DATA SONIFICATION

1

DEFINING DATA SONIFICATION

"The use of non-speech audio to convey information."

"The transformation of data relations into perceived relations in an acoustic signal for the purposes of facilitating communication or interpretation"

Kramer et al., 1999

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2

WHY USE DATA SONIFICATION?

- Omnidirectional hearing
- Monitoring multiple streams of information
- Detecting pattern deviations
- Engagement

Is data sonification trying to replace data visualization? **No**

Bornmann, 2024; Naatanen et al., 2007; Qi et al., 2007; Daye & de Campo, 2006; Hermann et al., 2011 3

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FUNCTIONS OF DATA SONIFICATIONS

Data Exploration	Alerts	Status Monitoring	Art & Entertainment
• Analysis • Communication	• Briefly communicates simple information	• Dynamic information • Can be higher complexity	• Systematic musical compositions

Hermann et al., 2011 4

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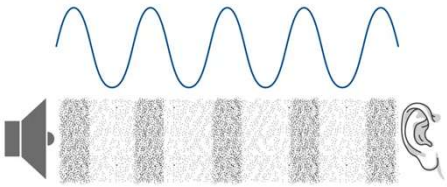
APPROACHES TO DATA SONIFICATION:
AUDIFICATION

Turn periodic data into sound waves

… This doesn't always sound great.



Hermann et al., 2011 [5]

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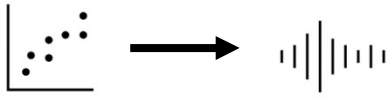
APPROACHES TO DATA SONIFICATION:
PARAMETER MAPPING

Turn data dimensions into acoustic dimensions



- Pitch
- Loudness
- Spatialization
- Duration
- Tempo
- Timbre and Instrumentation

Dubus & Bresin, 2013; Hermann et al., 2011 [6]

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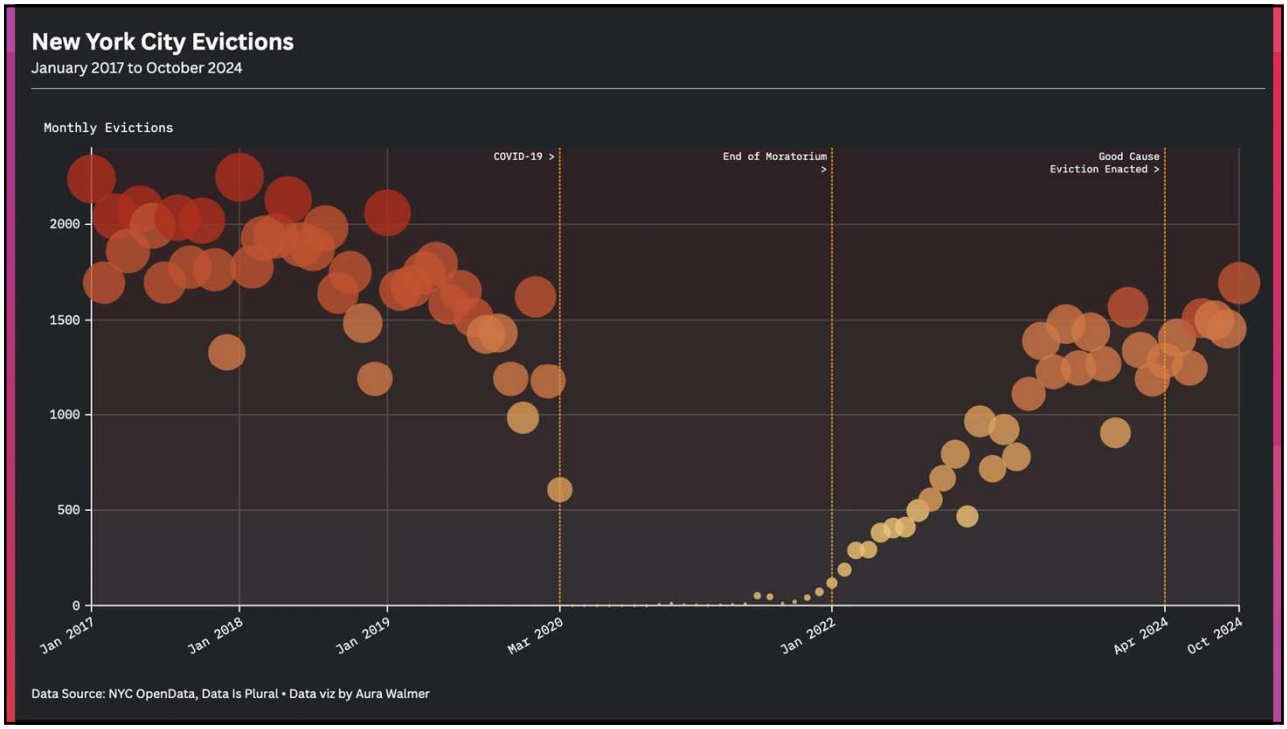

