Mapping

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Digital Lutherie
Master en Música para Experiencias del Entretenimiento
ENTI-UB

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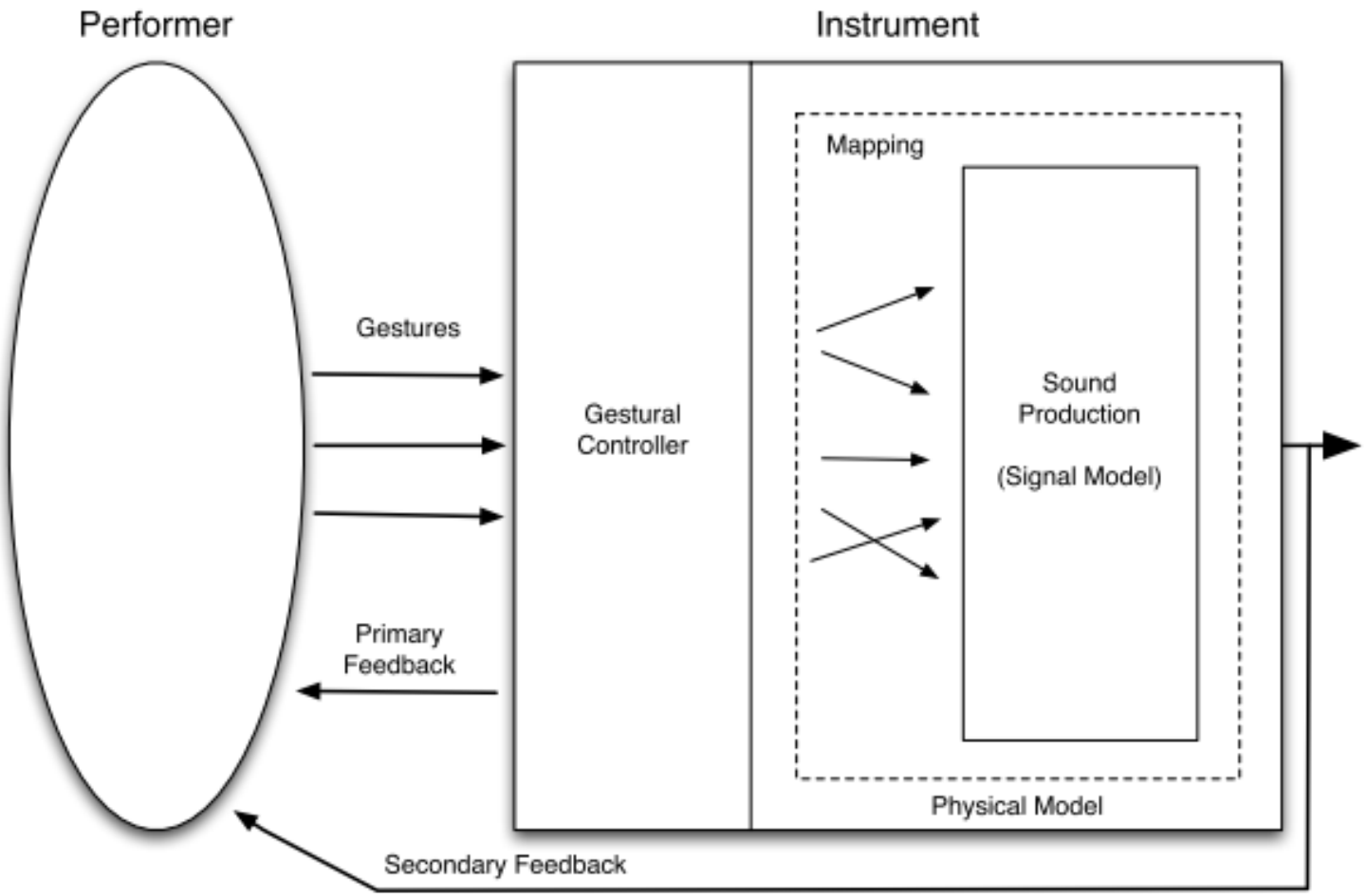
Outline

Mapping



Wanderley, M. M. (2001). Performer-Instrument Interaction: Applications to Gestural Control of Sound Synthesis. PhD thesis, University Paris 6.

