



# Martin Gasser

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## Profile

Trained as a computer scientist and musician/artist, I like to work on multi-disciplinary projects, and I focus on Sound&Music Computing and on applications of Artificial Intelligence&Machine Learning technology to music, other media, and the arts in general. My thinking is strongly human-centric - machines should assist humans, not replace them. I am well-versed in several programming languages, frameworks and major desktop operating systems. Furthermore, I am experienced in development for mobile and embedded devices. I have academic as well as industry experience, and I am also an avid musician.

## Education

- 2013–2016 **University Course for Computer Music and Electronic Media (ELAK)**, *University of Music and Performing arts, Vienna*.
- 2002–2004 **Vienna University of Technology**, *Vienna, Austria*.  
Computer Graphics & Digital Image Processing, MSc.
- 1996–2002 **Vienna University of Technology**, *Vienna, Austria*.  
Media Informatics, BSc.
- 1991–1995 **Carinthian State Conservatory**, *Klagenfurt, Carinthia, Austria*.  
Jazz guitar, classical guitar
- 1986–1994 **Europagymnasium**, *Klagenfurt, Carinthia, Austria*.  
Focus on Computer Science and English

## Employments

- since 2023 **Senior software developer**, <https://mu.se>.
  - R&D in the fields of Machine Learning and Music Technology
- 2021–2023 **Senior development consultant**, <https://mu.se>.
  - Development of Machine Learning technology in the field of music analysis
- since 2021 **University lecturer**, University of Applied Arts, Vienna.
  - Lecturing in basics of software development and AI / Machine Learning
- 2020–2021 **Senior Scientist**, University of Applied Arts, Vienna.
  - Department of Cross-Disciplinary Strategies
  - Lecturing in basics of software development (Web, JavaScript, node.js, Python) and AI / Machine Learning
  - Development of multi-disciplinary projects involving Software, Graphics & Sound with students
  - Evolution of the curriculum
- 2017–2019 **Software developer**, *Re-Compose, Vienna*.
  - Development of audio plug-ins in C++
  - Focus on music generation based on methods from Artificial Intelligence
  - Conceptualization and implementation of user interfaces
  - Overall technical responsibility

- since 2006 **Researcher**, *OFAI – Austrian Research Institute for Artificial Intelligence*, Vienna.
- Research and development in the fields of music technology and intelligent music processing
  - Key research areas
    - Machine learning, data mining, content-based audio similarity
    - Spectro-temporal audio signal processing
    - Design and implementation of high-performance and reliable software targeted at soft real-time and/or embedded environments
    - Full-stack web development
    - Computer Vision
  - Numerous publications at international peer-reviewed conferences in the field of music information retrieval and music technology
- 2006 **Research intern**, *Centre for Digital Music, Queen Mary, University of London*, London, UK.  
Research internship in the field of intelligent music processing/music software
- 2005 **Software developer**, *Ecetra Central European e-Finance AG*, Vienna.
- Maintenance and development for an online banking system based on a proprietary Java Application Server infrastructure
- 2003–2004 **Software developer**, *VRVis Zentrum für Virtual Reality und Visualisierung Forschungs-GmbH*, Vienna.
- Development of interactive visualization software for analysis of high dimensional, large, and time-dependent data in Java, C++ and OpenGL
  - UI design & implementation
  - Multithreaded data analysis, storage/caching infrastructure for large data
- 2000–2001 **Software developer**, *Unikat university information systems*, Vienna.
- Development of web applications in PHP
- 1999 **Software developer**, *CoCo Software Engineering*, Vienna.
- Development of application server components in Java

