Interactive Mapping for Sonic Interaction Design using Machine Learning

Federico Visi

Hamburg, 8 February 2020

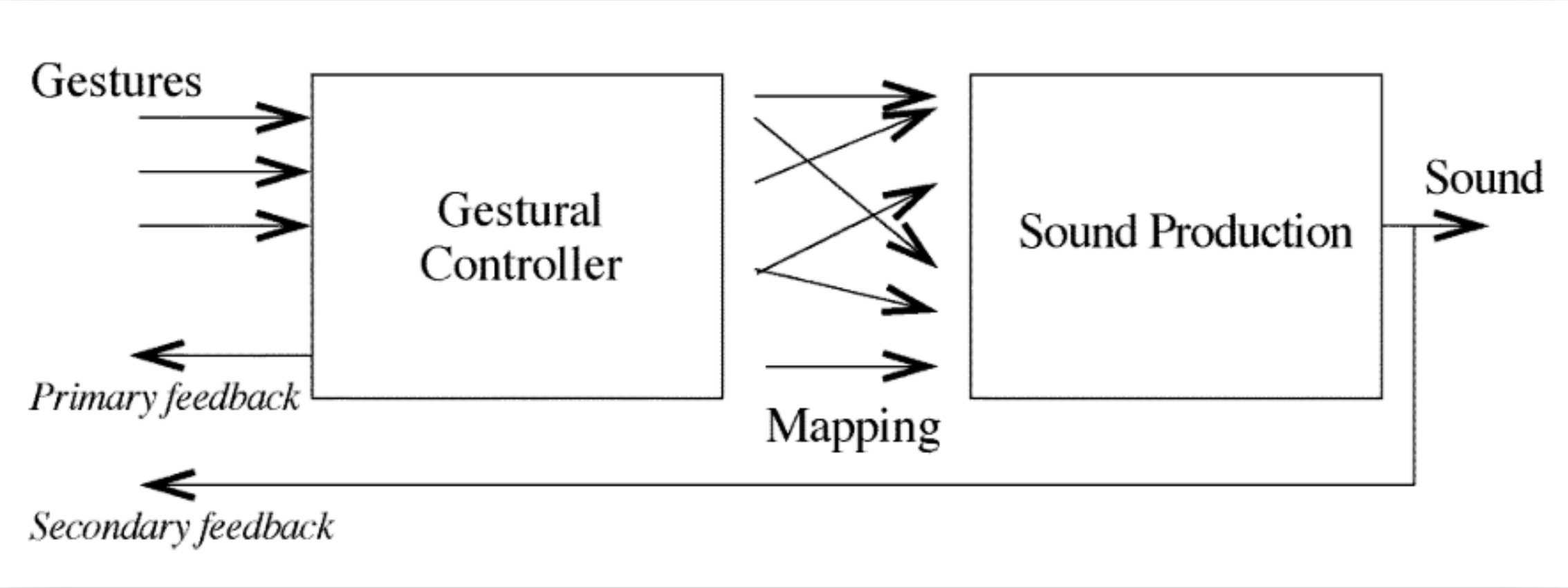
www.federicovisi.com


steim

Gestural interfaces

See also: E. R. Miranda and M. Wanderley. *New Digital Musical Instruments: Control And Interaction Beyond the Keyboard* (Computer Music and Digital Audio Series). A-R Editions, Inc., Madison, WI, USA, 2006.
A. R. Jensenius and M. Lyons, Eds., A NIME Reader: Fifteen years of New Interfaces for Musical Expression. Berlin, Springer, 2017

The Importance of Mapping



Rovan, J. B., Wanderley, M. M., Dubnov, S., & Depalle, P. (1997). Instrumental Gestural Mapping Strategies as Expressivity Determinants in Computer Music Performance. Kansei-The Technology of Emotion Workshop. Proceedings of the AIMI International Workshop, 68–73.

Designing Mappings

"Clearly, electronic music systems allow much freedom for the performer, because the mappings […] are not constrained by any biomechanical regularities. […]

However, […] it is exactly this freedom of mapping that may disturb the sense of contact and of non-mediation".

