Aerodynamics of Bladed Machinery
(Aerodinamica masinilor cu palette)

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“Editura Academiei Romane”, Bucharest, Romania, 2010

DOI: 10.13111/2066-8201.2011.3.2.13

This text provides to the specialists in the field of turbomachinery a set of mathematical models for the analysis of aero- and gas dynamic processes, which occur during the operation of bladed machines.

The paper was printed by the publisher “Editura Academiei Romane”, Bucharest, Romania, 2010, and contains 915 pages grouped in 13 chapters.

Although the processes in the turbomachinery are highly complex, the authors of this paper have focused their attention mainly on the aerodynamic phenomena underlying the operation of this kind of machines.

The present paper was designed in two main parts (although they do not appear explicitly as such): Chapters 1-7 are focused on the fundamentals of Thermodynamics, Aerodynamics and Gas Dynamics, while the chapters 8-13 are referring to the blade cascades and their applications.

Also, for a better understanding, the authors have tried to present the problems in a gradual way, from simple to complex.

Thus, after an overview of the main types of bladed machines, the early chapters of the paper depict the main results of the Thermodynamics of ideal and real gases, offering formulas which will be applied later, in the subsequent chapters, in order to estimate the performances of the machines.

The basic equations of Gas Dynamics written in a very general form are detailed in the next, together with all the theorems necessary for the analysis of flow through the blade cascades.

Although the presented equations can be successfully used for numerical approaches, the paper does not insist on this point. Instead, there are developed some simplified models, which yield analytical solutions very useful for the pre-design process.

A separate chapter is devoted to the compressible flow, highlighting the basic equations of flow in subsonic, transonic and supersonic regime, along with some original developments proposed by the authors, leading to useful results for the analysis of flow through blade cascades.

The viscous flow is treated separately by using various boundary layer models for laminar, turbulent, incompressible and compressible regimes.

The Aerodynamics of airfoils and the methods of analysis of flow around them are presented in a special section. Since the results are applied later to the blade cascades, some practical applications with numerical outputs are included.

The airfoil cascades are treated in the subsequent chapters, where several methods of analysis are presented and concrete numerical applications are performed as comparison between various methods.
There are treated sequentially: linear cascades, circular cascades (both in the incompressible regime) and linear cascades in compressible flow. Numerical results are presented as examples of application for the theoretical methods previously shown.

A subsequent chapter is dedicated to the presentation of three-dimensional models of flow through the blade cascades. Here, an original model of analysis leading to more precise results is detailed (method of secondary flows).

The next chapter is focused on solving the direct problem of blade cascades approached as a useful tool for the design engineers dealing with the estimation of compressors and turbines maps. Also, the problem of instability that may occur in the bladed machines is analyzed in the later chapter.

A final section is dedicated to the air propellers and wind turbines, describing the aerodynamic methods of analysis, which are similar to those used for the blade cascades.

The bladed machines have various applications. Many of them are the basis of the aviation propulsion systems, so that some notations used in this paper come from the aircraft literature. However, the general equations describing the aerodynamic phenomena are the same, regardless of the end use of the bladed machines.

The References contain 118 titles, 17 of them being original contributions of the authors.

As a conclusion, the book can be considered to be of great use to all those who are in contact with the bladed machines, but it is primarily intended for designers and researchers in the field.

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Unsteady Aerodynamics, Aeroacoustics and Aeroelasticity of Turbomachines. Edited by KENNETH C. HALL. The bladed-disk assembly considered in this study is representative of the rst stages of modern LPTs. A global view of the whole assembly may be seen in figure 6. The vibration characteristics of the cantilever, interlock and welded-pair conurations has been obtained with the same grid. Department of Aerohydromechanics, Institute for Problems in Machinery Ukrainian National Academy of Sciences, 2/10 Pozharsky st., Kharkov 310046, Ukraine. gnesin@ipmach.kharkov.ua. Romuald Rzadkowski, Jacek Sokolowski. Institute of Fluid-Flow Machinery, Polish Academy of Sciences 80-952 Gdansk, ul. Fiszeria 14, Polish Naval Academy. z3@imp.gda.pl. The detailed aerodynamic models obtained using blade element theory for different geometric conurations and aerodynamic properties of the aerofoil sections are then converted to lumped parameter models that can be used for robotic applications. These applications include but not limited to body fixed frame velocity estimation and individual rotor thrust regulation [1, 2]. The principles of aerodynamics will provide the foundations for developing exacting and precise flying techniques and operational procedures. The content of this textbook has been arranged to provide as complete as possible a reference for all phases of flying in Naval Aviation. Hence, the text material is applicable to the problems of flight training, transition training, and general flying operations. Much of the specialized mathematical detail of aerodynamics has been omitted wherever it was considered unnecessary in the field of flying operations. Also, many of the basic assumptions and limita-tions of certain parts of aerodynamic theory have been omitted for the sake of simplicity and clarity of presentation. Numerical simulation had become an attractive method to carry out researches on structure design and aerodynamic performance prediction of straight-bladed vertical axis wind turbine, while the prediction accuracy was the major concern of CFD. Based on the present two-dimensional CFD model, a series of systematic investigations were conducted to analyze the effects of computational domain, grid number, near-wall grid, and time step on prediction accuracy.