**Abstract**

This habilitation thesis represents my research activity since 2010, after receiving the title of Doctor in Engineering Sciences, until now.

This work is a collection of analytical and experimental studies where the Mechanics of Continuum, Fatigue and Fracture Mechanics concepts are applied to solve different problems. Structured in three parts, the work contains carried out researches, proposals for the academic career development, annexes and references.

In the first part are discussed researches conducted on non-metallic materials, components and structures.

The work starts with an exhaustive study on mechanical behaviour, fatigue and fracture of total dentures. The research was conducted within a postdoctoral internship funded by the European Commission, at Politehnica University of Timisoara. During this study, a series of acrylic resins used as dental prosthesis bases were tested. The study is followed by numerical and experimental analyses related to the stress and strains fields in dentures. Reverse Engineering techniques have been also used for three-dimensional modelling of real dentures. The second study is an independent research in which relationships were proposed for bending deflection of sandwich beam loaded with a concentrated force. The novelty of this study consists in taking into account the additional effect given by the concentrated force that is significant for flexible core structures. The work continues with an experimental research on fibre-reinforced composites. This study was conducted within a postdoctoral research program at Vrije University Brussels, Belgium. In this study, the damage parameters from Ladeveze's model were experimentally determined. This model can be successfully used in damage prediction of composite materials. The second part contains research on metallic materials, components and structures, and starts with an analytical study on the mechanical behaviour of a cylindrical cell core structure used in the construction of sandwich panels. The analysed structure is an own proposal, for which relationships of the equivalent elastic constants computation have been developed, using the homogenisation technique of the mechanical properties. The work also includes an experimental study on the fatigue crack propagation in a low alloy steel. The research was conducted within a postdoctoral fellowship at Aalto University, Finland. In this study, the fatigue crack growth rate was determined both in the base material and laser welded. Moreover, the residual stress effect on fatigue crack growth rate was analytically and experimentally analysed. The third study is an individual research that highlighted the *crack tip shielding* effect during the fatigue crack propagation. The work continues with an

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experimental study in which the first fatigue tests of the overhead line conductors in Romania were carried out. This analysis consisted in defining a laboratory testing methodology of the electrical conductors, the actual testing and respectively the analysis of the local damage of the component wires of the conductor. The second part ends with an experimental and numerical analysis were a methodology was developed for failure analysis of a coupling of railway wagons failed by fatigue.

The third part contains proposals for career development and has three directions: scientific, professional and academic. Clear proposals and solutions are being discussed in this section.

The work ends with annexes and references and also represents a content that reflects the professional profile of the author.

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