Audio Information Processing

TU(R)NING SPACE – Analysis, synthesis and perception of kinetic auditory space in music, art and hearing science

International Symposium, Technical University of Munich, 4-5 July 2025

Friday 4 July 2025

14:00 h Welcome (Bernhard U. Seeber & Tim Otto Roth)

14:05 – 15:20 h Session 1 **Locating Auditory Objects in Space**

Where and how do we localize sounds? Beyond the processing of binaural cues, the session focusses on contributions from learnt knowledge about sources, on context from room acoustics and the dynamic evolution of spatial relations of sound objects. Also, perceptual 'metaphysical' varieties are taken into consideration.

Varieties of Spatial Hearing
Dr Nicola Di Stefano
Institute for Cognitive Sciences and Technologies (ISTC), Rome, Italy

Attention for hearing in space
Prof. Annie Moulin
Equipe Perception Attention Mémoire, Centre de recherche en Neurosciences de Lyon, France

moderation: Prof. Bernhard U. Seeber

15:30 – 16:45 h Session 2 **Acoustic mobilization – the challenge of kinetic sound objects**

How can we can handle the dynamics of sound events? Pierre Schaeffer, who established the Musique concrète with his tape-recording pieces, coined the term 'objet sonore'. What are sound objects in art or the natural world and what are the challenges when they start to move?

Sound in space: pushing the limits of auditory motion perception
Dr Cédric Camier
Saint-Gobain Research Paris, Coda dptm, Acoustic team, Center of Interdisciplinary Research of Music and Media Technology, Montréal, Canada

Sound objects in natural space – from psychoacoustics to natural space perception
Prof. Christian Lorenzi
Experimental Psychology, Ecole normale superieure, Paris, France

moderation: Dr. Antoine Bourachot (Audio Information Processing, Technical University of Munich)

16:45 h **Coffee Break**

17:15 – 18:30 h Session 3 **Acoustic turn: The impact of Fourier, Ohm & Helmholtz**

What are the foundations of a modern hearing culture? The findings of Fourier, Ohm & Helmholtz underly not only the modern understanding of acoustics, but also triggered a paradigm shift in natural and cultural science. The session discusses this turn to a "thinking with sound" and modern ways for sound analysis.

Analyzing the musical scene
Prof. Meinard Müller
International Audio Laboratories Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

When Sound Meets Self: Defining Acoustic Space in the late 19th Century
Prof. Viktoria Tkaczyk
Media and Knowledge Technologies, Humboldt University, Berlin, Germany

moderation: Prof. Bernhard U. Seeber

20:00 h Evening Panel – public & in German, live captioning in English

Vorhang auf für den Lautsprecher: Klangkunst im Spannungsfeld zwischen Installation, Kunst und Musiktheater (Curtain up for the loudspeaker: Sound art in the tension field between installation, art and music theater)
Prof. Helga de la Motte-Haber
Systematic Musicology, Technical University Berlin, Berlin, Germany

Prof. Florian Hecker
sound art, Akademie der Bildenden Künste München, Munich, Germany

Sabine Schäfer
composer, sound art/media art, Karlsruhe, Germany

moderation: Dr. Tim Otto Roth

Afterwards: Visit of the Heaven's Carousel installation at Alte Pinakothek

Saturday 05 July 2025 morning

9:00 h meet & greet over coffee

9:15 – 10:30 h Session 4 **In and out of Neuronal Tune: Spatial Intonation**

How does the brain shape our sound experience? The neuronal system pieces together auditory objects from tonotopically separated information. Pitch and temporal information is crucial for forming objects while the spatial evolution of the scene and the source's timbre help us follow sources over time.

Pitch and timbre: Insights from behavioral and neuroimaging studies
Prof. Andrew Oxenham
Psychology, University of Minnesota, USA

Perception of pitch, interval and contour: Insights from music and processing deficits
Prof. Barbara Tillmann
Université Bourgogne Europe, CNRS, LEAD UMR5022, 21000, Dijon, France

moderation: Dr. Julia H. Schröder (Freie Universität Berlin, Germany)

10:30 h **Coffee Break**

11:00 – 12:15 h Session 5 **Birth of Electroacoustic Music: From Interruption to Mobilization**

What are the foundations of sound synthesis and its artistic consequences? Already in 1837 Charles Grafton Page sketched an early form of an electroacoustic loudspeaker, which revolutionized with some latency music and the work with acoustic space in the 20th century.

