

# *Sonification - Sound of Science*

## *VU, WS 2013*

*Lecture 1 - Intro to Sonification*

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# *Sonification - Sound of Science*

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- Organizational (important dates, topics, assignments, grading system)
- Your background and interests (audio programming languages, sonification experience)
- Intro to sonification

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02.10.13	Intro to Sonification
09.10.13	Auditory Scene Analysis
16.10.13	Data and programs
23.10.13	Audification, Auditory Icons and Earcons
30.10.13	Parameter Mapping
06.11.13	Model-Based Sonification
13.11.13	Interactive Sonification
20.11.13	Aesthetics and Computer Music
27.11.13	Project plan - Feedback
04.12.13	Sonification Hackathon
15.01.14	Project presentation and Installation

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The grading criteria:

creativity, execution, and presentation

- Assignments (60%)
- Final Project and Installation (40%)
- Papers and Research (extra 20%)

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For next week:

Download Super Collider from: <http://www.supercollider.sourceforge.net>

Read at least one of these papers and be ready to talk about them in the class:

[1] T. Hermann, A.V. Nehls, F. Eitel, T. Barri, and M. Gammel, "Tweetscapes - real-time sonification of twitter data streams for radio broadcasting," in Proc. of the International Conference on Auditory Display, 2012.

[2] D. Pirro`, A. Wankhammer, P. Schwingenschuh, A. Sontacchi, and R. Ho`ldrich, "Acoustic interface for tremor analysis," in Proc. of the International Conference on Auditory Display, 2012.

[3] R. McGee, J. Dickinson, and G. Legrady, "Voice of sisyphus: An image sonification

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stethoscope

geiger counter

sonar

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Why sound is used spontaneously?

- tradition of listening to the data (e.g. medicine, mechanics)
- technological reason:
  - no other measurement device is available
  - sound is a by-product of measurement
  - domain science and sound use the same technological aids
- monitoring processes

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### Advantages of Sonification

- advantages of our auditory perception:
  - high temporal resolution
  - large frequency range
  - omnidirectional
  - parallel auditory streams, backgrounding
- eye-free conditions ( e.g. sight-impaired)
- useful when visual information overload



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### Limiting Factors of Sonification

- sound parameters lack strict orthogonality
- individual differences and necessity of training (perceptual and cognitive abilities of the users)
- aesthetics: sound can easily get annoying
- longer history of visualization
- user's cultural bias

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A taxonomy of intended sonification uses

- presentation: auditory demonstration of finished results
- exploration: interaction with the data; heuristic for generating hypotheses (because of high temporal resolution of auditory, pattern detection and anomalies)
- analysis: requires well-understood, reliable tools for detecting specific phenomena (e.g. trend identification, data structure or pattern recognition)
- monitoring: processes that benefit from continuous monitoring by observer (industrial production, hospitals), any sudden change is hearable
- pedagogy: learning and understanding structures and patterns in data for non visual students or visually impaired
- artistic uses: sonification-based sound art and installations