M. Leman. *Embodied Music Cognition and Mediation Technology.* MIT Press, 2008.

Mapping as a Compositional Process

[…] a shift from creating wanted sounds via interactive means, towards creating wanted interactions having audible traces.

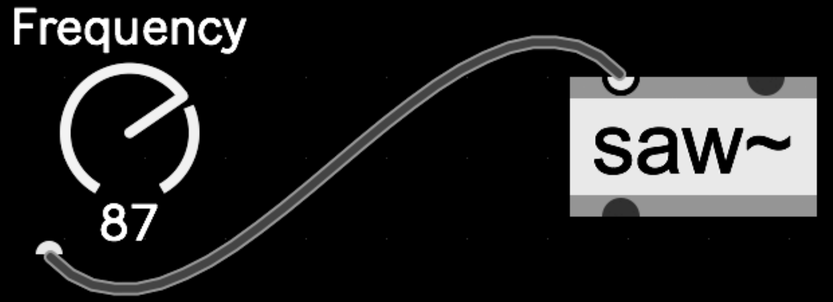
A. Di Scipio. *‘Sound is the interface’: from interactive to ecosystemic signal processing.* Organised Sound, 8, 2003.

[…] the instrument itself becomes a part of the composition.

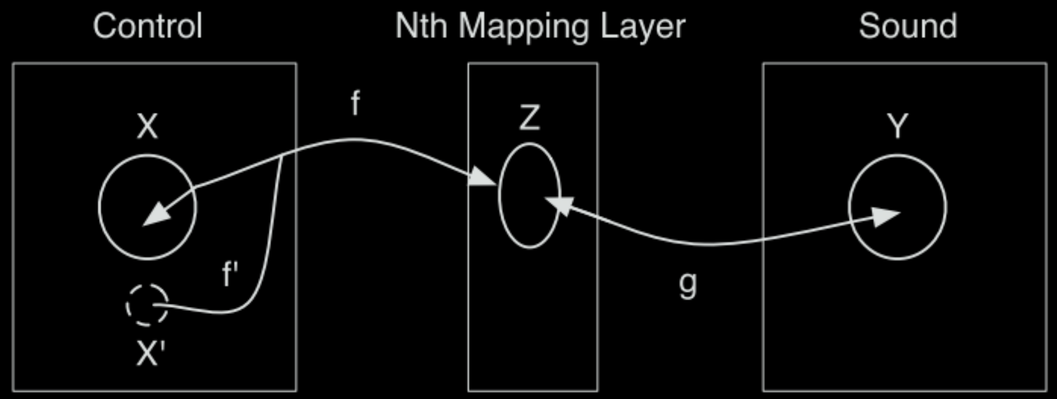
T. Murray-Browne, D. Mainstone, N. Bryan-Kinns, and M. D. Plumbley. *The Medium is the Message: Composing Instruments and Performing Mappings.* In Proceedings of the International Conference on New Interfaces for Musical Expression, 2011.

Different Kinds of Mapping

- One-to-one (a parameter is mapped explicitly)