Outline

Definition

"In an acoustic instrument, the playing interface is inherently bound up with the sound source. [...] Since they are inseparable, the connections between the two are complex, subtle and determined by physical laws. With electronic and computer instruments, the situation is dramatically different. [...] This means that the relationship between them has to be defined. The art of connecting these two, traditionally inseparable, components of a real-time musical system (an art known as **mapping***) is not trivial."*[1]

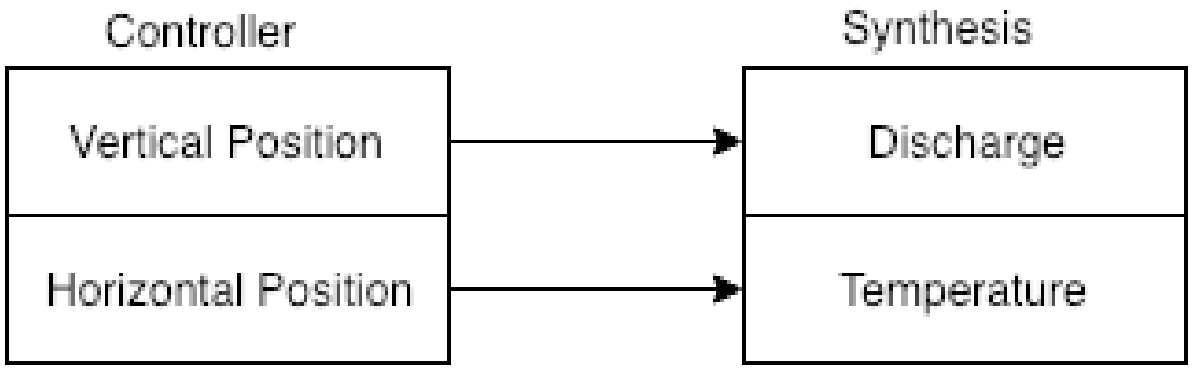
[1] Hunt, A., Wanderley, M. M., West, S. S., & Paradis, M. (2002). The importance of parameter mapping in electronic instrument design. Proceedings of the 2002 Conference on New Instruments for Musical Expression (NIME-02).