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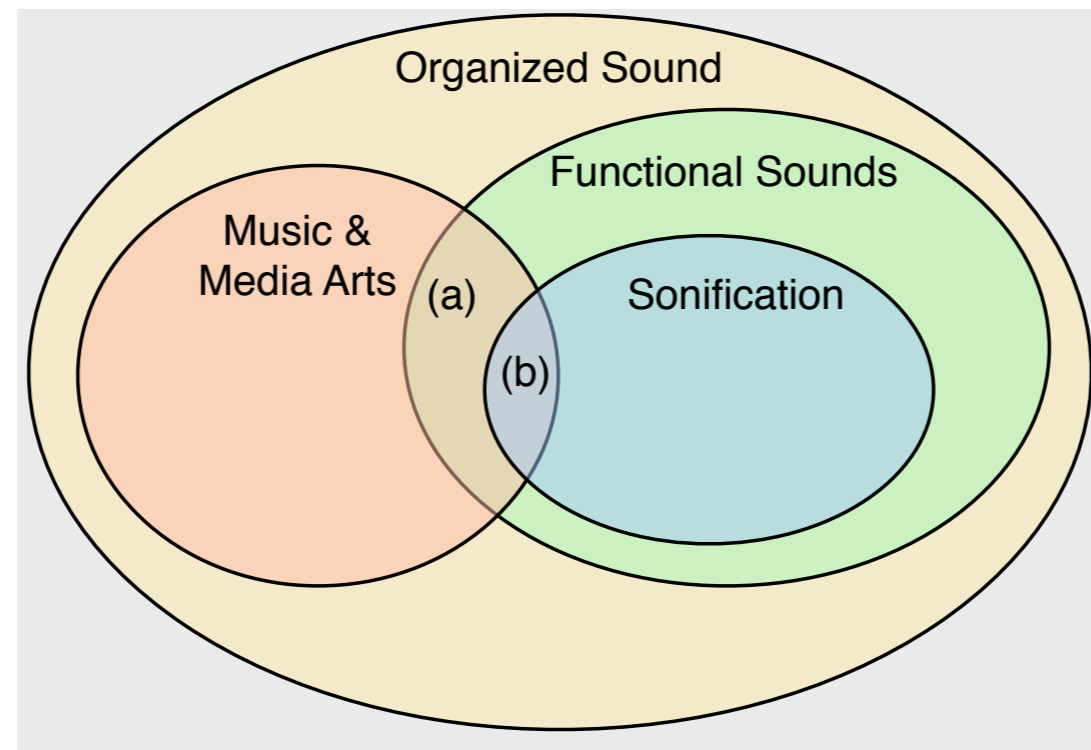
<http://heavylisting.com/tweetscapes/>

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*sonification is the use of non-speech audio to convey information [Kramer 99]*

*sonification is the data-dependent generation of sound, if the transformation is systematic, objective and reproducible, so that it can be used as scientific method. [Hermann 09]*