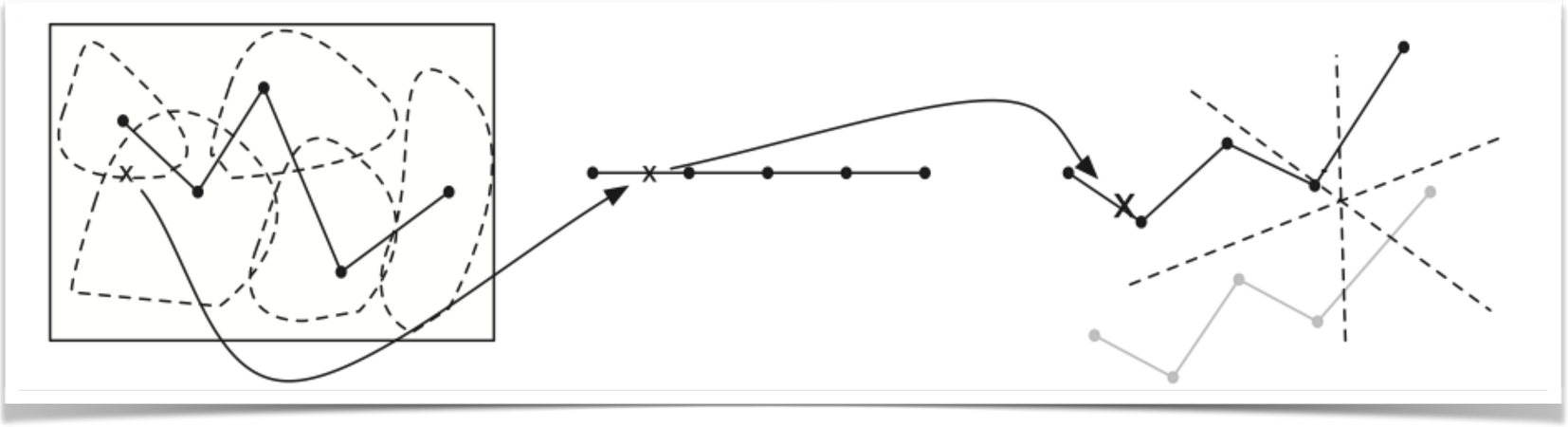
- Many-to-many (many parameters are mapped implicitly, e.g. through interpolation of multidimensional parameter spaces)



Van Nort, D., Wanderley, M. M., & Depalle, P. (2014). Mapping Control Structures for Sound Synthesis. Computer Music Journal, 38(3), 6–22.

Functional Many-to-many Mapping

- Not a deterministic point-to-point mapping but a holistic approach that defines states in the control and sound domains (what) and the geometries that relate them (how).



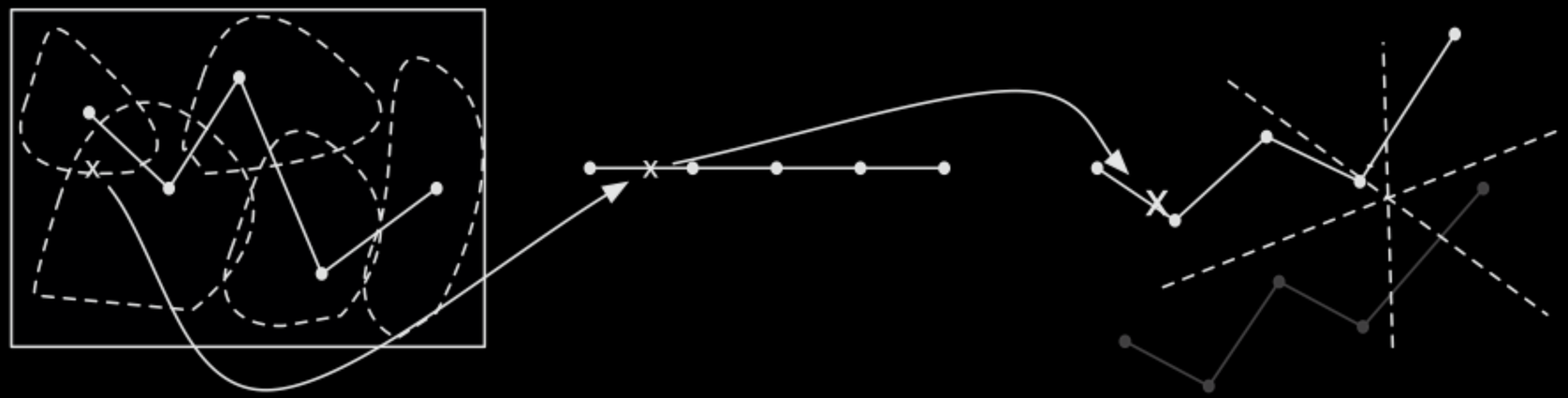
Van Nort, D., Wanderley, M. M., & Depalle, P. (2014). Mapping Control Structures for Sound Synthesis: Functional and Topological Perspectives. Computer Music Journal, 38(3), 6–22. doi:10.1162/COMJ_a_00253

Yes, but **how**?

