patch forces and torques, slip angle, tyre-road relative slip, etc.

New finite element models will be developed for research on tyre-road interaction, but also in view of investigating the “intelligent tyres”.

Research for developing the “Formula Student” race car of the University POLITEHNICA of Bucharest will be continued, and autonomous vehicle research will be initialized. Also, research will continue in the field of automotive testing and NVH.

PhD students will be involved in the research activities, and the research results will be integrated in contracts, patents and articles published in Web-of-Science indexed journals.

The main directions of professional evolution comprise: design, development and upgrade of research rigs, manufacturing the first “Formula Student” vehicle of the „UPB Racecar” team, extension of the automotive testing activities, as well as continuation of the modelling and programming activities alongside the research team including PhD students.

The main directions of evolution of my own academic career include: continuous operation and development of the MSc Programme “Research and Development in Automotive Engineering - CDIA” which I manage; continuation and development of international academic partnerships; finalization of scientific books; continuous modernization of taught courses; supporting students to find appropriate employment; attracting graduates towards the academic career; improving and upgrading laboratory equipment; coordinating students activity in graduation projects and dissertation theses.

In the third part of the habilitation thesis I have included references to 50 articles related to the thesis themes, most of which are own works or authored in collaboration.