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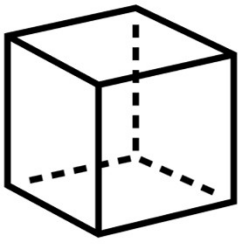
APPROACHES TO DATA SONIFICATION:
MODEL-BASED SONIFICATION

Making use of dynamic models which mathematically describe the evolution of a system in time



Hermann et al., 2011 8

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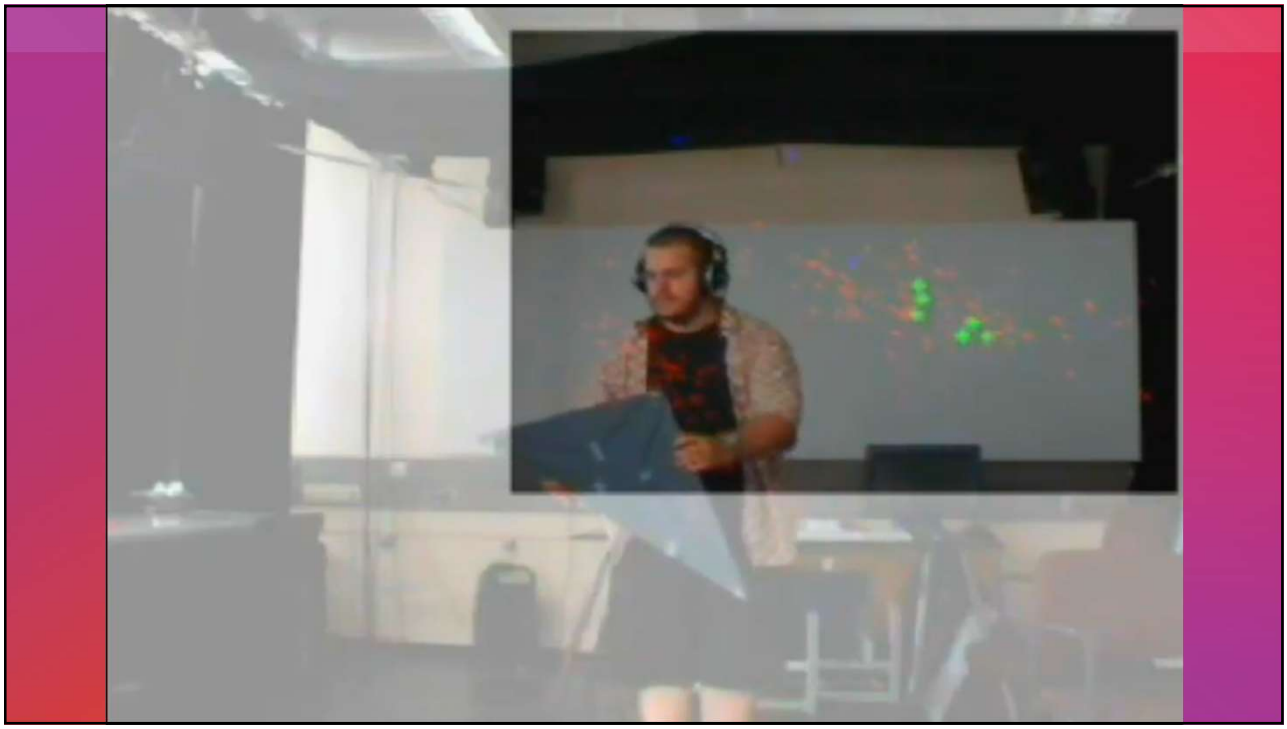