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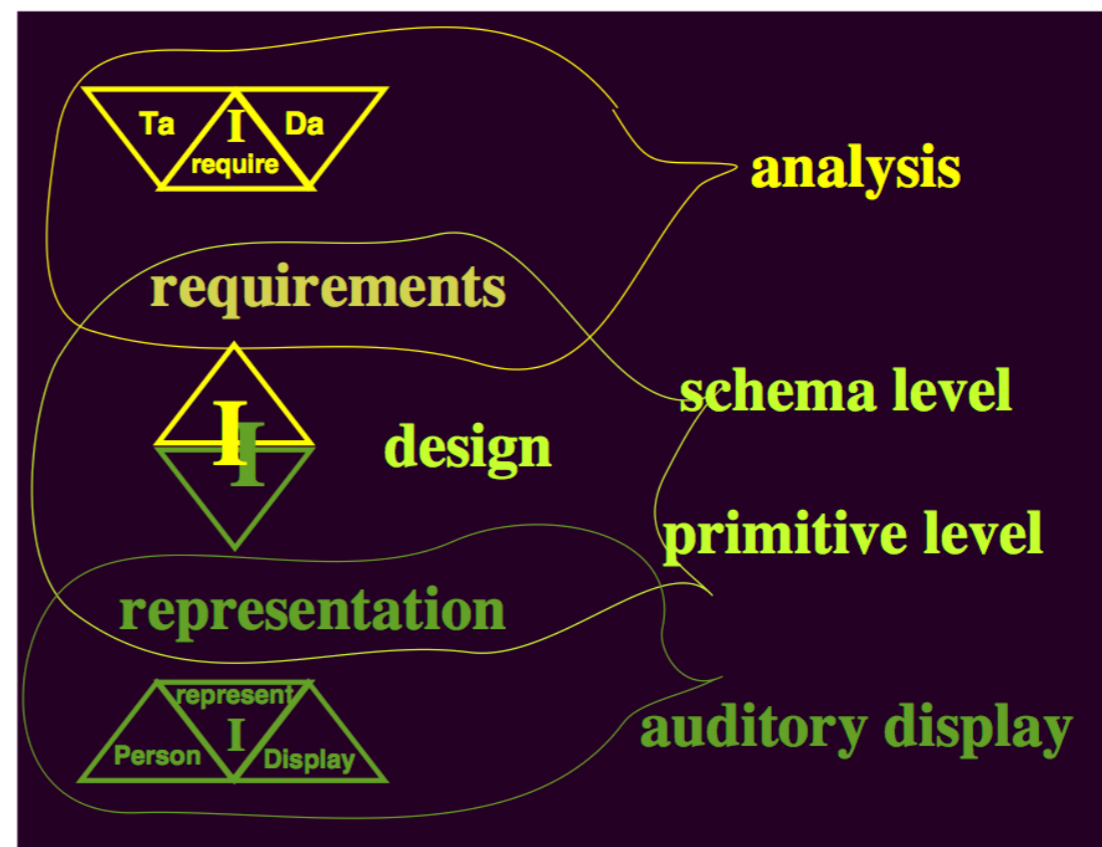
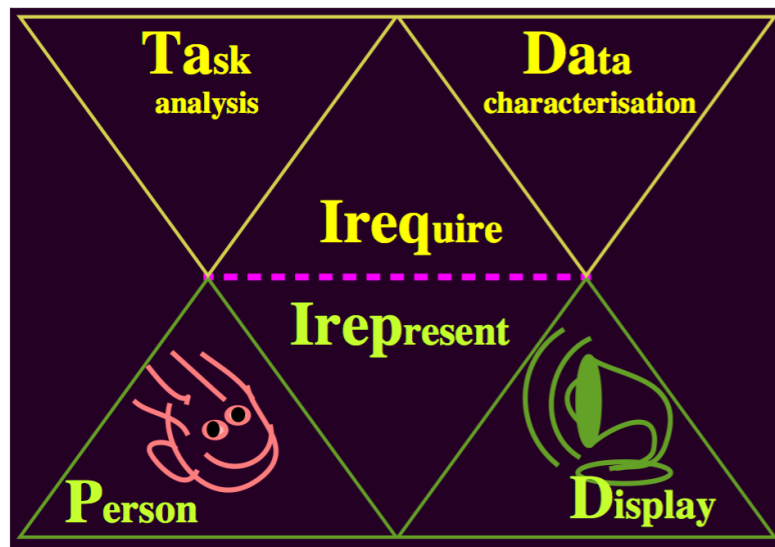
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1. research question - hypothesis and prediction
2. data description (e.g. using TADA)
3. choosing a sonification method (e.g. using SDSM)
4. how could it sound like? (using metaphors)
5. describing the sonification designs
6. sound synthesis, transfer function, sonification operator
7. discussion: what is hearable? how does it sound like? does it need any filtering, scaling, ...
8. gathering results, hypothesis
9. evaluations (using the sonification tool, how fast and how efficient can the user solve the problems? with how much training?) : clarity, efficiency, intuitivity, technical effort, ...