## Projects

- 2021-2023 **MuseClass**, MuseGroup, USA.
- Computer-assisted assessment of musical exercises
  - Deep Learning for pitch tracking and music transcription
- 2019-2022 **Co-corporeality - Responsive spaces in the era of Biomediality**, University of Applied Arts/University Vienna/OFAI, Vienna.
- The arts based research Co-corporeality examines the necessity to conceive the built environment beyond its misconception as a mere dead entity. The goal is to establish an interaction between a human and a living material, such as biological-polymers, in order to develop a responsive environment.
  - FWF PEEK
  - Collaboration between the University of Applied Arts, the The University of Vienna/Department of Material Engineering, and the Austrian Research Institute for Artificial Intelligence
  - Research into interactive machine learning, computer vision, human-computer interaction
  - Co-organization of workshops with art students
- 2018 **Rotting Sounds - Embracing the temporal deterioration of digital audio**, University of Music and Performing Arts, Vienna.
- Most of today's media output, be it audio or video, is produced and stored in the digital domain. Although digital data are adorned by the myth of lossless transmission and migration, everyday experience does prove the existence of degradation and, ultimately, data loss in various forms. This pertains to the physical nature of storage media and playback devices as well as to media formats and software in the context of their technological infrastructure. The project strives to elaborate on the causes, mechanisms and effects of such deterioration, specifically in the context of digital audio. Since degradation cannot be avoided on principle, it is our general aim to unearth latent degrees of freedom pertaining to the artistic practice in the omnipresence of decay.
  - Consulting about software-related questions
- 2017–2019 **Amadeus**, Amadeus Active Acoustics, Vienna.
- Efficient implementation of audio processing functionality for a commercial multichannel acoustics system
  - C++14, multithreading, SIMD extensions
  - Web-based remote control interface
- 2017-2018 **I2C8**, Re-Compose, Vienna.
- Concept & design of a commercial MIDI plug-in for chord sequence generation
  - Focus on innovative and intuitive UI
  - Implementation in C++, using the JUCE framework
  - Based on machine learning techniques/statistical models of typical chord patterns
  - Release management

- 2017–2019 **Socially Aligned Visual Art Technology And Perception**, University of Applied Arts/University Vienna/OFAI.
- Cooperation with the University of Applied Arts and the Department of Psychology, University of Vienna
  - Implementation of computer vision algorithms in common machine learning frameworks (Tensorflow/PyTorch)
  - Prototyping of algorithms in Python, deployment as native C++ applications
- 2017–2018 **Spexx**, Re-Compose, Vienna.
- Concept & design of a commercial audio effect plug-in
  - Focus on innovative and intuitive UI
  - Implementation in C++, using the JUCE framework
  - Optimized for multi-threaded processing, to support glitch-free operation
  - Release management
- 2016–2018 **Raumklanginstrument**, *University of Music and Performing Arts*, Vienna.
- Real-time spatialization environment based on a combination of wavefield synthesis, VBAP and Ambisonics rendering
  - Implementation of controller plug-ins, JUCE
  - Implementation in C++, using the JUCE framework
  - Improvements of the rendering engine running on Linux/SuperCollider
- 2013–2015 **PhenicX**, OFAI, Vienna.
- Performances as **H**ighly **E**nriched **a**nd **I**nteractive **C**oncert **e**xperiences.
  - EU FP7 project.
  - Development of offline score-performance alignment technologies capable of aligning long (i.e., hours) of audio signals in C++
  - Development of real-time score-following technologies in (C++)
  - Development of REST-based Web API's for providing access to music metadata and alignment data (node.js)
  - Development of web interfaces for interactive explorative visualization of classical music performances (angular.js)
  - Native implementation of real-time score following on iOS (C++, Swift)
  - Co-organization and technical realization of large-scale live experiments with Amsterdam's world-renowned Royal Concertgebouw Orchestra
- 2009–2010 **FM4 Soundpark music recommendation system**, OFAI/Austrian Broadcasting Corporation, Vienna.
- Design and implementation of a music recommendation component and corresponding user interfaces for the FM4 Soundpark platform
  - Integration with the legacy infrastructure of the project partner
  - Web service component in Python/CherryPy, audio analysis and similarity computation in C++, front-end development in HTML, Flash, and Java
- 2007–2012 **Flower: Real-time multirate dataflow processing**, OFAI, Vienna.
- Design and implementation of a modular, extensible real-time dataflow framework
  - Coordination of a small development team
  - Cross platform (Mac OSX, Windows, Linux, iOS)
  - Automatic load balancing based on the Work Stealing principle
  - Modern lock-free C++ design, uses C++11/the Boost libraries and generic programming techniques
  - Is currently used in various research applications at the Johannes Kepler University Linz
- 2002–2004 **SimVis: A system for interactive visual analysis of time-dependent and multi-dimensional data**, VRVis Research Center, Vienna.
- Development of interactive data analysis components based on fuzzy logic operations
  - Development of OpenGL-based user interfaces
  - Optimization for performance (SIMD operations) and large data (caching layer)
  - Combination of user interface layer in Java and low-level data processing in C++

