

MINISTRY OF THE NATIONAL EDUCATION
THE PETROL-GAS UNIVERSITY OF PLOIESTI

HABILITATION THESIS ABSTRACT

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Abstract Of The Habilitation Thesis

Soft Computing Techniques with Engineering Applications

Candidate: Prof.dr.eng. Valentina Emilia Balas

The “*Soft Computing Techniques with Engineering Applications*” empowerment thesis summarizes the results of the scientific research activity that I have carried out after obtaining the Doctor's scientific title.

My doctoral thesis, entitled “*Intelligent sensors with internal model and fuzzy techniques*” was realized at the Politehnica University of Timisoara, coordinated by Professor Mircea A. Ciugudean. I defended “*cum laude*” the thesis in June 13, 2003. I obtained my PhD in Electronics and Telecommunications on September 22, 2003, based on the Order of the Minister of Education and Research no. 4741 of 25.08.2003.

After obtaining the doctoral degree I promoted through competition in 2004 as an Associate Professor, and then in 2013 as a Full Professor.

After my doctorate, my work pursued two main objectives:

- a) The didactic career, carried out at the Faculty of Engineering of “Aurel Vlaicu” University”;
- b) The scientific research, at the Faculty of Engineering of “Aurel Vlaicu” University” of Arad and of its Research Center for Intelligent Systems;

During the postdoctoral period I have published over 250 articles and scientific papers, of which 43 ISI and 47 ISI Proceedings, with a wide range of topics, most of them in the Soft Computing field.

The thesis is structured into three distinct parts and several chapters.

The first part presents the scientific achievements in the field of the empowerment thesis. Chapter 1 makes a review of the intelligent transport systems and has been the object of 16 scientific papers. One of the original concepts in these papers, the Constant Time to Collision (CTTC) was included in a Renault research program, finalized through a PhD thesis in 2013, in Lyon, by Felicitas Mensing.

The research methodology intensively uses modeling on vehicles (cars, railway wagons or airplanes). The models are validated by using real-time data: braking distances, acceleration times, maximum speeds, etc. The models are used both for testing automated algorithms, mainly of the fuzzy system category, and by including them in the structure of the algorithms as internal models.

The most representative algorithm in this category, CTTC, applies to car following. The CTTC introduces an objective criterion for optimizing the distance between cars and adapting it to the instantaneous speed of the following car, so that the time until the next collision is constant at all times. Several cars that apply this criterion form CTTC platoons, where the collision risk is equally distributed between the participants. When the highway administration imposes a certain value of TTC, it is possible to regulate the traffic intensity on large parts of the road. Felicitas Mensing has shown experimentally that this criterion can also be applied to urban traffic, where, in addition to increasing traffic safety, produces a fuel saving of up to 30-35%.

Other results included in the empowerment thesis are the following:

- Introducing a new traffic assessment indicator, the inverse time to collision ($CTTC^{-1}$), which is directly measuring the collision risk;
- Introducing a vehicle braking algorithm at a required distance from any initial speed, while maintaining a constant braking force throughout the braking process;
- Estimation of the brake system wear (discs and brake set) and wheels, etc.

The second chapter presents an analysis of the scientific papers published in the field of intelligent control, image analysis, medical applications, etc., all of them using Soft Computing techniques.

The second part of the empowerment thesis entitled “*Professional, Academic and Scientific Career Development Plans*” presents the directions for further development of the professional, academic, and scientific career of the candidate. After empowering, the research ideas will be used in some established research themes, which will be capitalized in doctoral theses.

The third part of the empowerment thesis the “*Bibliography*” will present the bibliographic resources on which the thesis is based and will include an important part of the scientific achievements published by the candidate.