Definition


Controller
Control Parameters
Mapping
?
Synthesis
Sound Variables

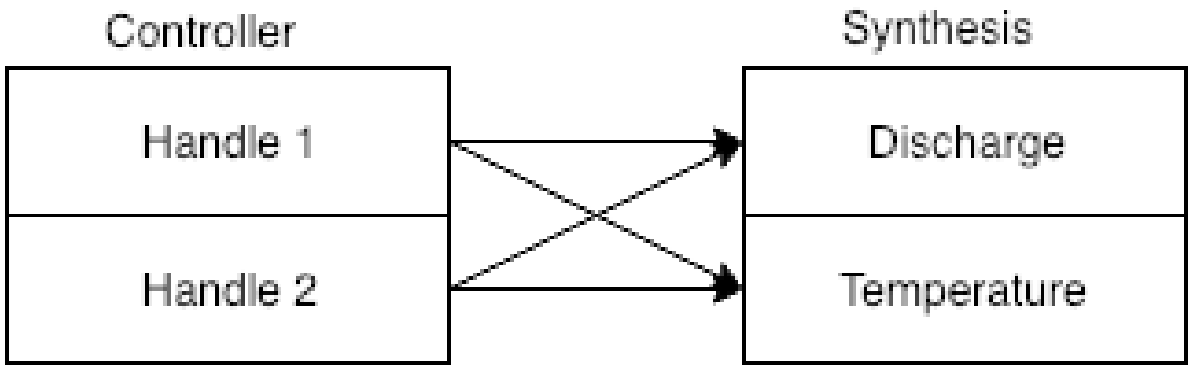
Definition

Definition


Controller
Synthesis
Vertical Position
Horizontal Position
Discharge
Temperature

Definition

Definition


Controller
Synthesis
Handle 1
Handle 2
Discharge
Temperature

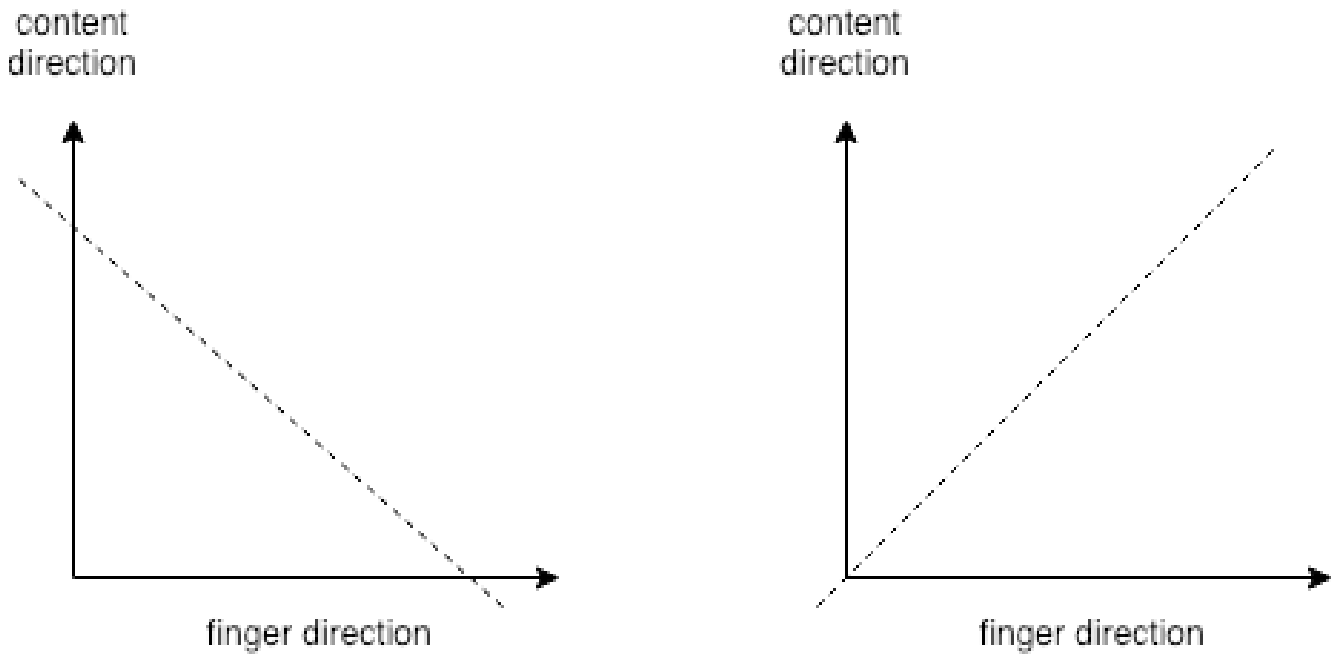
Definition

Which one is better?

Definition

Definition

Reverse scrolling vs. natural scrolling



Definition

Which one is better?

Outline

Taxonomy

Mapping types

- One-to-one
  - Each input parameter controls one sound variable.
  - The most simple approach...
  - Example: Theremin

Taxonomy

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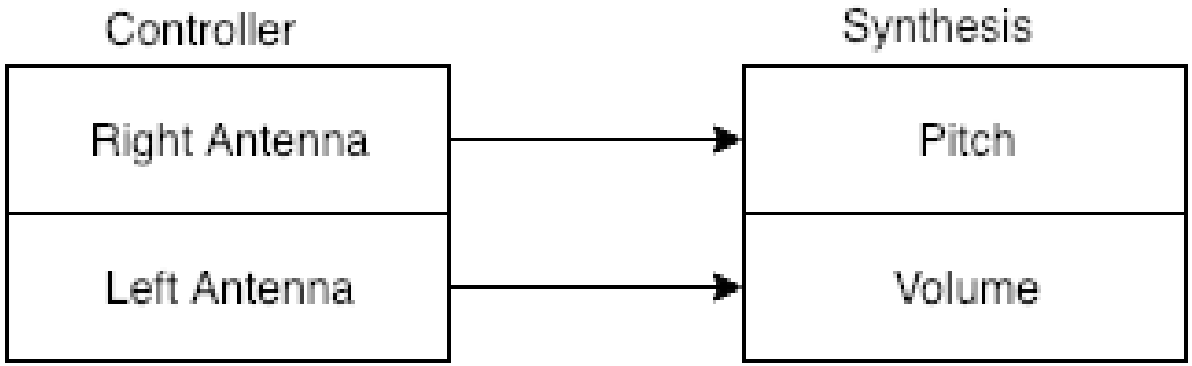

Taxonomy

Mapping types

- Many-to-one (converegent)
  - Multiple input parameters control the same only sound variable.
  - Example: Violin (*"Where is the volume control?"*)[2]

[2] Hunt, A. (2000). Mapping Strategies for Musical Performance.