## Other digital art & music projects

- 2023 **Brick by Brick**, Vienna/Austria.
- Immersive interactive sound installation
  - <https://martingasser.com/works/brick-by-brick/>
  - Exhibited in September 2023 as part of the Other Island group exhibition
- 2023 **Ingeborg Bachmann Kuppel**, Vienna/Austria.
- Sound installation for a public monument
  - <https://www.bachmann-kuppel.at/karlsplatz-wien-2023/>
  - Exhibited in May 2023 on Karlsplatz, Vienna

- 2022 **Spin-Wave Voices**, Linz/Austria.
- Interactive visualization and sonification of numerical simulations
  - <https://ars.electronica.art/planetb/en/spin-wave-voices/>
  - Exhibited at Ars Electronica 2022
- 2022 **Degrees of Life**, Vienna/Austria.
- Final exhibition of the Co-Corporeality project
  - Development of wearable and wireless Eye-Tracking technology, control of Arduino-based robots
  - <https://cocorporeality.net/news/views-on-degrees-of-life-28>
  - Exhibited in Vienna 23.2.2022 – 11.3.2022
- 2021 **Sylva**, Oviedo/Spain.
- An artificial garden that is seeded and nurtured by robotic gardeners, controlled by an AI system
  - Development of embedded computer vision technology, network streaming of image/depth sensor data
  - Collaboration with <https://maeid.com/>
  - Exhibited at the Princess of Asturias Award exhibition 2021 in Oviedo/Spain
- 2021 **Magic Queen**, Venice/Italy.
- Combination of a bio-degradable structure made of 3d-printed soil with machine learning and computer vision technology
  - Development of embedded computer vision technology, network streaming of image/depth sensor data
  - Collaboration with <https://maeid.com/>
  - Exhibited at the Biennale Architettura 2021 in Venice
- 2021 **Soundtrek**, Vienna.
- Interactive geo-location based sound art piece for smartphones
  - Development of the playback engine in JavaScript / WebAudio
  - Collaboration with Black Unicorn
  - Part of <http://klangmanifeste.klingt.org/programm.html>
- 2020 **Cross Perception**, Vienna/Linz.
- Immersive audio-visual work for a fulldome environment
  - Exhibited at Ars Electronica 2020
  - Reflection on the meanings of things and their audio-visual manifestations
  - Used technology
    - Realtime object detection in PyTorch
    - Sonification of detected objects with Python and Ableton Live
    - Max/MSP for projection into Ambisonics environment
    - Unity3D for visuals
  - Collaboration between
    - University of Applied Arts Vienna / Cross-Disciplinary Strategies
    - Johannes Kepler University Linz / Institute for Computational Perception
    - Kathrin Hunze (<https://raumperspektive.com/>)
  - <https://ars.electronica.art/keplersgardens/en/cross-perception-work/>
  - <https://raumperspektive.com/#cross>
- 2018 **Instant Choir**, Vienna.
- Collaboration with Mimu Merz
  - <http://werk-x.at/produktion/instant-choir-2-0>
  - Interactive performance, involving the audience in a theatre setting
  - Conceptualization and implementation of the technical aspects
  - Implementation of iOS and Android smartphone apps in Swift and Java (based on a hybrid architecture that can load site-specific content for different performances), App Store rollout
  - Implementation of the backend infrastructure, mainly in node.js and Max/MSP, on-site support during the performances
- 2016-2017 **Musical Robots**, Vienna.
- Collaboration with Alfred Lenz (<http://www.alfredlenz.com>)
  - Old instruments are transformed into robots with servos, stepper motors and control software running on Arduino
  - Used in live performance at Donaufestival Krems 2017 - <https://www.donaufestival.at/en/festival/program/75-karl-karner-linda-samaraweeroova>
- 2014-2015 **Cross-platform VASP/AMP**, Rappottenstein/Vienna.
- Cross-platform port of Günther Rabl's windows-only VASP/AMP composition/sound manipulation software package (written in FORTRAN).
  - Integration into audio plugin (Audio Unit/VST) using the JUCE C++ framework and into a Max/MSP external.
  - Co-organization of workshops for musicians and students