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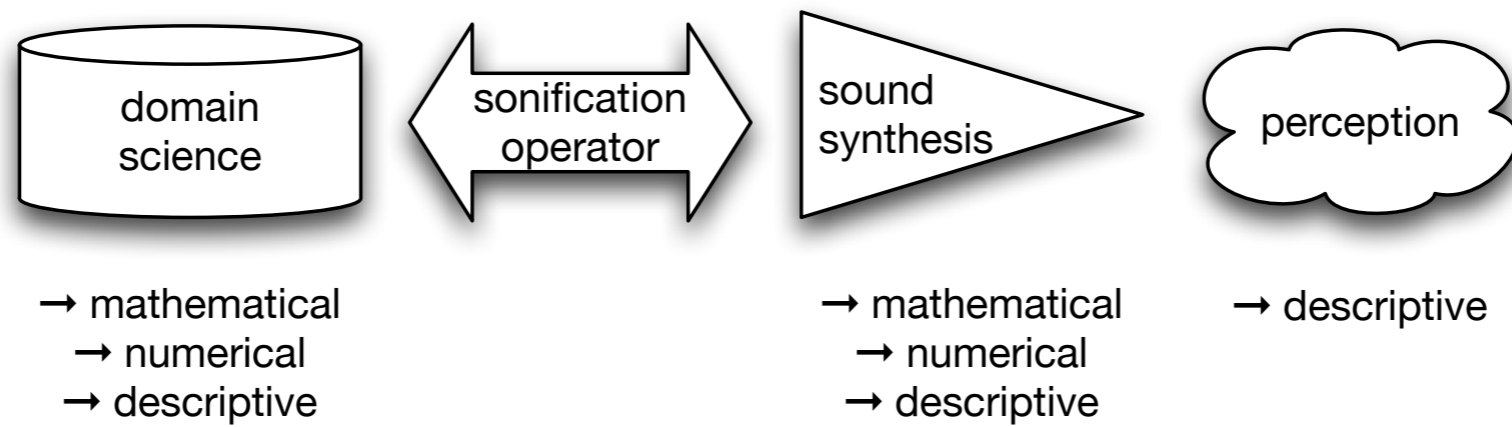
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*TADA: Task and Data Analysis*  
Stephen Barrass



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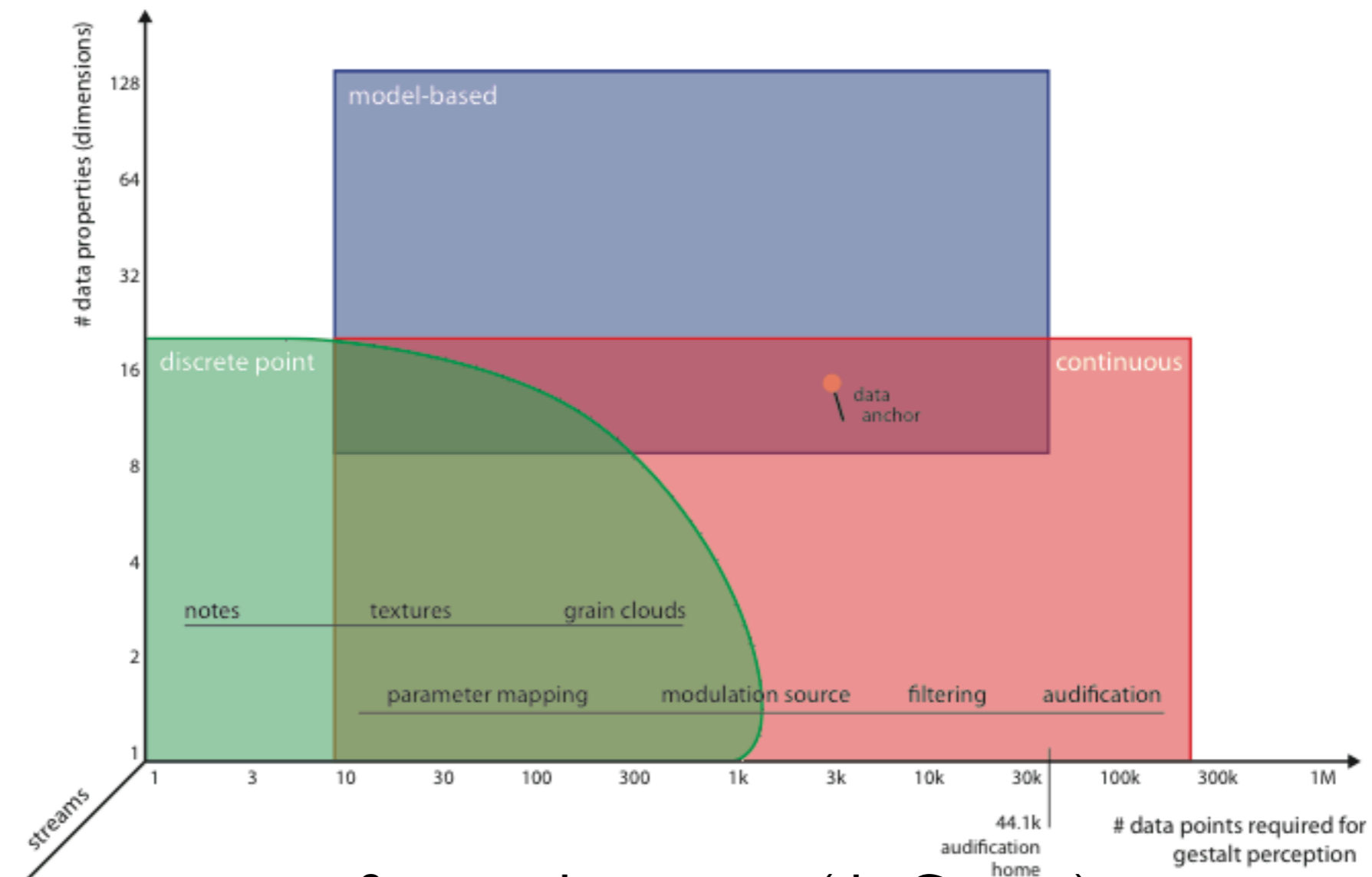


