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LECTURE NOTES

19

# Modelling in Biomechanics

*edited by*

Józef Joachim Telega



Centre of Excellence for  
Advanced Materials  
and Structures



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Centre of Excellence for  
Applied Biomedical Modelling  
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**Józef Joachim Telega**  
(1943–2005)

Professor J. Joachim Telega died on January 28<sup>th</sup> in the morning, due to complications following kidney transplant surgery.

He was an outstanding scientist, mechanic, mathematician and biomechanician. We lost a sincere friend, a teacher and a guide. He was a member of numerous scientific societies and served on editorial boards of many international scientific journals. He was active in various fields of science. His broad interests and expertise enabled him to contribute to many domains such as: applications of mathematical programming to limit analysis, shake-down and optimization, plasticity, nonlinear elasticity, Cosserat and polar media theory, mathematical, and particularly variational methods in solid and structural mechanics, the invariant theory and tensor functions and their applications to the formulations of constitutive relationships, micromechanics and homogenization (deterministic and stochastic), effective properties of composites including piezoelectric and fissured composites, porous media, thermodiffusion, electrokinetics, coupled fields, geological faults, contact mechanics, variational inequalities, exact controllability and stabilization of structures and, of course, biomechanics. He was an author of 13 books and over 350 scientific papers.

In 1980s he turned his attention to biomechanics. It struck him, how the vast knowledge of mechanics and engineering, accumulated over several centuries, can be used to describe structures and processes taking place within the living organisms: muscles, bones, joints etc.

He never ceased learning. He set himself to supplementing his vast mechanical and mathematical knowledge with the facts from various disciplines that he recognized useful in his work: biology, biochemistry, biophysics. He also embarked on studies in more specific fields, such as physiology or histology.

Being himself a subject to orthopaedic treatments, he initiated the research on biomechanical aspects of joint replacement within the Institute of Fundamental Technological Research of Polish Academy of Sciences. Thanks to his expert command of modern mathematical tools and continuously enhanced biological knowledge, he was able to coordinate the work of interdisciplinary teams consisting of clinicians, experimental biologists, theoretical mechanists as well as engineers.

He often engaged in various kinds of scientific cooperation, in Poland, as well as abroad. Since 2001 he was the head of the Division of Variational Methods and Biomechanics within the Department of Mechanics of Materials and Biomechanics of the Institute of Fundamental Technological Research (IFTR) of Polish Academy of Sciences.

On his initiative, the Centre of Excellence for Applied Biomedical Modelling and Diagnostics ABIOMED was formed within the IFTR. This institution, funded by the European Commission and Polish Committee for Scientific Research, was aimed at promotion of research and dissemination of knowledge in the field of biomechanics and biomechanical engineering. Professor Telega became the scientific coordinator of the centre.

He also contributed a lot of work to another project supported financially by the EC: the Centre of Excellence for Advanced Materials and Structures AMAS. Professor acted as the executive editor for the centre. He edited five volumes of the centre's "Conference Proceedings" series and twenty volumes of "Lecture Notes". The present volume is published by the joint effort of both Centres of Excellence, and is, at the same time, the last volume of the "AMAS Lecture Notes" professor Telega edited. It bears the number *19*, although it is published long after the volume *20* found its way into print.

The present volume contains the lectures delivered during the advanced course "Modelling in Biomechanics" that took place in April 2003. I had the privilege of co-organising it with professor Telega; we also worked on his lecture together, and I delivered the part pertaining to thermal problems during the course. The work on the notes began several months before the course, but the material delivered to the participants—although large in quantity—

was somewhat chaotic. In the following months we set to work organizing and enhancing it. Professor wanted the paper to cover the entire field of soft tissue modelling, hence the enormous size and large number of references present in the final version. Soon it became apparent that many issues can only be mentioned, and some must be omitted altogether, if the Notes are to be published in a reasonable time. Professor intended to extend the material contained in his lecture and put it in a book form. As we know now, this book will never be published.

Among the notes that he had left me and those that he made in the hospital, I found many of the last corrections to be made to our paper presented here. I had to perform the final adjustments without his aid, but he did supervise the edition of the whole volume to the very last stages, and I am convinced that the reader will find it as valuable and interesting as professor Telega wished it to be.

*Maciej Stańczyk*

## Foreword

This volume contains eight comprehensive papers presented as lectures during the Advanced Course on Modelling in Biomechanics (MiB), held in April 7–11, 2003 in Warsaw. The Course was organized within the framework of activities of the Centre of Excellence for Advanced Materials and Structures (AMAS). The editing of the volume was also supported by the Centre of Excellence for Applied Biomedical Modelling and Diagnostics (ABIOMED).

The lectures delivered during the course covered broad spectrum of modelling of biological materials both solids and fluids. Molecular (biophysical) aspects were also included (ionic membrane transport and muscle contraction).

As the Editor of the volume and chairman of the Course MiB I would like to acknowledge organizational efforts of my Ph.D. student Maciej Stańczyk and Dr. Andrzej Gałka.

J. Joachim Telega  
Chairman of the Course

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