



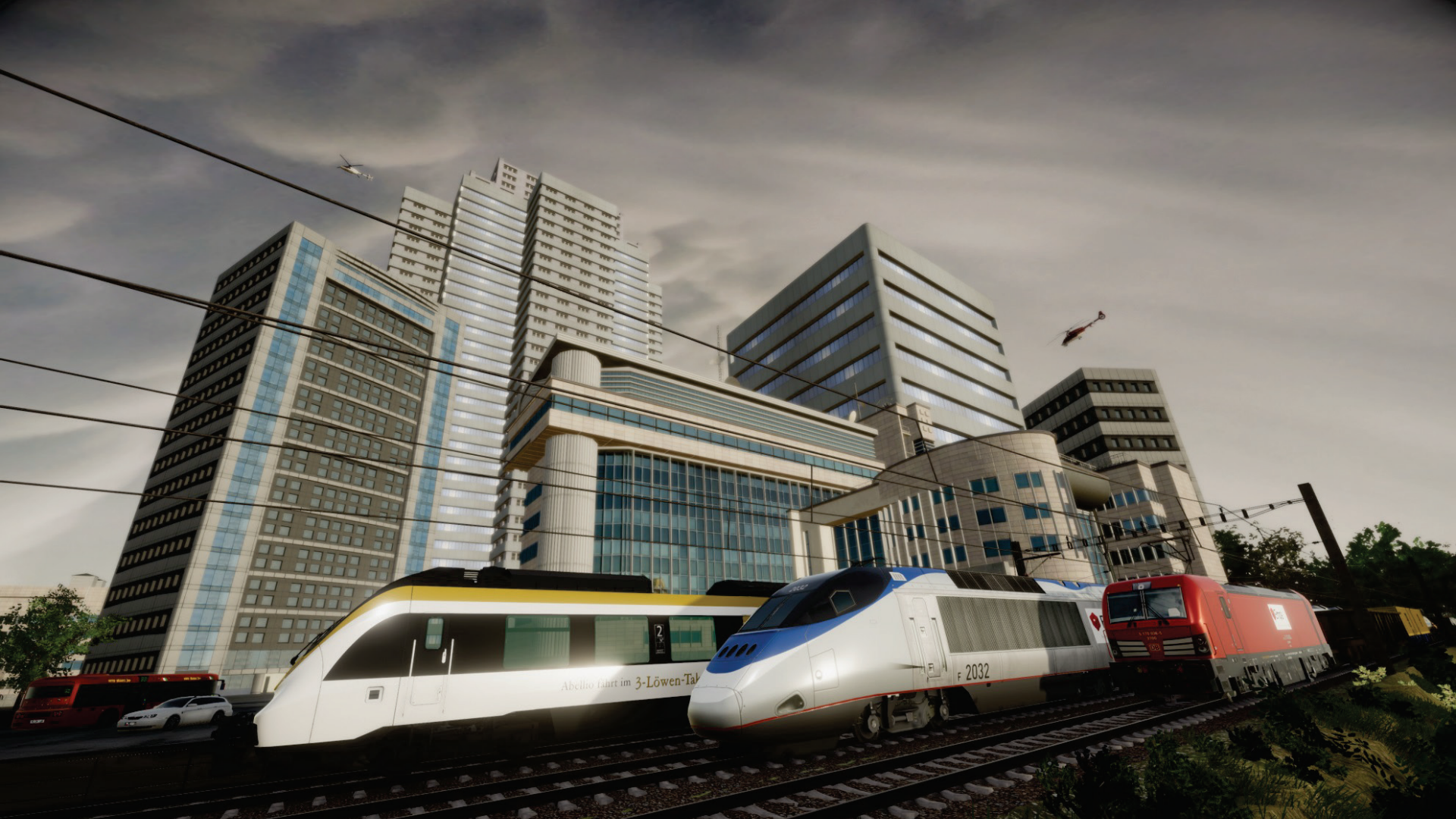
Acoustics II

Auralization

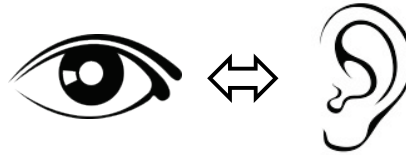
Reto Pieren

2024

What is Auralization?



What is Auralization?



- ... analogy to visualization (Mendel Kleiner 1993)

[Kleiner, M. et al. 1993. Auralization – An overview. Journal of the Audio Engineering Society 41(11).]

- **Acoustical simulation technique** to artificially render an acoustical situation audible → «listen into the future»

What is Auralization?