$$\mathring{S} : \mathring{D} \rightarrow \mathring{Y}$$

sonification operator is a function from the data space to the sound space

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sonification design map (de Campo)

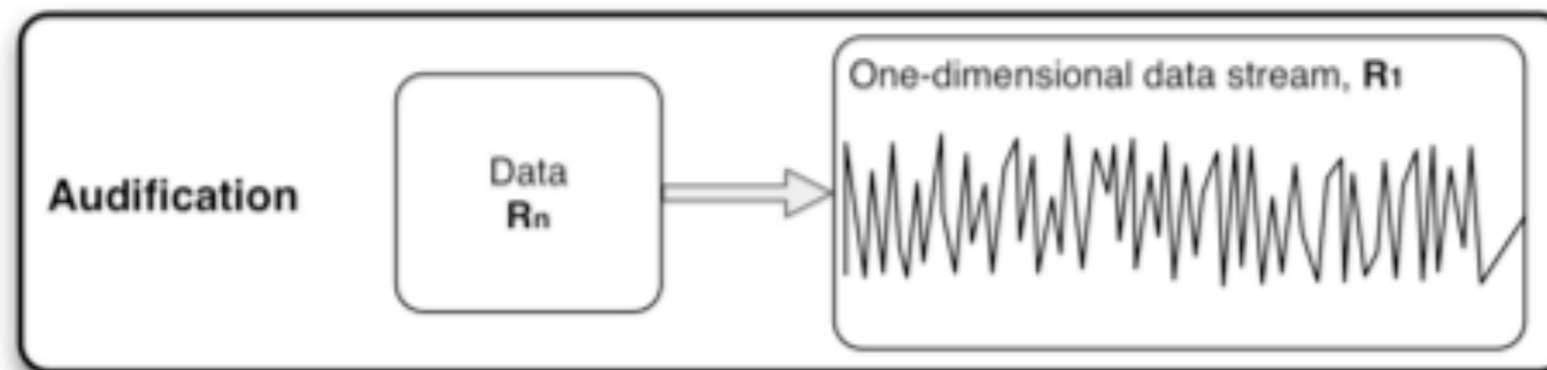


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### *sonification techniques and approaches*

*Audification is the most prototypical method of direct sonification, whereby waveforms of periodic data are directly translated into sound.*  
[Kramer]



