



60 YEARS' ACOUSTICS AT RWTH AACHEN UNIVERSITY

Michael Vorländer^{1*}

Janina Fels¹

¹ Institute for Hearing Technology and Acoustics, RWTH Aachen University, Germany

ABSTRACT

The Institute of Technical Acoustics, ITA, was founded at RWTH Aachen University in 1963. First leaders were Wilhelm Janovsky and Heinrich Kuttruff. Today, institute directors are Michael Vorländer (since 1996) and Janina Fels (since 2012). In 2021, the Institute was renamed "Institute for Hearing Technology and Acoustics - IHTA", due to its increased involvement in interdisciplinary networks at RWTH Aachen University, with an increased focus on hearing research. Since 1963, generations of students in electrical engineering and information technology were educated in graduate courses, as well as physicists and mechanical engineers. The increased activities are also reflected in a broader range of teaching modules and laboratory equipment. From 2025 on, the institute will continue with an additional emphasis in hearing technology but without losing the broad coverage of technical acoustics and acoustic virtual reality.

Keywords: *history, acoustics, university*

1. INTRODUCTION

In 1963, the Institute of Technical Acoustics, ITA, was founded at RWTH Aachen University. The focus in the first decades was acoustics in its very wide range of fundamentals and applications covering musical acoustics, room acoustics, ultrasound, psychoacoustics, noise control, and signal processing for measurement and sound analysis. The leadership included Wilhelm Janovsky (1963-1971, figure 1), Heinrich Kuttruff (1972-1995), Michael

Vorländer (1996 -) and Janina Fels (2012 -). In 2021, the Institute was renamed "Institute for Hearing Technology and Acoustics - IHTA", due to its increased involvement in interdisciplinary networks at RWTH Aachen University, with a stronger focus on hearing research. Since 1963, generations of students in electrical engineering and information technology, as well as physicists and mechanical engineers, have been trained in graduate courses. The paper summarizes some historical facts of the academic contributions. Names and dates were mostly taken from [1].

2. EARLY YEARS - 1963-1972

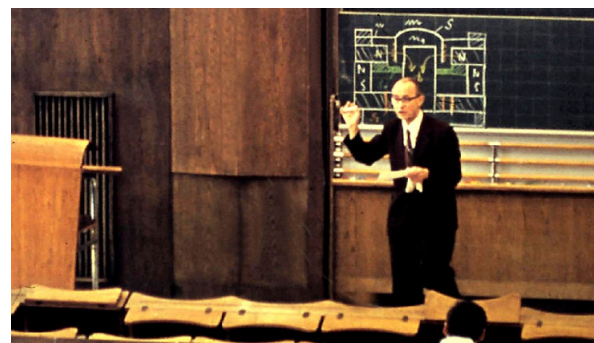


Figure 1. Wilhelm Janovsky teaching electroacoustics in the "FT" auditorium (picture taken by Franz Buchholz).

2.1 Acoustics in communication engineering

Since the 1950s, the Institute for Communications Engineering (IENT), (headed by Volker Aschoff, later Rector of the RWTH) offered lectures on electroacoustics. Aschoff was the teacher of Jens Blauert, who is one of the founders of all we know about binaural hearing. Aschoff was followed by Hans Dieter Lüke who continued the work of the IENT group on psychoacoustics and binaural hearing

*Corresponding author: mvo@akustik.rwth-aachen.de.

Copyright: ©2023 Vorländer et al. This is an open-access article distributed under the terms of the Creative Commons Attribution 3.0 Unported License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

until the 1990s. Klaus Genuit and Hans-Wilhelm Gierlich, the driving forces behind HEAD acoustics, graduated from the IENT.

2.2 Acoustics becomes independent

During Aschoff's time, and even before that, Wilhelm Janovsky was involved as expert and docent in various field of acoustics. Finally he was offered a full professor's position in 1961 and head of the Institute of Technical Acoustics – ITA, in 1963/64. Wilhelm Janovsky supervised 6 PhDs in 1963-1970. His main research areas were sound and vibration in general, and psychoacoustics. He also co-supervised 16 PhDs, most at mechanical engineering. Also in 1963, the „Ultrasound Laboratories“ led by Reimar Pohlman were associated with the ITA. Pohlman was leading the “Ultrasound labs” in Aachen between 1957 and 1977. He was teacher of Joachim Herbertz, who was later professor in Duisburg and actively involved in health effects caused by high frequency airborne sound.

3. ITA RWTH 1972-1996

The decades of the 70's, 80's and 90's were marked by Heinrich Kuttruff. With him, a very strong focus was set on room acoustics and ultrasound, but not reducing the fundamentals in the education program and in research. Kuttruff's research and teaching was strongly influenced by his career background from the 3rd Institute of Physics of Göttingen University and his mentor Erwin Meyer [2]. After doctorate in room acoustics and habilitation in ultrasound (cavitation and sonoluminescence), he taught as a docent in Göttingen and was appointed professor first at the Technical University of Darmstadt and professor and director of ITA in Aachen in 1972.

Starting with 1972, acoustics at RWTH got a significant change in terms of increased laboratory, workshop and office space in a new building (figure 2). After structural restrictions and interim solutions, this was the starting signal for expanded research and teaching activities.

Heinrich Kuttruff taught “Technical Acoustics” (part I and II), “Ultrasound”, and “Room acoustics”. The Technical acoustics laboratory of 11 student experiments completed the teaching portfolio, of course also including thesis projects for students finishing a diploma degree (5 years) in electrical engineering or in physics. The class size in the fundamental lectures was about 100, in the special lectures around 20, the number of students who worked on their final thesis was about 10 per year (thus being considered as “acousticians”). This is to be correlated with typically 800 beginners in the electrical engineering diploma course.