- Different definitions in use

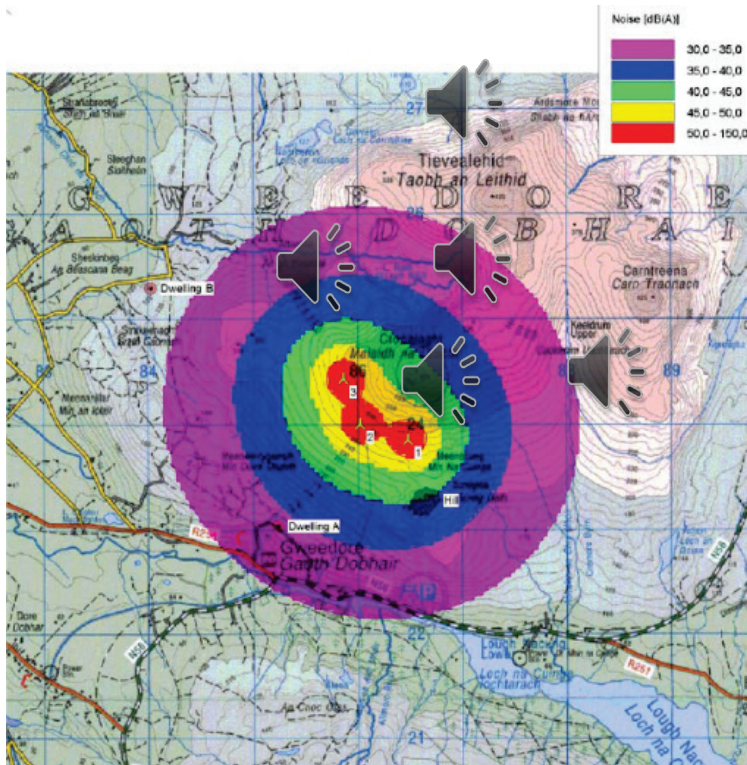
[Vorländer, M. 2008, Auralization - Fundamentals of Acoustics, Modelling, Simulation, Algorithms and Acoustic Virtual Reality, Springer.]

- Used some decades in room acoustics, increasing interest in other fields

[Savioja, L. & Svensson, U.P. 2015. Overview of geometrical room acoustic modeling techniques. Journal of the Acoustical Society of America 138(2).]

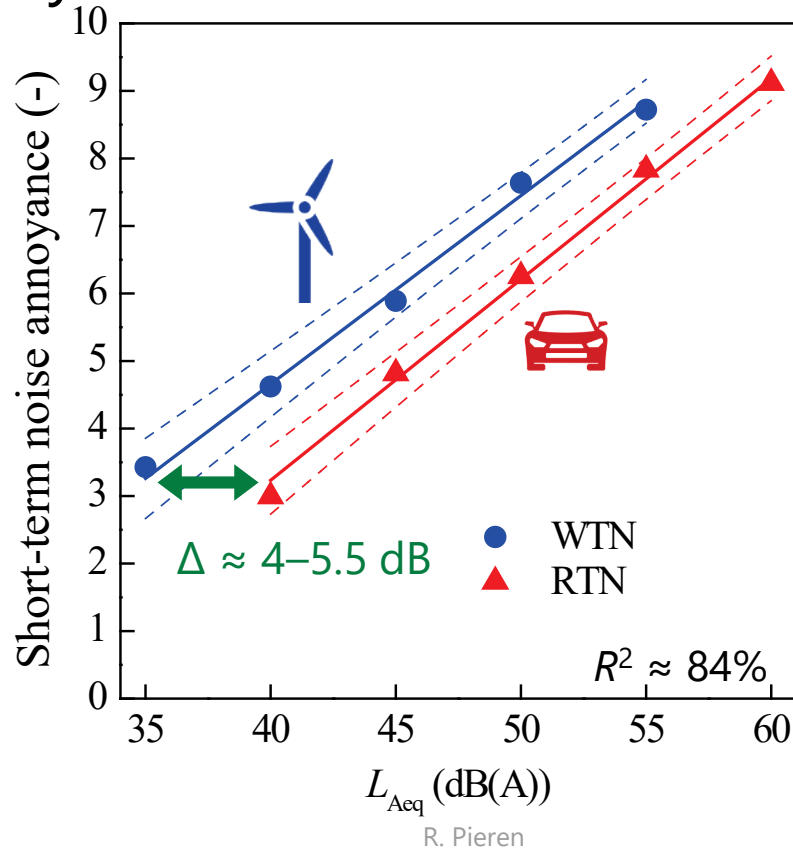
Applications

Why Auralization?