From cybernetics to complexity in ecosystemic musical practice
Dr. Dario Sanfilippo
Vienna, Austria

Thinking Pure Tone Waves – feedback synthesis in which gravity and acoustics are brought into generative equation
Virgile Abela
Marseille, France; associated artist to MAS Plateform LMA-ECM-CNRS-AMU & Laboratoire Modulaire, ESAM

moderation: Dr Tim Otto Roth

12:15 h **Closing discussion & farewell**

from 12:30 h Demonstration of the interactive audiovisual research space "real-time Simulated Open Field Environment" of the Audio Information Processing group in the anechoic chamber, building N9, TUM.

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Registration

Registration and attendance are for free. No registration required for the public evening event.

Please register at **https://ers.mytum.de/ahDXMHXL/** for in-person and online participation. The link will be sent automatically.

Funding

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Organization

Prof. Bernhard U. Seeber, Audio Information Processing (AIP), TUM
Dr Tim Otto Roth, imachination projects
TUM Center for Culture and Arts

TUM will take photographs and/or film during the event for publication in our publications, on our website www.tum.de and on our social media channels, and for editorial reporting by third parties. If you do not want to be photographed or filmed, please inform our photographers or filmmakers and Bernhard Seeber. The purpose of the processing is to document the event through photography/film.

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Location & Getting there

[Room 2300 “Friedrich von Thiersch”, Gabelsbergerstrasse, 80333 Munich, Germany]

(modified from openstreetmap.org)

Use “fancy” entrance “T3” below the TUM Clock Tower, go to 2nd (parquet) or 3rd (balcony) floor and enter room 2300 on right hand side of staircase.

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A few nearby (artsy) things to do while in Munich

- Pinakothek der Moderne, https://www.pinakothek-der-moderne.de/
- Alte Pinakothek, https://www.pinakothek.de/de/alte-pinakothek
- Museum Brandhorst, Exhibition “Five Friends. John Cage, Merce Cunningham, Jasper Johns, Robert Rauschenberg, Cy Twombly”, www.museum-brandhorst.de
- Lenbachhaus, https://www.lenbachhaus.de
- Kunsthalle München, Exhibition “Civilization – The way we live now”, https://www.kunsthalle-muc.de/en/civilization/
- Haus der Kunst, https://www.hausderkunst.de/en/
- Open Art Munich – Gallery Weekend, 3-6 July 2025, openart-munich.de
- Visit small art galleries in the “Kunstareal” – https://kunstareal.de and app “Kunstareal Walks”
- Exhibition “Lee Miller Photography”, Amerikahaus, https://www.amerikahaus.de, until 31.07.2025
- Exhibition “Picasso, Beckmann, Turner und andere Geschichten, die das Meer erzählt”, Olaf Gulbransson Museum Tegernsee, https://www.olaf-gulbransson-museum.de, until 20.07.2025
- 42nd Film fest Munich, https://www.filmfest-muenchen.de, until 6 July 2025
- Tollwood summer festival, https://www.tollwood.de/
- Bergson new concert hall with in-residence “Jazzrausch Bigband”, https://bergson.com
- Jazzclub Unterfahrt, https://www.unterfahrt.de
- Gasteig HP8 “interim” concert hall, https://www.gasteig.de
- For concert and art listings see https://www.muenchen.de/en/events and https://www.in-muenchen.de/

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Some ideas about…

TU(R)NING **SPACE** – **Analysis, synthesis and perception of kinetic auditory space in music, art and hearing science**

1 QUESTION

'These different perspectives of spatialisation, this new way of composing was only possible through the discovery of timbre as an independent musical dimension'. (György Ligeti, 1974)

Even 180 years after the acoustic-experimental confirmation of the Doppler effect with trumpeters on a steam locomotive, the interaction of space, time and the composition of sound continues to fascinate the arts and sciences. For instance, the sound sculpture "Heaven's Carousel" (www.imachination.net/carousel) by conceptual artist & composer Tim Otto Roth and the psychoacoustic research at the Technical University of Munich examine the ability to analyse and perceive auditory scenes with moving sources in space in different ways. This includes a number of aspects, such as the source properties and the interaction between the acoustic source and receiver, the perceived source direction, distance and reflections on surfaces in the room.