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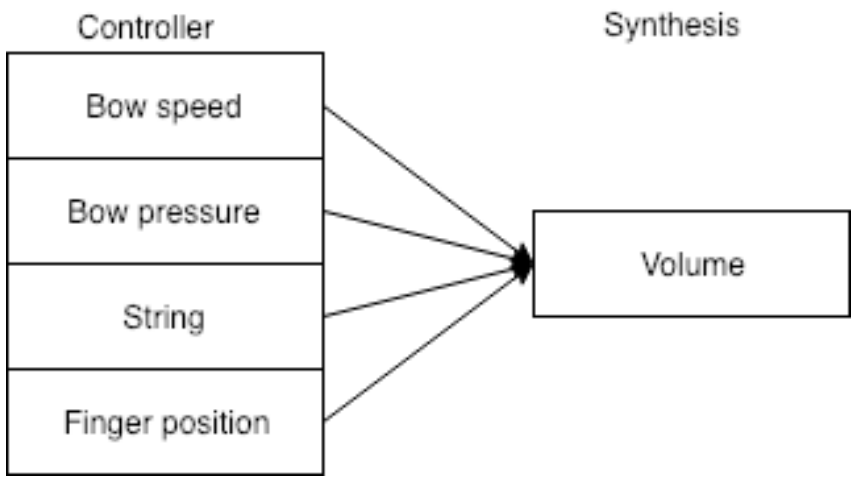

[3] Hunt, A. (2000). Mapping Strategies for Musical Performance.

Taxonomy

Mapping types

- One-to-many (divergent)
  - One input parameter controls many sound variables.
  - Example: Violin (*"Which sonic parameter does the bow control?"*)[4]

[4] Hunt, A. (2000). Mapping Strategies for Musical Performance.

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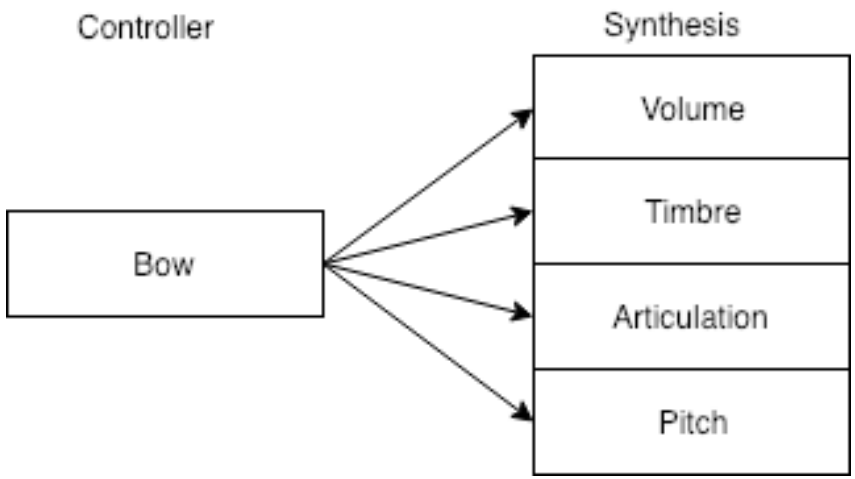