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*example: medicine*

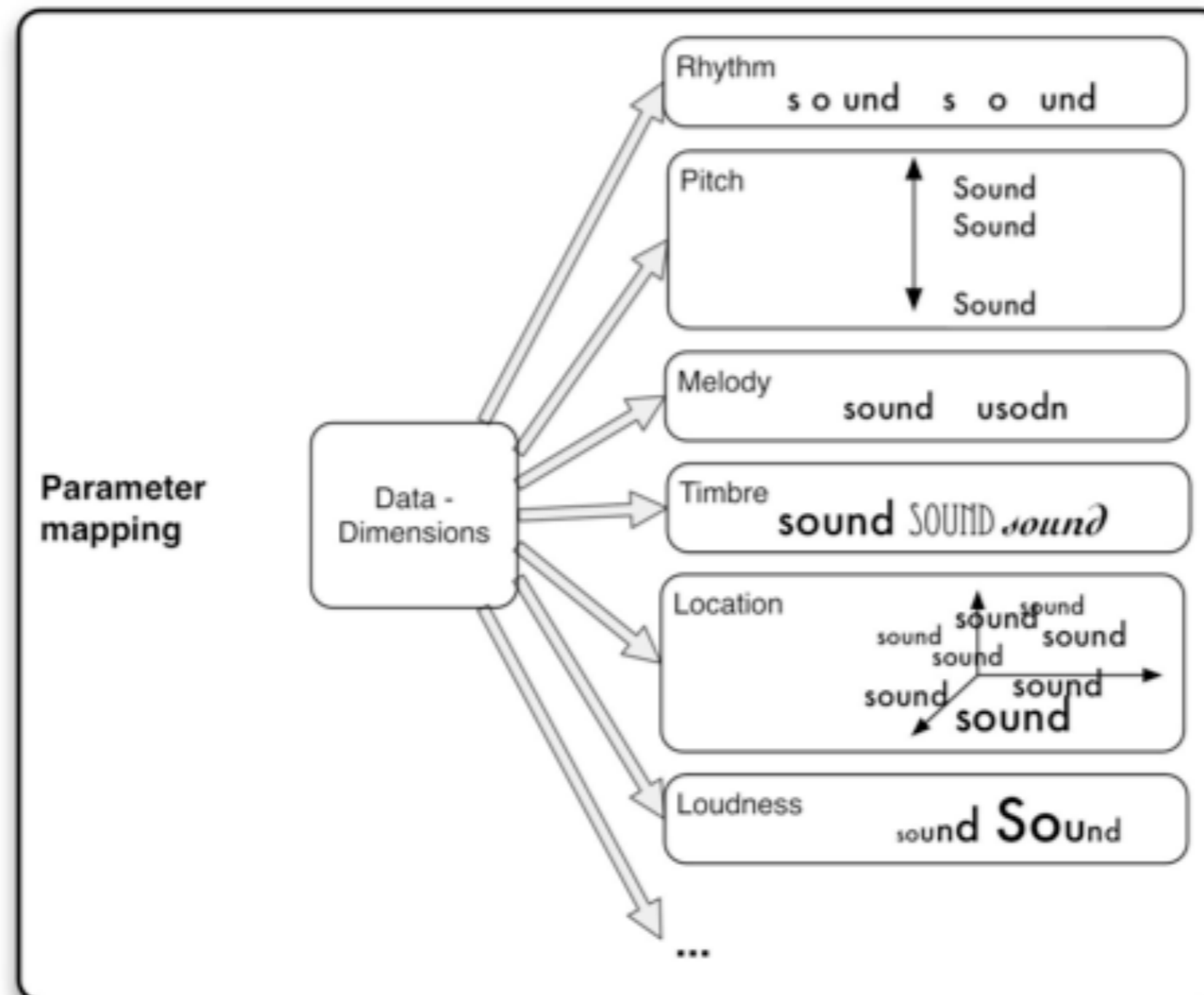
parkinson

essential

psychogenic

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*sonification techniques and approaches*