Figure 2. New ITA building, Neustr. 50, in Aachen-Burtscheid (picture taken by Franz Buchholz).

The research topics were quite diverse and span from nonlinear bubble dynamics, room acoustics, quality of violins, noise propagation in urban areas, multi-channel electroacoustics, speech enhancement.

The main achievements from that time were an alternative approach for artificial head design, based on the best-matching individual who “donated” his individual shape as basis for the ITA dummy head. The best match was determined in inter-subject listening experiments with a dataset of individual HRTF. Another significant achievement was the early version of room acoustic ray tracing software and its continuous maintenance (until today) on the one hand, and DSP hardware and software for control and measurement of electroacoustic and acoustic systems on the other.

4. ITA RWTH AFTER 1996

After Heinrich Kuttruff retired, Michael Vorländer was appointed his successor in 1996. Coming from the Physikalische Bundesanstalt (PTB) in Braunschweig, he included more elements of measurement, calibration and digital measurement technology in the lecture series, but kept the basics of Kuttruff's "Technical Acoustics". The ultrasound laboratory was closed due to high maintenance costs and lack of space.

The tradition of sustaining the software tools and the infrastructure over a long time was kept on purpose. This way, the simulation software emerging from the 1980s could be used a basis for continuous extension and improvement. Also, the DSP technology framework was maintained.

In 2012, Janina Fels joined as an assistant professor. She set up her own group with a focus on hearing technology and expanded its activities over the years. In 2020, she was appointed Full Professor for Hearing Technology and Acoustics.

4.1 Teaching: Continuity with slight adaptations

With the scientific and the technological progress after 2000, computer simulation became more emphasis. This was also expressed by a new lecture on “Acoustic Virtual Reality”. “Psychoacoustics” was taught by Klaus Genuit who was invited to join the teaching activities as adjunct lecturer (later adjunct professor). “Measurement techniques and electroacoustics” (taught by Gottfried Behler) and Medical Acoustics (part I: Technologies for Hearing Systems and Ultrasound, part II: Audiology and Voice, taught by Janina Fels) were added in 2009, also “Psychoacoustics and Methods for Listening Experiments, in 2016”. “Room acoustics” was transferred into an intensive course format (1 week full-time) with added content of sound reinforcement systems and supported by external lecturers (Alfred Schmitz, Anselm Goertz).

In 2020, teaching was further extended towards more offers for students of architecture (Josep Llorca-Bofi).

The class size in the fundamental lectures today is about 200, in the special lectures around 40, the number of students who worked on their final thesis was about 20 per year (thus being “acousticians”). This is to be correlated with typically 350 beginners in the Bachelor’s course of electrical engineering and information technology.

4.2 Research: Extension towards hearing technology

With two full professorships, more diversity is covered, and more infrastructure is required. In research, acoustic virtual reality and binaural hearing technology became the core of research but still in a very wide setting of research questions and applications. This is also reflected in the integration of research consortia (and teaching) in interdisciplinary teams at RWTH Aachen University which combined acoustics with architecture, electrical engineering, mechanical engineering, biology, psychology, and computer science.

In particular, hearing technology group grew over short time, so that the institute’s name was changed from ITA (technical acoustics) to IHTA (hearing technology and acoustics). Funds for large research consortia such as the priority program AUDICTIVE were acquired by Janina Fels, linking the disciplines of hearing science with virtual reality and cognitive psychology. This is a proof that acoustics can play a big role in an interdisciplinary context of sound, perception, and design.

Also, between 2021 and 2026, a third group in IHTA, named “PAAD” (Person-focused Analysis of Architectural Design) led by the Junior Principal Investigator (equivalent to assistant professor) Josep Llorca-Bofi.

5. CONCLUSION AND OUTLOOK

Acoustics at RWTH Aachen University was established by ITA, now IHTA, since 60 years. The growth in terms of capacity and impact in research and teaching started around 2010, with more emphasis on hearing research and with a second professorship. Teaching was supported by external docents. And this was well accepted by the students who, in relation to registration of first-years students, came to study acoustics in much larger numbers than in the 1960s and the 1990s. This may be an indication of the increased relevance of acoustics in many more branches of engineering. Digital technology as well for measurements as for computation paved the way for breakthroughs in system identification and simulation. With the most recent appointments, the branch of hearing technology is added to IHTA’s activities but, most important, without losing the technical part of measurement and simulation of acoustic systems in general. From today’s perspective, acoustics at RWTH Aachen University has a promising future in its interdisciplinary integrated structure.

Up-to-date information about IHTA can be found on the Website [3].

6. ACKNOWLEDGMENTS

The authors are grateful for personal information and a photograph archive of Franz Buchholz, the head of the electronic workshop at ITA between 1963 and 2000.

7. REFERENCES

- [1] N. Gilson, W Kaiser, “Elektrizität — Energie — Information: Die Geschichte der Fakultät für Elektrotechnik und Informationstechnik an der RWTH Aachen,” GNT-Verlag GmbH; 1. Auflage (1. April 2010)
- [2] Guicking, D. „Erwin Meyer. Ein bedeutender deutscher Akustiker. Biographische Notizen.“ Göttinger Universitätsverlag, Göttingen 2012, ISBN 978-3-86395-059-0 (https://www.univerlag.uni-goettingen.de/bitstream/handle/3/isbn-978-3-86395-059-0/Guicking_meyer.pdf?sequence=1)
- [3] IHTA website: www.akustik.rwth-aachen.de