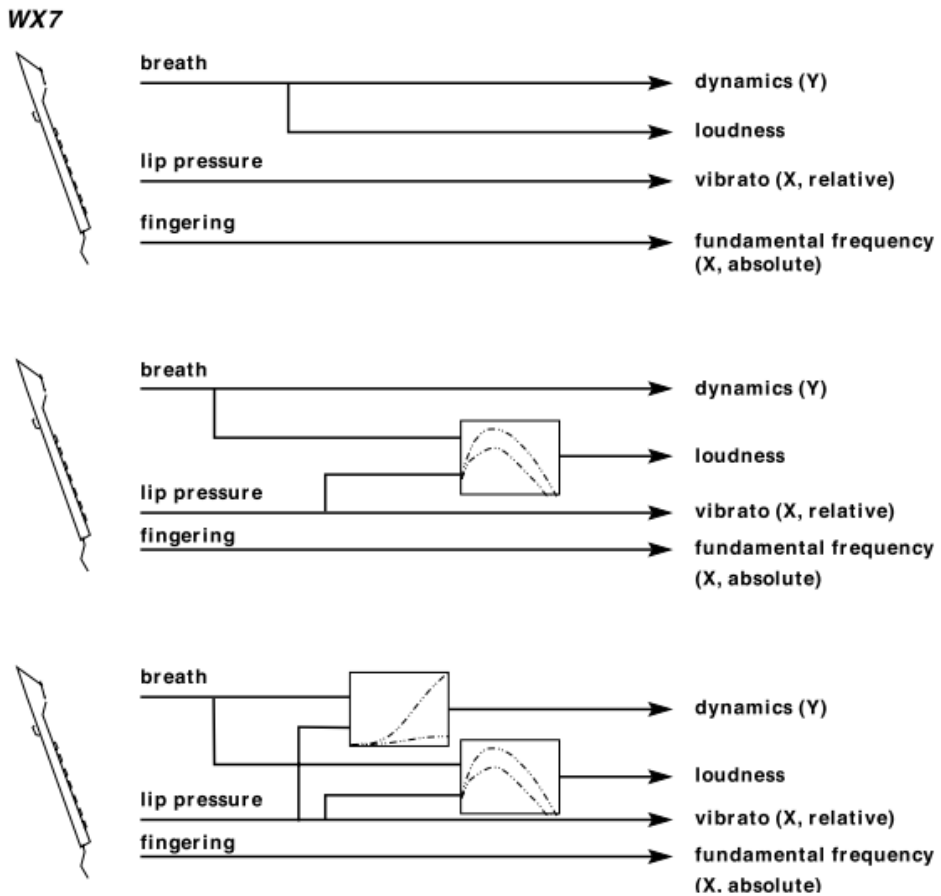
[5] Hunt, A. (2000). Mapping Strategies for Musical Performance.

Taxonomy

Acoustic instruments present multiple simultaneous convergent/divergent mappings...

Taxonomy

Rovan's clarinet experiment[6]



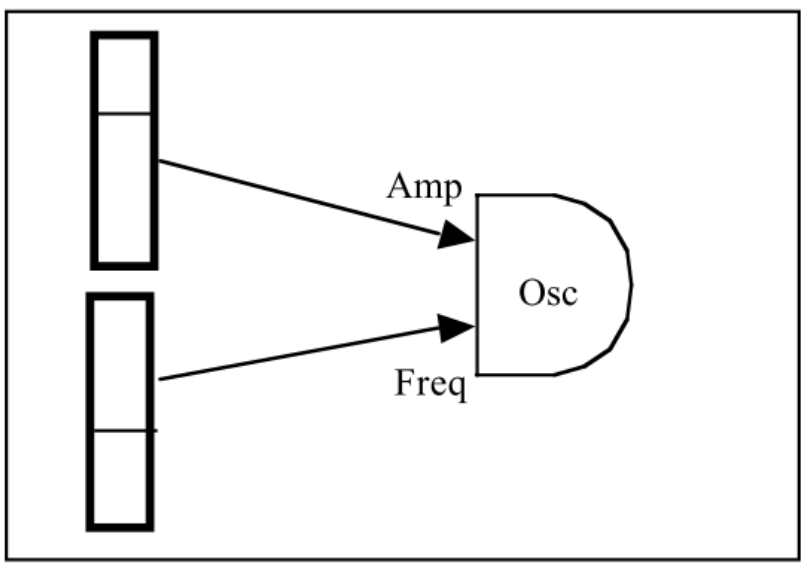
[6]Hunt, A., Wanderley, M. M., West, S. S., & Paradis, M. (2002). The importance of parameter mapping in electronic instrument design. Proceedings of the 2002 Conference on New Instruments for Musical Expression (NIME-02).

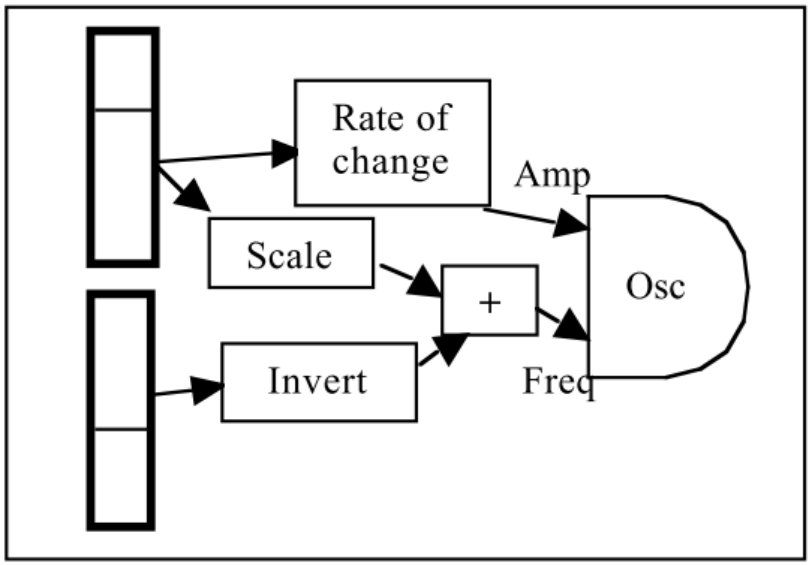
Taxonomy

Which one is better?

