



Universitatea
Transilvania
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HABILITATION THESIS

SUMMARY

Title: Contributions to the Analysis of Multibody Systems and
Composite Materials Properties

Domain: Mechanical Engineering

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The present habilitation thesis is based on the scientific and professional achievements of the author during the period of 2011-2023, after the completion of the doctoral thesis. During this time, the author continued his research in the field opened by his doctoral thesis, entitled "Contributions to the identification of individuals using motion analysis", under the scientific coordination of Prof. Sorin Vlase, completed in 2011, the year in which the author was awarded the scientific title of Doctor in Mechanical Engineering.

Structurally, this work is divided into two parts, namely the presentation of scientific and professional achievements, followed by career development plans. Judging by the author's scientific and professional achievements, three important areas in which he conducted research can be identified, namely:

1. Human motion capture and analysis, with multidisciplinary applications
2. Study of composite materials properties
3. Vibration analysis of musical instruments

The author was led on the path of these three domains by common elements, needs, and requirements that he encountered during his research, initially in the first domain and then in the second and third.

Regarding *human motion capture and analysis with multidisciplinary applications*, the initial idea behind approaching this field was a question: if it is relatively easy for us to visually identify a known person from a group based on observing their gait with the naked eye, could we find a series of physical and kinematic parameters on which to base our identification and associate them with the movement of that person? From here, things rapidly moved towards related fields where motion analysis plays an essential role, namely sports (especially technical sports events, where the posture and movement of the athlete significantly influence performance), medicine, with a focus on motor recovery (again, posture and motion parameters say a lot about how a patient recovers their motor functions), and music, especially following the artist-instrument pair (pursuing the same idea, posture and movement parameters of the artist during the interpretation of a musical passage on an instrument).

The orientation in this field was towards human motion capture and analysis using accessible methods and systems in terms of price since the author's interest was for the results of these researches to be practically exploitable without significant efforts. Moreover, most of the studies and experimental tests performed and presented in this part of the

habilitation thesis were carried out together with the students of the Mechanical Engineering study program (completed, by some of them, in the form of Diploma Projects) and with ordinary people as subjects, from students and athletes to elderly people with motor problems.

Studies focused on the artist-instrument pair have been carried out with a focus on stringed instruments, particularly violins and guitars, made of wood. It is quite evident that the properties and quality of the instrument directly influence a musician's artistic performance, and for a better understanding of the field, studies in the analysis of the artist's movement should be complemented with research regarding the instrument. Since the instrument is made of wood, which can be considered a natural composite material, and considering the author's already existing interest in composite materials (these being seen as possible solutions for sports equipment or walking support devices), a series of studies have been carried out in the second identified field, namely the *study of composite material properties*.

The third research direction is also related to the artist-instrument pair. Starting from the performer's movement, continuing with the analysis of wood and musical instrument construction, the focus has shifted to the effect that matters in the end, namely sound. As this is obtained through vibrations that occur at the musical instrument level, naturally, a third research direction has emerged in the field of vibrations, with a focus on the analysis of vibration in systems where there is direct human-machine contact.

The second part of the habilitation thesis consists of presenting the plans for the evolution of the university career, both from a didactic and scientific research perspective, presenting both the current stage and future plans for each direction.

Following a series of notable results in the didactic and scientific research fields, including 6 textbooks, 22 ISI Web of Science indexed articles, 12 of which in impact factor journals, 13 articles indexed in BDI (ISI WOS or Scopus) presented at international conferences (6 as first author), three monographs, a patent proposal in progress, a member of the team of three projects won recently (2012-2014, 2020-2022, 2022-2024), 144 ISI WOS citations without self-citations (Hirsch index 6), obtaining habilitation would represent an important step in the author's career, and the knowledge acquired could be capitalized on in the form of doctoral studies carried out under the author's guidance.