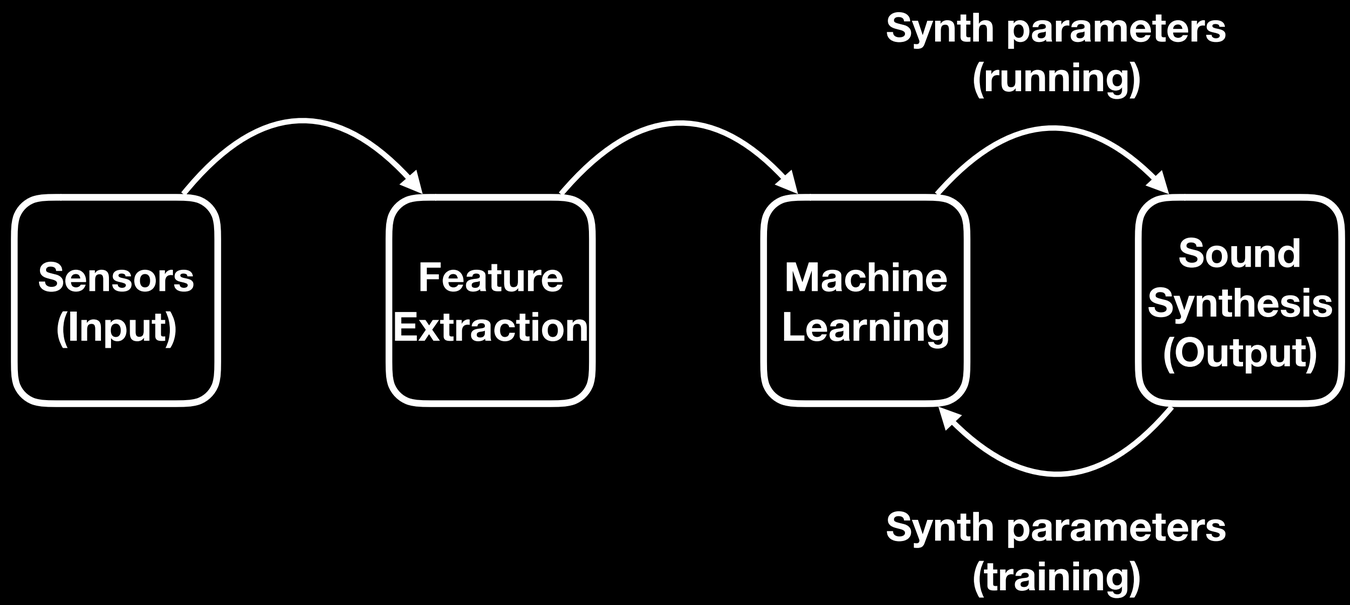
Using Machine Learning

Machine Learning

What: control gestures **How** these are related **What**: sounds



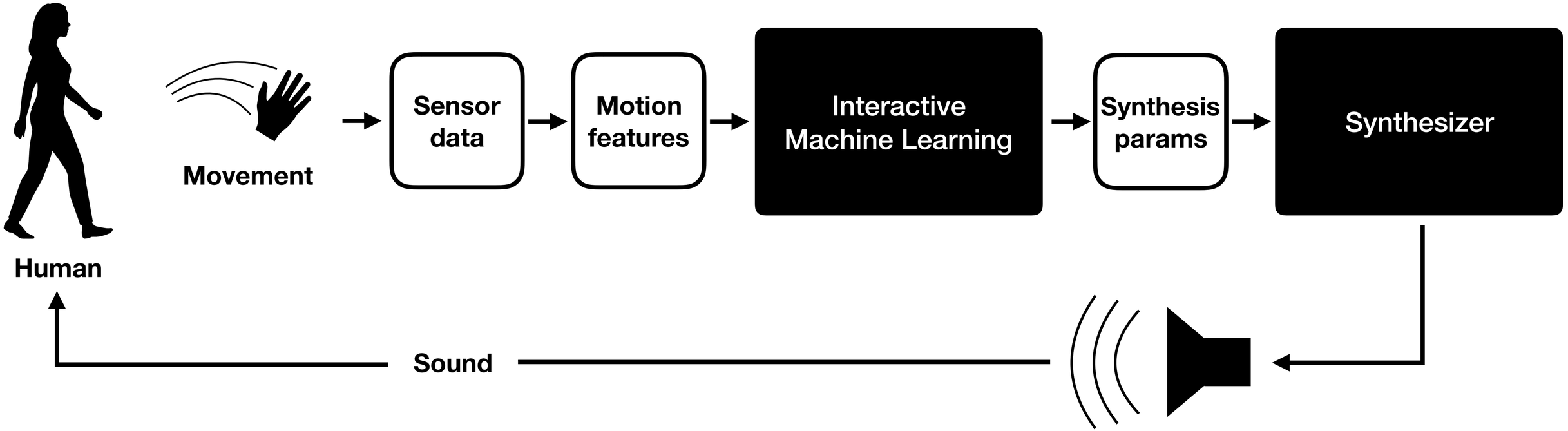
What: control gestures

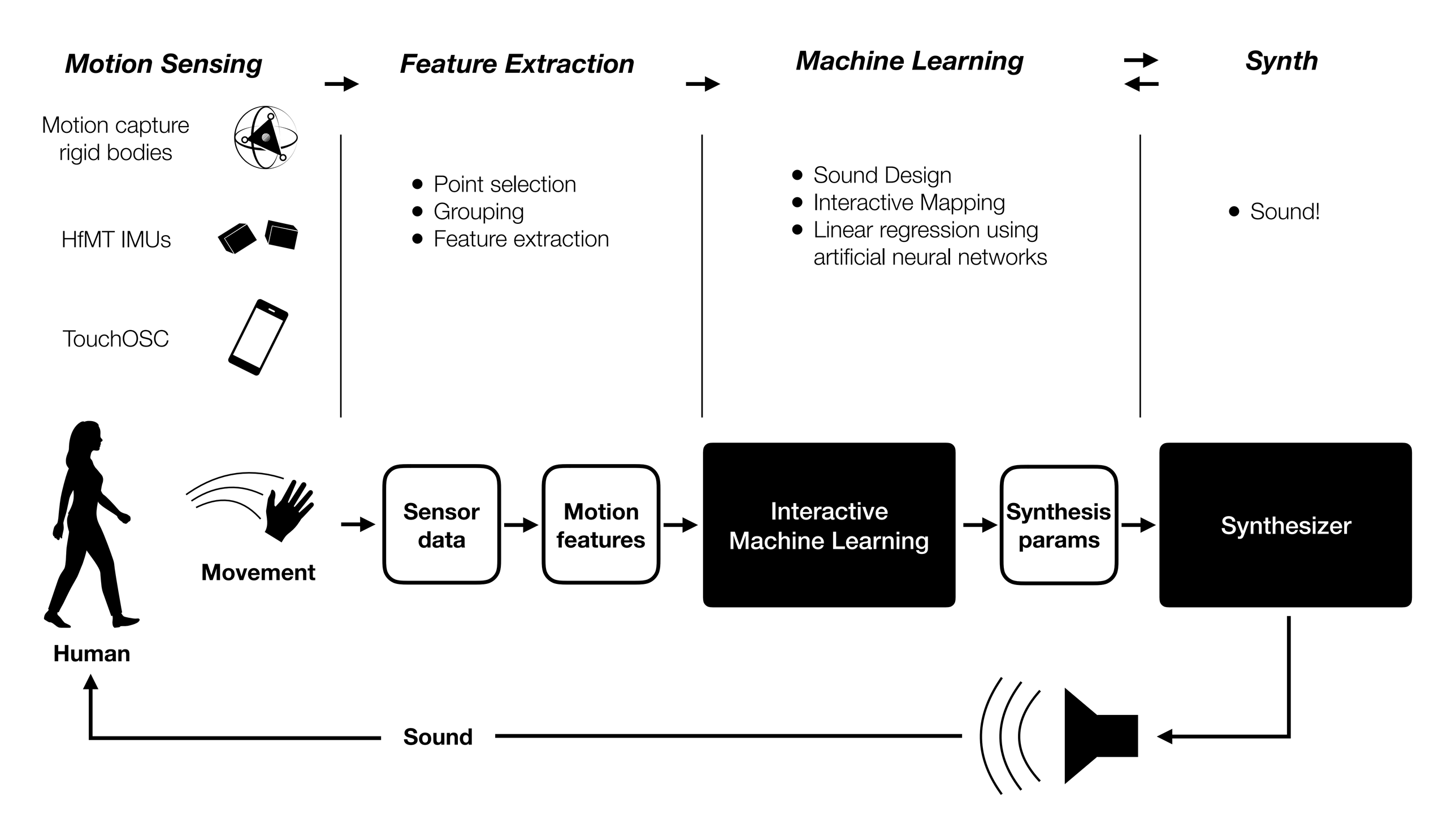


What: sounds

How these are related

Interactive Machine Learning Model




Motion Sensing
Feature Extraction
Machine Learning
Synth
Motion capture rigid bodies
HfMT IMUs
TouchOSC
• Point selection
• Grouping
• Feature extraction
• Sound Design
• Interactive Mapping
• Linear regression using artificial neural networks
• Sound!
Human
Movement
Sensor data
Motion features
Interactive Machine Learning
Synthesis params
Synthesizer
Sound

Supervised Learning

- Many algorithms, such as Artificial Neural Networks and Support Vector Machines (SVMs).
- Involves a training phase during which examples are recorded

Workshop Resources

- ***o.dot*** : OSC-centred multipardigm dynamic programming in Max
  https://github.com/CNMAT/CNMAT-odot