Taxonomy

Hunt's Observation[7]





[7]Hunt, A., Wanderley, M. M., West, S. S., & Paradis, M. (2002). The importance of parameter mapping in electronic instrument design. Proceedings of the 2002 Conference on New Instruments for Musical Expression (NIME-02).

Taxonomy

Which one is better?

Outline

Design Considerations

What about alternate controllers?

Design Considerations

- Metaphors
- Multi-level mappings
- Machine Learning

Design Considerations - Metaphors

General tendency to map gestures with parameters in a idiosyncratic way.

Design Considerations - Metaphors

"In many real-time devices (for example a violin, a bicycle, a clarinet or a drum-kit) the human operator has to inject energy or 'excite' the system before it will operate, and must continue to supply energy to keep it going."[8]

[8] Hunt, A. (2000). Mapping Strategies for Musical Performance.

Design Considerations - Metaphors

"[...] a wiring mistake by the student meant that the 'volume' antenna only worked when your hand was moving. [..] It was unexpectedly exciting to play. The volume hand needed to keep moving back and forth, rather like bowing an invisible violin. [...] Because of the need to keep moving, it felt as if your own energy was directly responsible for the sound. When you stopped, it stopped. The subtleties of the bowing movement gave a complex texture to the amplitude. We were 'hooked'."[9]

[9] Hunt, A., Wanderley, M. M., West, S. S., & Paradis, M. (2002). The importance of parameter mapping in electronic instrument design. Proceedings of the 2002 Conference on New Instruments for Musical Expression (NIME-02).

Design Considerations - Metaphors

"[...] tampering with the apparent laws of physics is a luxury made possible in virtual environments. By being aware of these laws, it is possible to alter them for provocative and intriguing artistic effects, creating models of response unique to the computer. More furious and strenuous activity, for example, could result in quieter sounds and silence. [...] Such 'unnatural' correlations makes motion all the more meaningful."[10]

[10] Winkler, T. (1995). Making Motion Musical : Gesture Mapping Strategies for Interactive Computer Music.

Design Considerations - Metaphors

myo synth 4 linux

Design Considerations - Multi-level Mappings

Adding intermediate abstraction layers to the mapping.

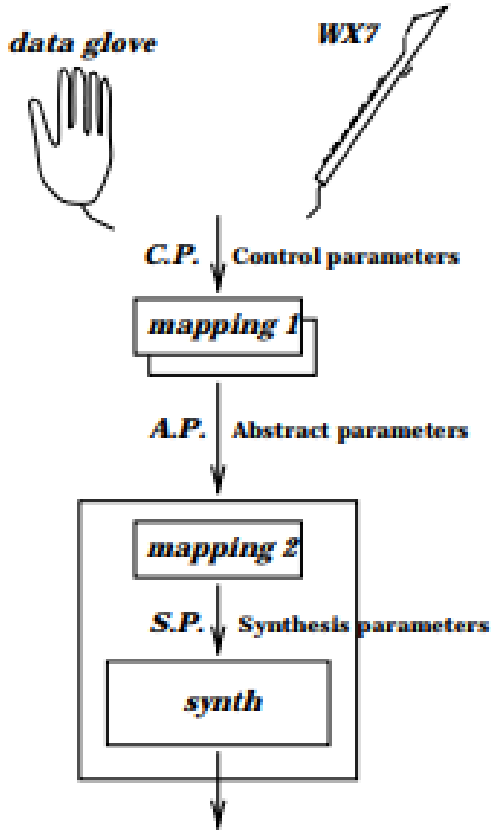
Design Considerations - Multi-level Mappings

Abstract Layer:

- Flexibility
- Controller/synth mapping independency

Design Considerations - Multi-level Mappings

Abstract Layer:



Wanderley, M. M., Schnell, N., & Rovan, J. (1998, October). Escher-modeling and performing composed instruments in real-time.