- Inclusion of sound perception in assessment
- Applications:
 - Communication instrument: intuitive instead of acoustical quantities, e.g. LAeq, RT, C80,...
 - Evaluation of design variants regarding geometry or materials
 - Research on sound perception

Application example: Psychoacoustic experiment on noise annoyance



[Schäffer, B. et al. 2016. Short-term annoyance reactions to stationary and time-varying wind turbine and road traffic noise: a laboratory study. *Journal of the Acoustical Society of America*, 139(5).]

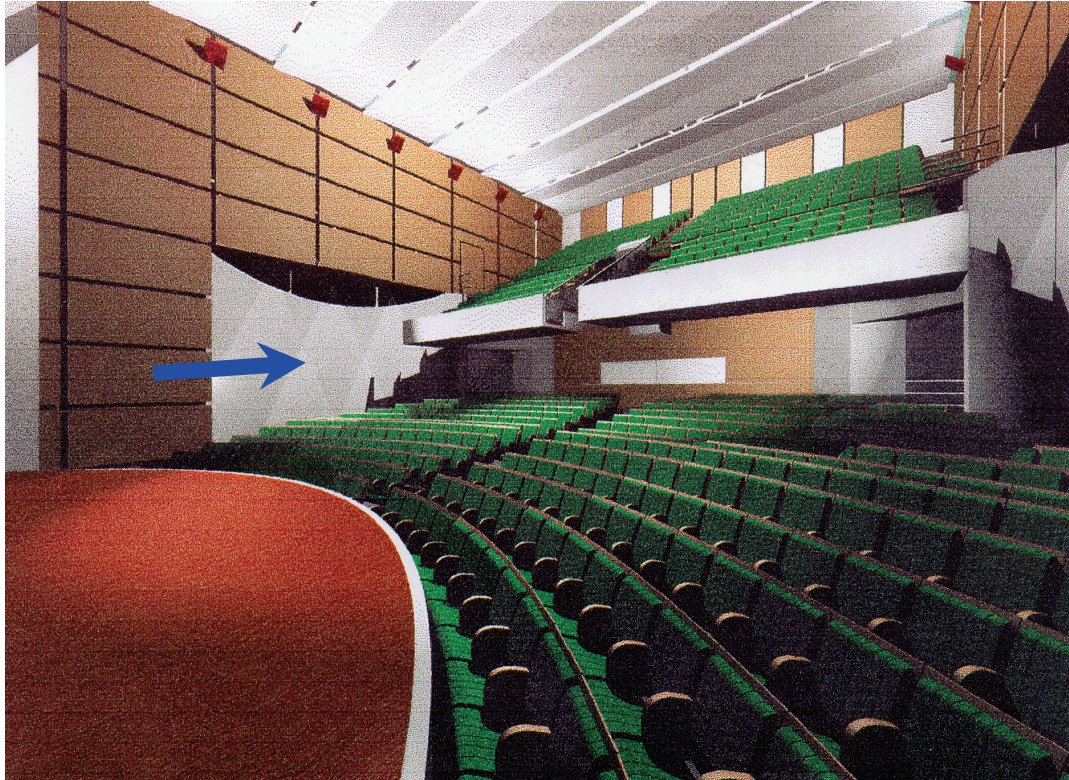
Application example: Presentation of potential railway noise mitigation measures



(picture by S2R at InnoTrans 2022)

Application example: Acoustical treatment of planned theater (concave surfaces)

without absorbers:

