Abstract

Within the Habilitation Thesis entitled "Scientific achievements in the field of modeling, simulation and control of industrial processes", the main results of the research activity obtained after the graduation of the PhD studies, in 2010, at the Technical University of Cluj- Napoca, are presented. During this period, although I approached several areas of research, most achievements were in the field of industrial process control. In the Habilitation Thesis, the research results were presented by approaching four main subdomains of this field. The results of the research have been materialized through the publication of scientific papers in ISI and BDI international specialized journals and in a large number of scientific papers presented in prestigious international conferences. I also participated, either as manager or as member in several research projects won by national competition or by internal competition organized by Technical University of Cluj-Napoca. The Habilitation Thesis is structured in 7 chapters.

In the first chapter, the achievements obtained in the professional career are presented. My personal development in the academic field is presented, the main areas of research are outlined and other professional achievements that I consider relevant are listed.

In the second chapter of the Habilitation Thesis a summary of the PhD thesis is presented. In the summary the main scientific achievements obtained during the PhD studies are mentioned. This chapter, in which is presented in a detailed manner the approach of PhD theme, has the goal of providing an information base which contains the post graduation research results related to the topic of the PhD thesis. Also, this summary within the Habilitation Thesis offers the possibility of clearly dissociating the results of the research obtained before and after the PhD graduation.

In the third chapter of the Habilitation Thesis the scientific results obtained in the field of PhD thesis, after graduation the PhD studies, are presented in order to highlight the continuity of the research in this field. Within this chapter, the modeling, simulation and control of the technological processes related to a rotary-hearth furnace is presented, subject which is considered the first main subdomain in the field of industrial process control. In the presented context, both automation of the furnace thermal processes and automation of its servicing system were approached. Due to the importance of the above mentioned topic, through the connection with the field of PhD thesis, within this chapter more details regarding the mathematical approach, respectively regarding the performed simulations were presented.

The second main subdomain is represented by modeling, simulation and control of wastewater neutralization processes, subdomain which is presented in the fourth chapter of the Habilitation Thesis. The main modeling strategies for this type of processes are outlined. Also, based on each obtained type of mathematical model, control structures of various complexities are proposed. At the end of the chapter, an approach based on the neural control of the pH value in the neutralizing tanks, is presented.

In the fifth chapter of the Habilitation Thesis, the third main subdomain is presented, more precisely the modeling, simulation and control of the technological process of heating the bitumen emulsion. The mathematical model of this process is determined taking into consideration the temperature variation in the volume of the tank in which the bitumen emulsion is stored. The proposed bitumen emulsion temperature control system provides the possibility of controlling the temperature in different points of the tank. Within this chapter two 3D simulations in relation with the two independent variables that appear in the process work, are presented.

The scientific achievements of the fourth subdomain, the subdomain of modeling, simulation and control of isotope separation processes are exposed in the sixth chapter of the Habilitation Thesis. In this chapter, a mathematical distributed parameter model which reproduces with high accuracy the isotope separation process work is proposed. As a case study, an isotope separation column for ^{13}C separation through CO_2 – carbamat chemical exchange is considered. Several possibilities for advanced control of the concentration of this isotope are presented.

The last chapter is the chapter of conclusions, which also presents some research directions that I want to approach in the future.

All four types of approached technological processes are processes with distributed parameters. In this context, the scientific achievements in another field I operate, more precisely the field of modeling, simulation and control of distributed parameter processes are highlighted. An important aspect of the research activities was the use and the refinement of the modeling-simulation method based on the matrix of partial derivatives of the state vector ($\mathbf{M_{dpx}}$), associated with Taylor series.