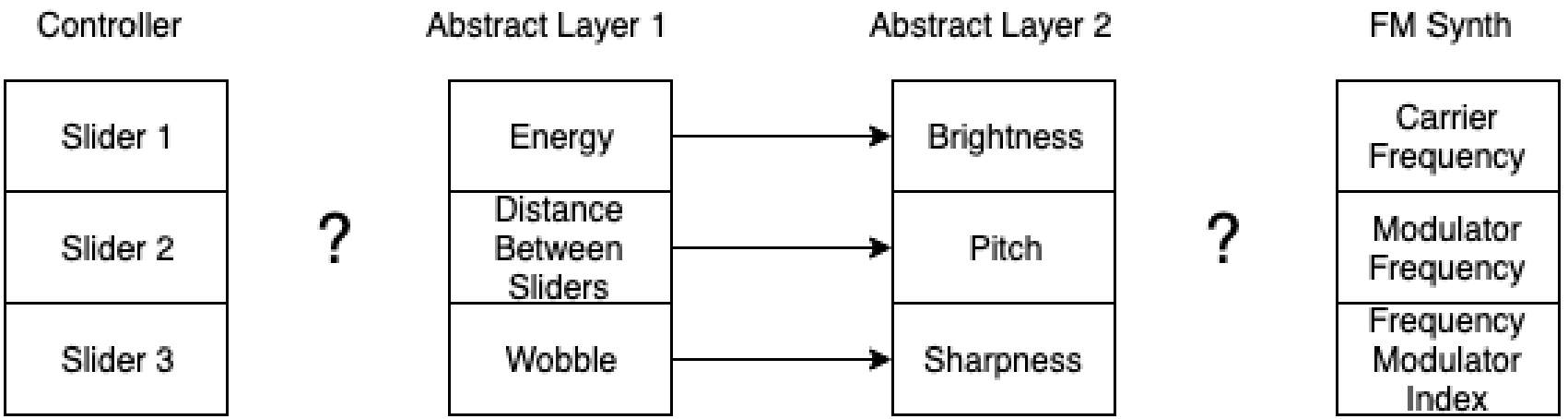
Design Considerations - Multi-level Mappings

2 Abstract Layers:

- One abstraction for each (controller/synth)
- *One-to-one mapping between abstract layers*

Design Considerations - Multi-level Mappings

2 Abstract Layers:



Based on Hunt, A., Wanderley, M. M., West, S. S., Paradis, M. (2002). The importance of parameter mapping in electronic instrument design, 1–6.

Design Considerations - Multi-level Mappings

Reactable SNAP Drum Machine

Design Considerations - Machine Learning

"Machine learning is the scientific study of algorithms and statistical models that computer systems use to effectively perform a specific task **without using explicit instructions**. *[...] Machine learning algorithms build a mathematical model of sample data, in order to make predictions or decisions without being explicitly programmed to perform the task."*[11]

[11] Wikipedia. Machine Learning. https://en.wikipedia.org/wiki/Machine_learning. Accessed 17/02/2019

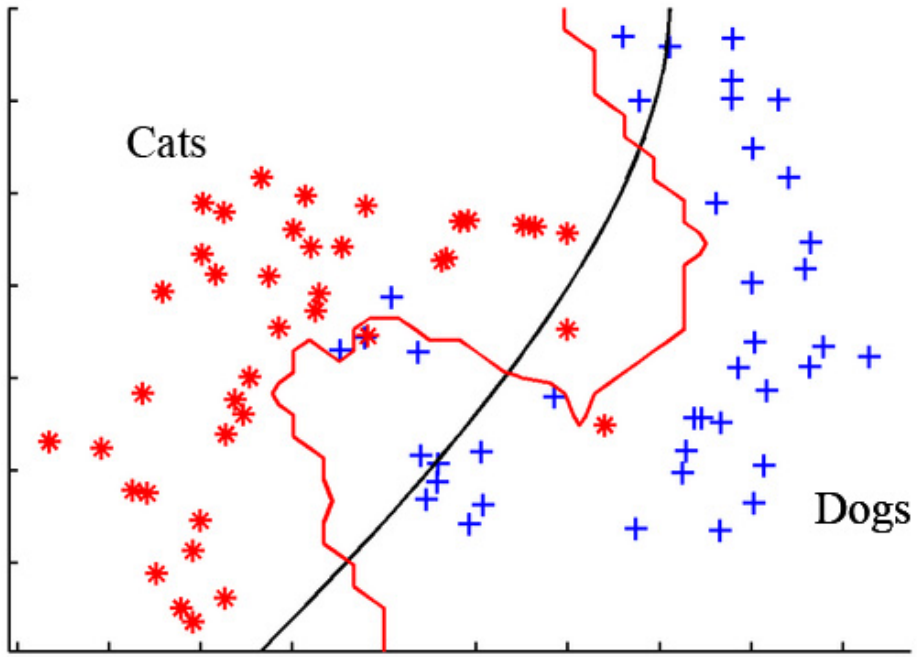
Design Considerations - Machine Learning