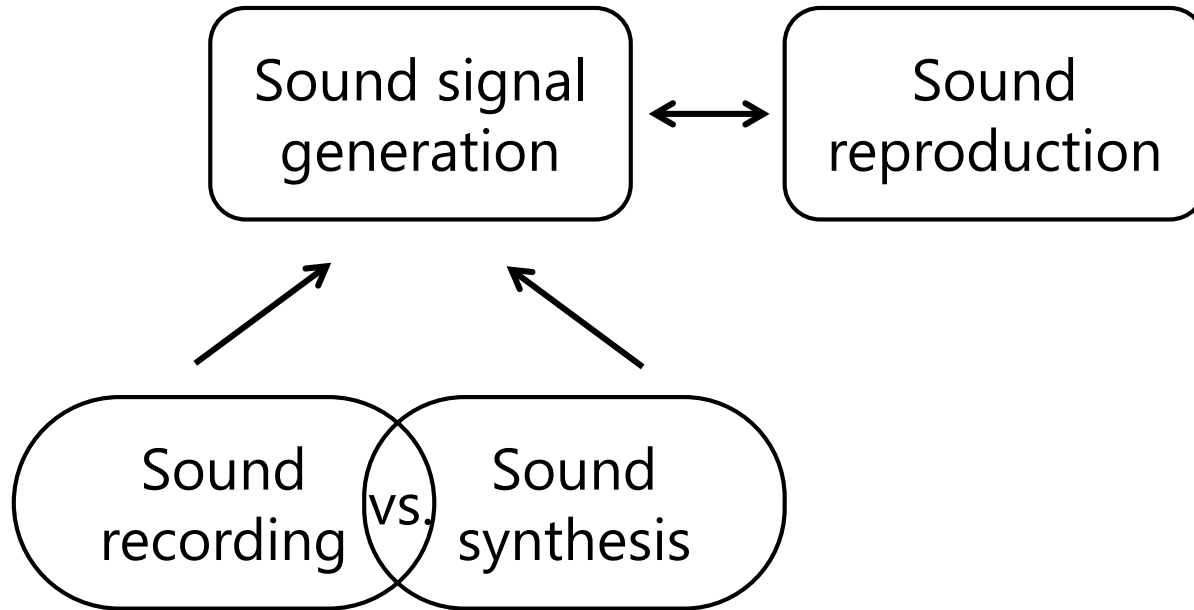


with absorbers:

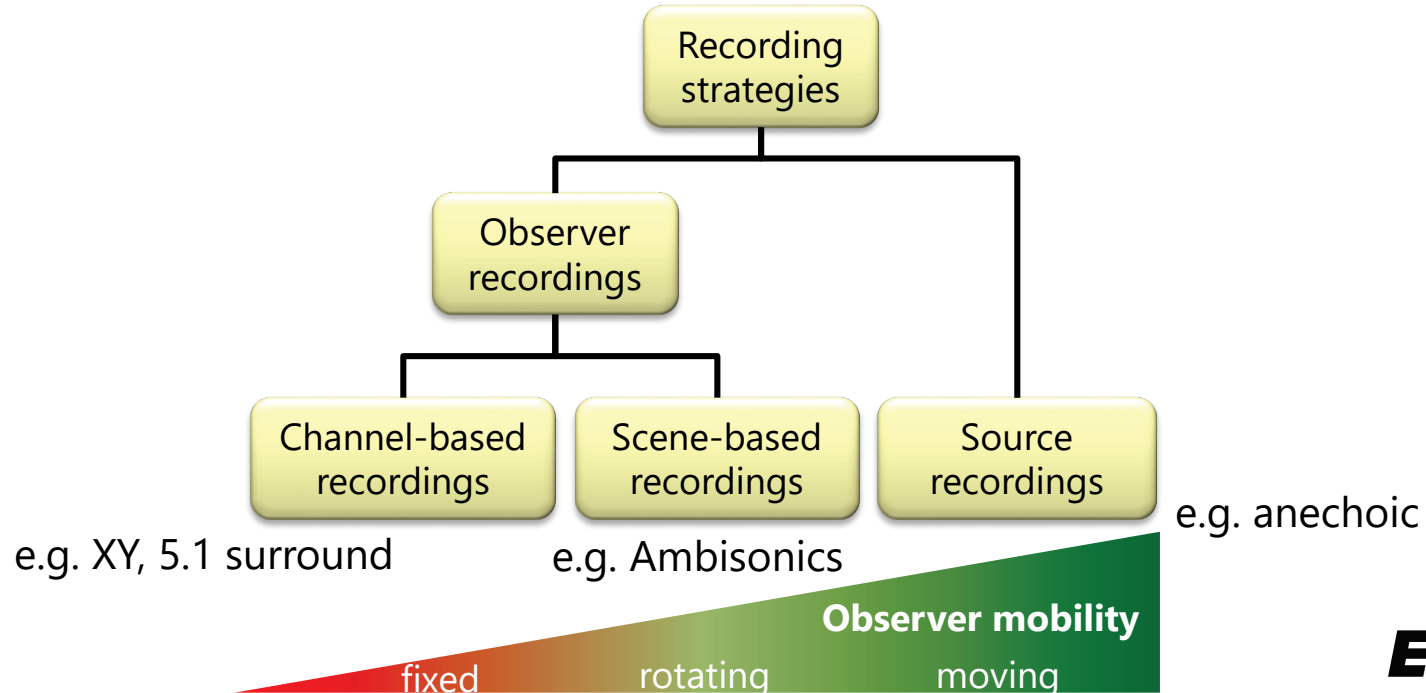


Principles

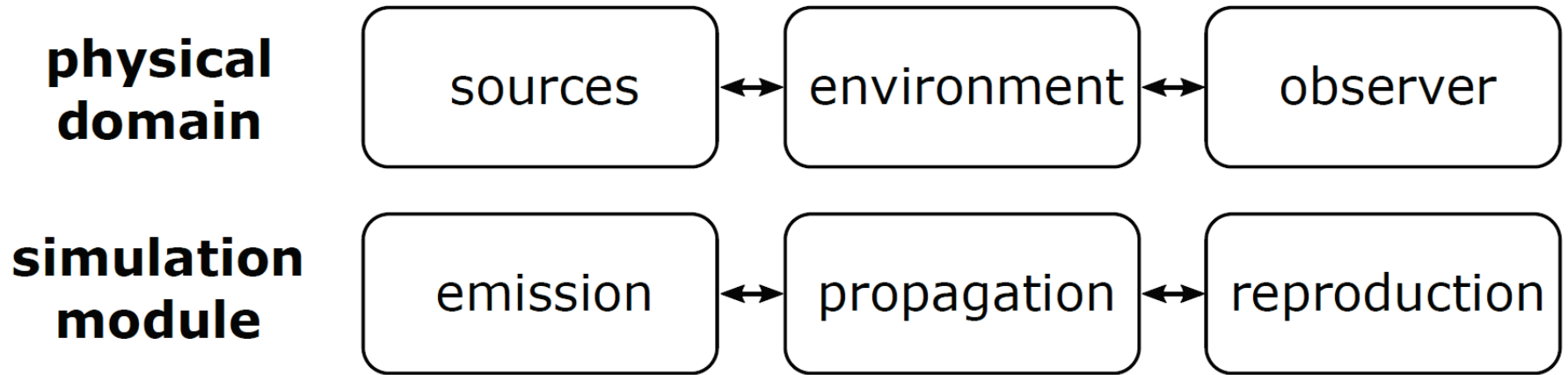
Principles: Two interlinked modules



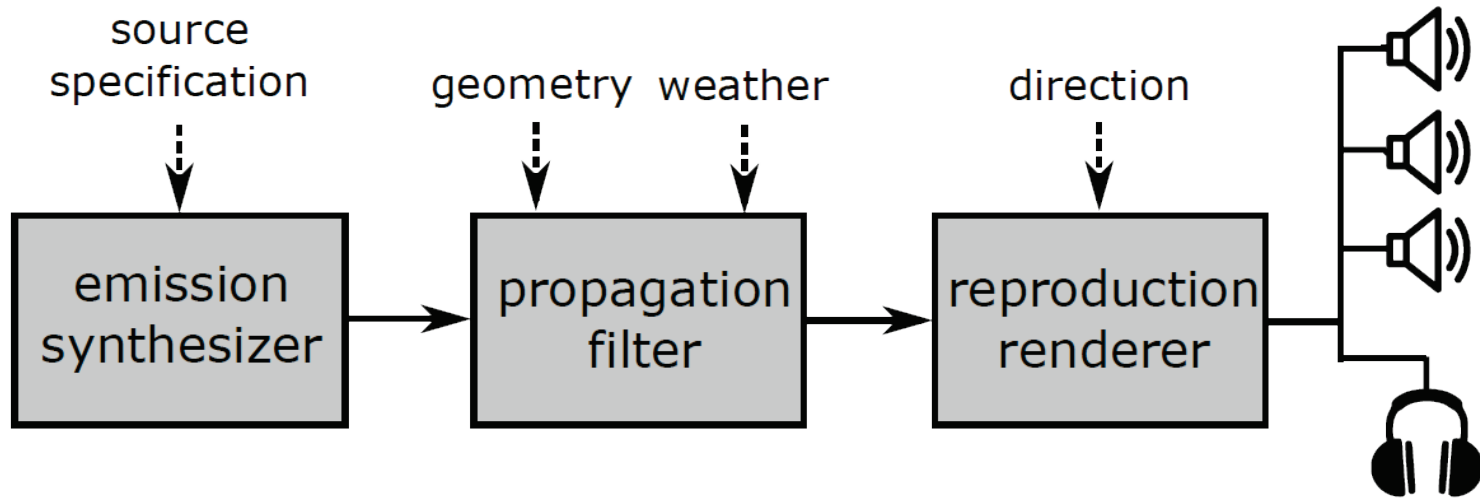
Principles: Sound recording types and their implication



General model structure: Source-path-receiver approach



Flexible auralization approach



- Synthesis of sound signals → source modifications
- Virtual sources in space (object-based modelling approach)
 - Propagation simulation → choose observer location
- Calculation of speaker feeds → different reproduction systems