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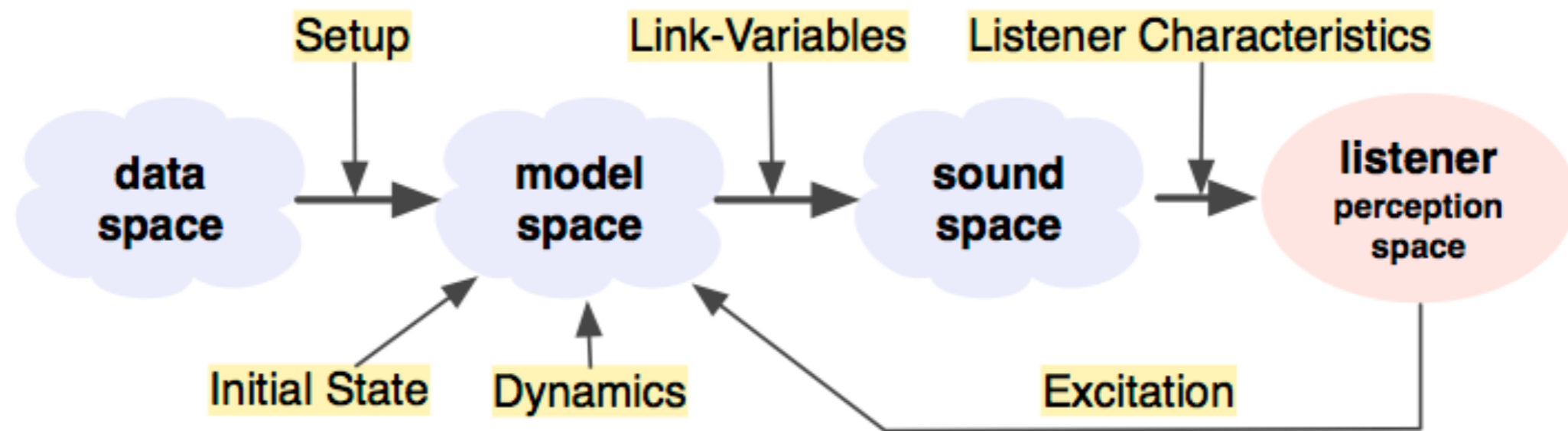
*example: sports, movement sonification*



[http://tangibleauditoryinterfaces.de/  
index.php/tai-applications/ jugglingsounds/](http://tangibleauditoryinterfaces.de/index.php/tai-applications/jugglingsounds/)

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### References

The Sonification Handbook. Edited by Thomas Hermann, Andy Hunt, John G. Neuhoff Logos Publishing House, Berlin 2011, 586 pages, 1. edition (11/2011). ISBN 978-3-8325-2819-5

ONLINE!: <http://sonification.de/handbook/>

International Conference on Auditory Display – Papers: <http://icad.org/biblio>

Kramer, Gregory, ed. (1994). Auditory Display: Sonification, Audification, and Auditory Interfaces. Santa Fe Institute Studies in the Sciences of Complexity. Proceedings Volume XVIII. Reading, MA: Addison-Wesley. ISBN 0-201-62603-9.

Das geschulte Ohr . Eine Kulturgeschichte der Sonifikation Hrsg. v. Andi Schoon u. Axel Volmar. Verlag transcript. 2012. ISBN 978-3-8376-2049-8

[TADA] Barrass, St., Auditory Information Design, PhD thesis, The Australian National University, 1997.

[SDSM] De Campo, A., Science by Ear. An interdisciplinary Approach to Sonifying Scientific Data. Dissertation. Institute of Electronic Music and Acoustics, University of Music and Dramatic Arts, Graz, 2009.

[Sonification Operator] Vogt, K., Höldrich, R., Translating Sonifications, J. Audio Eng. Soc., Vol. 60, No. 11, pp.