Supervised Learning is a great tool for complex/exhausting tasks:

- Classification
- Regression

Design Considerations - Machine Learning

Classification



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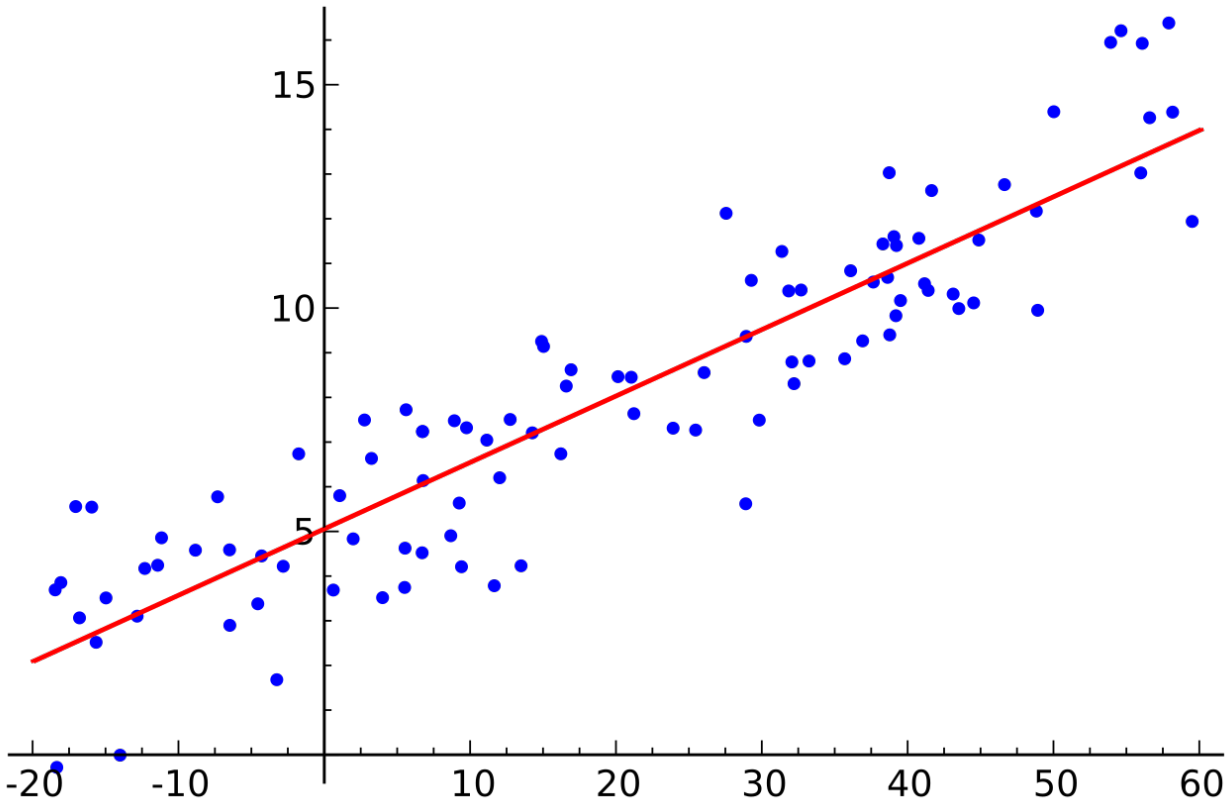
proft.me. Types of machine learning algorithms. https://en.proft.me/2015/12/24/types-machine-learning-algorithms. Accessed 17/02/2019.

Design Considerations - Machine Learning

Regression



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Design Considerations - Machine Learning

Supervised Learning: Output types

- Continuous: Regression
- Discrete: Classification

Very interesting for computer-assisted mapping!

Design Considerations - Machine Learning

Wekinator

Quick Walkthrough
Drum Machine
Face Gesture Recognition
Non-Linear Mapping