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有限会社 ブックマン 〒113―0033 東京都文京区本郷３丁目 4-8-501
Tel 03-5684-0561 Fax 03-5684-0562 E-Mail：sales @e-bookman.co.jp
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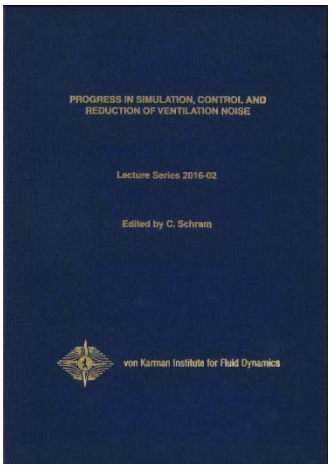

換気騒音の シミュレーション、制御、低減の進歩

Progress in Simulation, Control and Reduction of Ventilation Noise

VKI LS 2016-02

Edited by ***C. Schram***

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▶von Karman Institute for Fluid Dynamics の講演シリーズは、換気騒音のシミュレーション、制御、低減の進歩を詳細、且つ最新の側面から講じています。。

本書の内容

Ventilation noise, and acoustic emissions due to confined flow devices in general, are affecting our daily life. In buildings, heating, ventilating and air-conditioning (HVAC) systems have a significant impact on the quality of the workplace as well as the domestic comfort. The most frequently mentioned problem is linked to excessive noise and vibration. This unwanted noise makes the workplace uncomfortable and less productive. In schools, this noise has a negative effect on the learning capabilities of children due to problems related to speech intelligibility and loss of concentration. In air transport, current ICAO recommendations for the noise produced by the aircraft on the ground, at servicing and maintenance points, are so restrictive that it is necessary to optimize and specify acoustic treatments for the walls of inlets and exhausts of auxiliary power units (APU) as well as air-conditioning systems (ACS), in terms of both acoustic characteristics and layout in the ducts. The standard of acoustical comfort of vehicles is an important criterion to ensure customer satisfaction and to increase the quality of the vehicles in a worldwide market. In power generation and fluid transport, the main problems related to flow noise are reliability and safety. In nuclear power plants and in gas production pumping and transportation systems, very high levels of pulsations can be reached due to compressor noise or self-sustained oscillations caused by flow-acoustic feedback mechanisms. These pulsations induce vibrations and fatigue of the high pressure ducts and can lead to long maintenance and commissioning times, sometimes even mechanical failure of these ducts.

Clearly, significant progress is needed to better investigate, model, simulate and eventually mitigate aerodynamic sound generation in confined flows and ventilation systems. The Marie Curie project FLOWAIRS, funded by the European Commission under the 7th Framework Program, has permitted combining in an original research and training platform a broad range of multi-disciplinary skills to tackle the technical challenges faced by the industrial sectors of activity listed above. As a result, substantial scientific and technological achievements were made, and are gathered in a didactic form in this monograph.

The course begins with the fundamentals of duct acoustics, introducing the concepts of duct modal solution, cut-on/cut-off modes with or without mean flow, discussing the case of soft walls and surface waves, to conclude with some applications to ducted rotating machines. The second lecture provides a general introduction to linear acoustics as well as an overview of sound-generating flow mechanisms through aeroacoustic analogies (Lighthill, Curle, Ffowcs Williams & Hawkings). This lecture can be seen as a pre-requisite to the third course, focused on the physical mechanisms of tonal and broadband noise generation by rotating machines and on

their modeling through advanced analytical treatments. The numerical counterpart of that aspect is given in the fourth course, demonstrating the most recent low-order and high-order numerical developments by application to low-speed axial and centrifugal fans. The sixth course introduces the concept of acoustic N-ports for ducted systems, describing from a theoretical and an experimental viewpoint the passive (acoustic scattering) and the active (noise generation) components of the acoustic field in a duct including transverse modes. This approach is further treated in the seventh course in a numerical context, where System Identification techniques are applied for the determination of the noise produced by ducted singularities such as orifices or valves. Noise mitigation is addressed in both the eighth and ninth courses, presenting advanced modeling concepts related to locally reacting and bulk liners, periodic liners, trapped modes, flow effects and instabilities over liners, as well as advanced meta-materials. The tenth course covers recent advances in Uncertainty Quantification applied to aeroacoustic measurements and simulations. Finally, the last course discusses a topic of high technological interest for industrial flow distribution systems: the advent of flow-induced pulsations in corrugated pipes.

The Lecture Series director is Prof. C. Schram from the von Karman Institute.

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