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1. Objective and systematic mapping or transformations
2. Reproducible
3. Adherent to principles of auditory perception

BEST PRACTICES

Hermann, 2008[10]

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Pitch

- Most used dimension
- We can detect small pitch changes
- Consider perception of polarity

Polarity: How a change in a data dimension is mapped onto a change in pitch

AUDITORY DIMENSIONS

WHAT TO CONSIDER WHEN MAPPING DATA

Flowers, 2005; Hermann et al., 2011 [11]

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Loudness

- Use to signal a critical event
- Do not use to communicate continuous quantitative information

Why? Poor loudness discrimination & low fidelity of output

AUDITORY DIMENSIONS

WHAT TO CONSIDER WHEN MAPPING DATA

Flowers, 2005; Hermann et al., 2011 [12]

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Tempo

- Good perception of changes in rhythm
- Not recommended often

Consider tempo as time!

AUDITORY DIMENSIONS

WHAT TO CONSIDER WHEN MAPPING DATA

Flowers, 2005; Hermann et al., 2011 13

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Timbre

- Good for discrimination between data streams or points
- Choose distinct timbres

Caution: research is limited!

AUDITORY DIMENSIONS

WHAT TO CONSIDER WHEN MAPPING DATA

Flowers, 2005; Hermann et al., 2011 14

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AUDITORY DIMENSIONS

WHAT TO CONSIDER WHEN MAPPING DATA

Don't do too much at once!

Flowers, 2005 [15]

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BARRIERS

- Lack of standardized guidelines
- Lack of effectiveness research
- Issues with individual differences and training
- Lack of software

Hermann et al., 2011, Worral, 2019

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SOFTWARE

Highcharts

R sonify

Python & Sonipy

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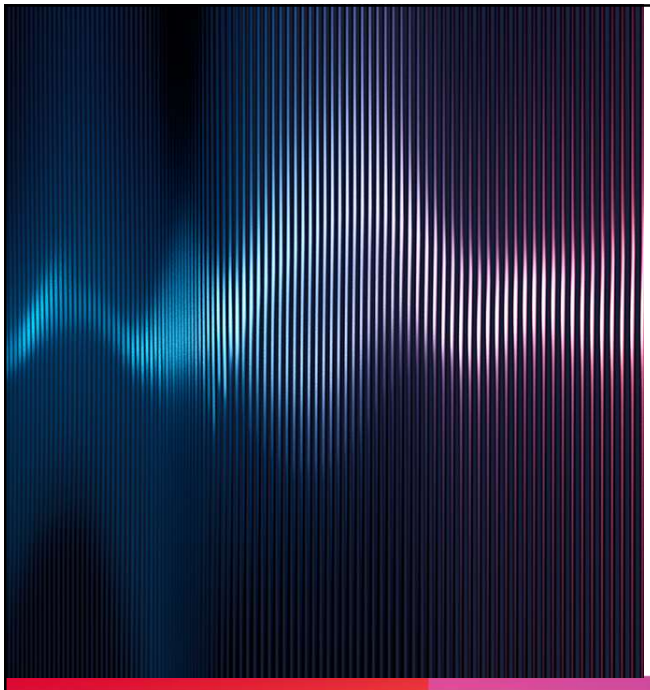

THANK YOU!

Resources of note

The Sonification Handbook (free)

https://sonification.de/handbook/

Highcharts (simple sonfication software)

https://sonification.highcharts.com/#/app

Data sonification archive

https://sonification.design/

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