- 2013 **Body/Tweets**, Vienna.
- Sonification and visualization of Twitter messages in real time
  - On exhibition at Klangmanifeste 2014 (<http://www.klangmanifeste.at>) and in Trezor (<http://www.trezor.at/>)
  - <https://vimeo.com/172708892>
- 2011 **Gehirnwäsche**, Vienna.
- Collaboration with Anne Glassner (<http://www.anneglassner.at>)
  - Concept and implementation of a closed circuit video installation with a hacked washing machine, Screen, Camera and Raspberry Pi
  - On exhibition in the Künstlerhauspassage Vienna and in Flat1 (<http://www.flat1.at/>)
  - <http://www.youtube.com/watch?v=1KG0YLNkUZc>, <https://vimeo.com/204761873>
  - Implementation of an accompanying iOS App, <http://itunes.apple.com/at/app/gehirnwasche/id494525402?mt=8>
- 2011 **Superior Wasteland**, Vienna.
- Improvisation project with real-time visualizations based on audio data
  - Development of Pure Data patches for real-time analysis of audio data
- 2007-2016 **Meat Transformer**, Vienna.
- Multimedial music/performance project (music, theatre, visuals)
  - Concept, music composition/production and live performance (guitar and live electronics)
  - Numerous live performances, e.g., <http://www.youtube.com/watch?v=AlYNAktkxSY>
- 2005 **Heartbeat**, Linz.
- Audio-visual installation with heart-rate sensor elements
  - Development of a generative synthesis module in the audio programming language SuperCollider
  - On exhibition at Ars Electronica Linz 2005
  - See [http://heartbeat.jku.at/downloads/hbPresstext\\_ger.pdf](http://heartbeat.jku.at/downloads/hbPresstext_ger.pdf)

## Technical skills

- All major operating systems (macOS, Microsoft Windows, Linux)
- Programming languages: C++, Java, Python, ObjC, Swift, HTML/JavaScript
- Machine learning/Computer Vision: OpenCV, Tensorflow, PyTorch
- Graphics API's: OpenGL/OpenGL ES, GLSL, HTML5 Canvas & WebGL
- Creative coding environments: Cinder, OpenFrameworks, Processing
- Experienced in database design and handling (SQL and NoSQL)
- Web development with Django, PHP, node.js, various frontend frameworks (Vue.js, React, Angular)
- IDE's/build systems/SCM: Xcode, Visual Studio, CMake, Git, Gitlab CI
- Pure Data, Max/MSP, SuperCollider; native audio development with Jack, CoreAudio/Audio Units, VST, AAX, JUCE
- Arduino
- iOS & Android development
- Scientific writing, experienced in  $\text{\LaTeX}$

## Additional skills & experience

- Languages: German (native), English (fluent), French (basic)
- Austrian driver's licence (A,B)
- Served as reviewer for scientific conferences in the field of Music Information Retrieval/
- Member of the organizing committee for the International Society for Music Information Retrieval Conference 2007, designed and serviced the conference web site
- Austrian civil service in a residential home, social reintegration of released prisoners

