

Habilitation Thesis

“Flow Hydrodynamics in Engineering and Biomedical Applications”

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ABSTRACT

In agreement with the legislation in force, this sentence of empowerment, is based on scientific results in the fields of interest of the candidate and published at a later date to obtain the title Ph.D. in Engineering Sciences, through specific references presented in the thesis.

Thus, the period which has elapsed since the completion of my Ph.D. thesis (2000) is materialized through the promotion of research in two directions:

- Flow hydrodynamics in industrial applications such as hydraulic machinery and equipment, cavitation in hydraulic equipment, where the main issues addressed were:
 - Cavitation model (numerical modeling, numerical and experimental validation of the model);
 - Cavitation around the hydrofoil;
 - Cavitation in the hydraulic equipments;
 - Cavitation in hydraulic turbines.
- Biomedical Applications of the fluid mechanics, especially fluid flow in the human circulatory system.

The main achievements and significant results are presented in detail, within the framework of Chapter II (b): *Scientific, professional and academic achievements*.

This chapter presents scientific achievements exemplified for the both directions of activity listed, as well as dissemination activity of these results at national and international level through articles published in prestigious journals and through the presentation and publication of the results at national and international events in the areas addressed by the author.

Defining elements associated with this chapter are:

1. Editorial and publishing activity: in the period after defense the PhD thesis, the author has published four books, contributed as co-author of a some of four books chapter, published as editor a some of nine books and proceedings of international and national conferences.
2. Scientific activity: My research activity is emphasised by the publication of a number of 25th articles indexed in ISI or BDI journals, a number of 24 articles indexed in ISI proceedings, a number of 26 articles published in Proceedings of the International Conferences, 4 national projects as project director, 12 contracts with industry as contract director, member in the 10 national and/ or international projects and 25 national/international contracts.
3. Educational Activity: co-adviser for bachelor, master and thesis in collaboration with Prof.dr.ing. Romeo SUSAN-RESIGA from Politehnica University Timișoara, Department of Mechanical Machines, Equipment and Transportation, as follows: in the period from 2009-2016 some four bachelor thesis, two masters thesis, and active member of the guidance committees for the preparation of the Ph.D. thesis.

The habilitation thesis, also presents the proposal for academic, scientific and professional career evolution, and the main directions of future development in the context of significant scientific achievements in field of the topic of the author.

In this context, the following research directions are defined:

1. Helical type flow investigation and developing of the new aorto-coronary bypass graft, approaching the following issues:
 - Put in evidence the advantages of the helical geometry, namely provide evidence that swirl flow generates by the helical graft operate to inhibit the development of vascular diseases such as thrombosis, atherosclerosis, and intimal hyperplasia.
 - Investigation of the swirling characteristics of the secondary flow produced by helical graft tube with various shapes.
 - Investigation of the helical graft geometries both by numerical simulation and experimental measurements for different geometrical configurations (different turns and helix amplitude, anastomosis angle, bypass graft diameter, a combination of the successive helix with various aspects of the helix amplitude).

2. Investigation of blood flow in the arteries subjected to therapeutic intervention of stenting through:
 - Investigation of the three-dimensional stent model is required to capture spatial variations of flow hydrodynamics and drug distributions.
 - Development and investigations a stent should provide optimum vessel coverage to ensure that the vessel tissue does not prolapse between the stent struts; however, a low artery-stent contact surface area should also be maintained, because the foreign material of the stent can initiate an aggressive thrombotic response.
 - Investigations of the complex interplay between stent design (distribution of struts, link design, strut thickness, and circumferential ring design) and stent performance, from the perspective of the drug delivery performance.

In the last part of the thesis, the author presents his own vision of academic and professional development, from both the perspective of the 17-year experience gained in the field of hydrodynamics, fluid flow and also based on the latest international results in preparation and implementation of strategies to ensure a high-quality professional development, and high-impact in academia and in the economic environment.

The author presents several directions of action such as:

1. Recruit, Retain and develop a cadre of brilliant researchers and academic staff.
2. Establish and support the next generation of senior researcher and scientific leaders.
3. Build sufficient capacity and expertise to support new/challenging research themes, in my field of specialization.
4. Create and develop laboratory facilities and learning environments to provide world-class research facilities while simultaneously creating modern, flexible education instructional spaces.

Based on the foundation and my scientific activity, I shall be able to achieve, consolidate and develop the goals presented in this thesis, thus contributing to outlining my academic personality and not least, to honour the institution that trained me, to be able to believe that my purpose is to add a plus to the prestige of its professors.