- ***modosc*** : real-time motion feature extraction
  https://github.com/motiondescriptors/modosc

- ***rapidmax*** : Max external for interactive machine learning
  https://github.com/samparkewolfe/RapidMax (Mac)
  https://github.com/MartinTownley/RapidMax_Windows

- ***GIMLeT*** : Gestural Interaction Machine Learning Toolkit
  https://github.com/federicoVisi/GIMLeT

Learn More…

Visi, F., & Dahl, L. (2018). Real-Time Motion Capture Analysis and Music Interaction with the Modosc Descriptor Library. Proceedings of the International Conference on New Interfaces for Musical Expression, 144–147. http://www.federicovisi.com/wp-content/papercite-data/pdf/visi-2018-nime.pdf

Visi, F. (2017). Methods and Technologies for the Analysis and Interactive Use of Body Movements in Instrumental Music Performance. University of Plymouth. https://pearl.plymouth.ac.uk/handle/10026.1/8805?show=full

Larboulette, C., & Gibet, S. (2015). A review of computable expressive descriptors of human motion. In Proceedings of the 2nd International Workshop on Movement and Computing - MOCO ’15 (pp. 21–28). New York, New York, USA: ACM Press. https://doi.org/10.1145/2790994.2790998

Dahl, L. (2015). Studying the Timing of Discrete Musical Air Gestures. Computer Music Journal, 39(2), 47–66. https://doi.org/10.1162/COMJ_a_00298

Fiebrink, R. A., & Caramiaux, B. (2018). The Machine Learning Algorithm as Creative Musical Tool. (R. T. Dean & A. McLean, Eds.), The Oxford Handbook of Algorithmic Music (Vol. 1). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780190226992.013.23

Caramiaux, B., & Tanaka, A. (2013). Machine Learning of Musical Gestures. In W. Yeo, K. Lee, A. Sigman, J. H., & G. Wakefield (Eds.), Proceedings of the International Conference on New Interfaces for Musical Expression (pp. 513–518). Daejeon, Republic of Korea: Graduate School of Culture Technology, KAIST. Retrieved from http://nime2013.kaist.ac.kr/

Thank you!

mail@federicovisi.com