Spatial-kinetic thinking with sound | The aim of the transdisciplinary symposium is to connect aspects of space, movement as well as the emerging source separation and pitch perception that have been discussed so far rather separately. Questions relating to the analysis but also the spatial and dynamic re-synthesis of sounds will be discussed with recognised researchers in the fields of acoustics, psychoacoustics, neuroscience and cultural studies. The transdisciplinary symposium is intended to create a network across the boundaries of the natural and cultural sciences and the arts and to exchange knowledge and experience both from fundamental sciences and methods applicable in the arts.

The currently emerging spatial sound reproduction, the 'virtual acoustics', offers both hearing science and sound art completely new possibilities for the representation of a wide range of sound sources in space. Therefore, now is a good time for a symposium that brings together acoustic researchers as experts in methods and auditory processes with artists as experts in sound composition and synthetic perception against the background of the analysis, synthesis and perception of complex acoustic scenes.
The transdisciplinary approach of the symposium also confronts contemporary research with a media archaeological look back to the last 200 years of acoustic research, leading to a new interdisciplinary 'thinking with sound' (*Tkaczyk 2023*).

Auditory research | In hearing science, aspects of perception in realistic, dynamic listening situations are currently being investigated primarily in relation to speech communication, e.g. as part of the CRC 1330 'Hearing Acoustics' and the SPP 2236 'Audictive' in Germany. Virtual acoustics is used to reproduce sound sources and their sound reflections increasingly realistically in virtual space and participants interact with these sound sources. Compared to previous hearing research with highly abstracted test situations (often monotonic or dichotic noise or sound stimuli presented via headphones), research in realistic, virtual listening environments is significantly more complex, with aspects of synthetic and analytical hearing playing an important role.

Space as a constitutive element of sound art | In addition to perception, the methods of spatial sound reproduction form an important bridge between auditory scientists and artists, which turned out to be crucial for the electroacoustic "Klangkunst", respectively sound art, that has emerged in recent decades (*de la Motte 1996*). A special research object and highlight of the conference programme is therefore the parallel presentation of the 'Heaven's Carousel' at the Kunstareal, which is within walking distance of the conference venue. Sine tones are reproduced on 36 loudspeakers rotating above the audience with a span of up to 16 metres - a form of additive source synthesis - which calls on the audience's skills in auditory scene analysis for source separation and localisation, thus inviting a discourse between art, perception and science.

Space, kinetics and timbre | As a kind of reminiscence of Fourier and Helmholtz, the sound accelerator 'Heaven's Carousel' becomes a special experimental sound source, as the motion (turning) inevitably has an effect on the pitch (tuning) due to the pitch-changing Doppler effect. This reference to the art installation, which gives the conference its title, will be taken up in a productive way in the separate panels in order to juxtapose current research on the influencing factors of scene analysis (pitch/harmonicity, temporal aspects, spatial hearing) from a psychoacoustic and neuroscientific perspective with artistic, media and musicological findings - including the discovery of space and timbre in the electroacoustic and instrumental music of the 20th century.

2 FORMAT

The symposium, which will be held in English from Friday noon to Saturday noon at the Technical University of Munich, is organized into 6 panels, each with two presentations by different scientists with related topics. The speakers will then meet at the end of their session in a moderated panel discussion and will also be available to answer questions from the audience. As an evening event for a larger audience, a round table is planned with sound artists discussing their artistic research approaches with scientists. The symposium will be broadcasted live on the internet (Zoom).

3 SCIENTIFIC BACKGROUND

The mechanisms for analysing acoustic scenes are essential for hearing and are being investigated neuroscientifically and psychoacoustically in Germany at the Bernstein Centre for Computational Neuroscience in Munich, the CRC 1330 ‘Hearing Acoustics’ and the SPP ‘Audictive’, primarily in the context of speech communication. While hearing researchers have the basic knowledge of the mechanisms, the step to reception, aesthetics, music and art generally does not take place. Conversely, there is little basic knowledge of the auditory system and the mechanisms of auditory perception in the field of arts, as the effect can be experienced directly perceptually. This symposium is therefore intended to build a bridge between the natural and cultural sciences and the arts in order to exchange knowledge with a special focus on different techniques.