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SCIENCE PASSION TECHNOLOGY

Workshop 7:

Breaking Barriers – Accelerating Heat Pump Deployment

Estimation of sound propagation using a web-based 2D-tool

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IEA HPT

Placement Impact on Heat Pump Acoustics
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Motivation

- A/W heat pumps are crucial for meeting environmental goals
- Outdoor units can cause noise concerns in residential areas
- Sound impact is difficult to judge from manufacturer data alone

⇨ **Development of a web-based tool that provides an easily accessible visualization of expected sound propagation for homeowners and planners**

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Modeling approach [1/2]

- A-weighted sound pressure level $L_p(d, \varphi)$ around an outdoor heat pump unit is estimated from manufacturer sound power data L_w
- Simplified model based on ISO 9613-2 (2024) considers installation-specific boundary conditions
- Hemispherical sound spreading over a reflecting ground plane is assumed: -8 dB conversion term
- Atmospheric absorption is neglected for short-range residential applications

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Modeling approach [2/2]

- $L_p(d, \varphi)$ is evaluated at receiver points in the horizontal map plane

$$L_p(d, \varphi) = L_w^{eff} - [20 \cdot \log_{10}(d) + 8] - A_{barrier} + C_{refl} + C_{dir}(\varphi) + C_{surf}$$

Main effects considered

- A_{shield} … **shielding:** Acoustic enclosures reduce the effective sound power level, $L_w^{eff} = L_w - A_{shield}$
- $A_{barrier}$ … **barriers:** Hedges / walls reduce the sound pressure level at the receiver due to barrier attenuation at a given wavelength ($\lambda = c_s / f$) and path-length difference (δ), $A_{barrier} = 10 \cdot \log(3 + 40 / \lambda \cdot \delta)$
- ***d* … distance attenuation:** Sound level decreases with increasing distance from the heat pump
- C_{refl} … **building reflections:** Nearby façades (+3 dB) or corner installations (+6 dB) can increase the sound level
- $C_{dir}(\varphi)$ … **directional radiation:** Fan orientation influences how sound spreads into the surroundings (e.g. -6 dB rearward)
- C_{surf} … **ground surface effects:** Hard surfaces reflect sound, while soft surfaces such as grass reduce propagation (-3 dB)

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Tool Architecture

- Web platform combining acoustic modeling with OpenStreetMap
- Builds on a previous tool from the Danish Technological Institute
- Users define heat pump type, position, orientation and surroundings
- Sound pressure levels are calculated on demand
- Calculated sound pressure leves are visualized as 2D sound propagation maps using geospatial data
- Modular structure enables multilingual use and regulatory adaptation

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Live Demonstration

More details during the pitch presentation on Friday, May 29, at 15:00!

For updates, visit:

https://heatpumpingtechnologies.org/project63/2dsp/

DISCLAIMER:

This free online tool provided by Institute of Thermal Engineering (TU Graz) is intended solely for scientific and demonstration purposes. It provides a non-binding estimate of heat pump sound levels based on simplified models and user-provided input data. Actual sound levels may vary significantly. The online tool does not replace professional planning, measurement, or official assessment. Verification by qualified experts is expressly recommended. The online tool is provided “as is”. TU Graz makes no warranties, whether expressed or implied, including, but not limited to, any implied warranties of fitness of the online tool for a particular purpose. TU Graz is not liable for any errors of the online tool and does not warrant or guarantee a specific utility of the online tool. The risk as to the quality, functionalism and performance of the online tool is with the user. In particular, TU Graz is not liable for direct or indirect damages or subsequent damages due to errors of the online tool.

Take-Home message

- Web-based tool for early-stage heat pump noise assessment
- Simplified ISO 9613-based model captures dominant short-range propagation effects
- Interactive map visualization supports homeowners, planners and communication
- Open and expandable platform for future regulatory and language adaptations

⇨ **Fast, intuitive map-based assessment of residential heat pump noise for early-stage planning and communication, not detailed expert noise assessment.**

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