## Theses

### Interactive Visualization of Expressive Piano Performance

Year 2004

Type Master thesis

Supervisor Univ.Prof. Dipl.Ing. Dr. Gerhard Widmer

Institution University of Technology, Vienna

**Abstract** Computer-supported performance analysis aims at musicians and musicologists investigating performance-related aspects of music. Since a key component of every supportive computer environment is the user interface, presentational and interactive aspects are of fundamental concern for the design and the implementation of a computer supported performance analysis system. In this thesis, an overview of music performance analysis, and of existing visual representations of musical performance is given. Moreover, well-known methods from Information Visualization (InfoVis) and User Interface Design (UID) are reviewed and its applications to the present problem space are discussed. Finally, a prototypical implementation of an extensible framework for visualization of expressive piano performance is presented, and a typical application scenario is described in a step-by-step fashion.

### The Digital Luthier

Year 2016

Type University course/specialization

Supervisor Mag. Katharina Klement

Institution University of Music and Performing Arts, Vienna

**Abstract** The development of a piece of music software can be interpreted as the creation of an electronic musical instrument; the craft of instrument building always stood at the borderline between engineering on one hand, and a deep understanding of musical concepts on the other hand. Furthermore, a musical instrument carries a lot of meaning (about how something should sound, and which musical ideas can be realized with it at all). Along this line of thought, the act of creating a musical instrument can be interpreted as an act of communication, which is even more evident in modern electronic music, where musical instruments are specified in formal languages on different abstraction levels. This work will give an overview of the various approaches to talk about and describe musical ideas, and it will briefly review linguistic/semiotic theory and its application in the domain of software engineering. As an example of how these concepts could be applied, the development of a Max/MSP external and a DAW plugin is described; the musical and sonic ideas in those software modules are based on the ideas and existing software developed by the Austrian composer *Günther Rabl* (<http://www.canto-crudo.at>). The challenge in this process was twofold: (1) The original ideas and concepts had to be followed and implemented as closely as possible and (2) interaction metaphors used in modern music creation environments had to be incorporated.

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## Publications

- [1] Barbara Imhof, Daniela Mitterberger, and Tiziano Derme, editors. *Co-Corporeality of Humans, Machines, and Microbes*, chapter Eye-Gaze Tracking Technology. Birkhäuser Verlag GmbH, Basel, 2022.
- [2] Barbara Imhof, Daniela Mitterberger, and Tiziano Derme, editors. *Co-Corporeality of Humans, Machines, and Microbes*, chapter Facial Expression Recognition. Birkhäuser Verlag GmbH, Basel, 2022.
- [3] Ali Nikrang, Maarten Grachten, Martin Gasser, Harald Frostel Gerhard Widmer, and Tom Collins. Music visualisation and its short-term effect on appraisal skills. In *Proceedings of the Human-Computer Interaction International Conference*, Copenhagen, Denmark, 2023.
- [4] Darrell Conklin, Martin Gasser, and Stefan Oertl. Creative chord sequence generation for electronic dance music. *Applied Sciences*, 8:1704, 09 2018.
- [5] Andreas Arzt, Harald Frostel, Thassilo Gadermaier, Martin Gasser, Maarten Grachten, and Gerhard Widmer. Artificial Intelligence in the Concertgebouw. In *Proceedings of the International Joint Conference on Artificial Intelligence*, Buenos Aires, Argentina, 2015.
- [6] Martin Gasser, Andreas Arzt, Thassilo Gadermaier, Maarten Grachten, and Gerhard Widmer. Classical Music on the Web – User Interfaces and Data Representations. In *Proceedings of the 16th International Society for Music Information Retrieval (ISMIR'15)*, Malaga, Spain, 2015.
- [7] Andreas Arzt, Sebastian Böck, Sebastian Flossmann, Harald Frostel, Martin Gasser, and Gerhard Widmer. The Complete Classical Music Companion V0.9. In *Proceedings of the 53rd AES Conference on Semantic Audio*, 2014.
- [8] Maarten Grachten, Martin Gasser, Gerhard Widmer, and Andreas Arzt. Automatic Alignment of Music Performances with Structural Differences. In *Proceedings of the 14th International Society for Music Information Retrieval Conference*, Curitiba, Brasil, 2013.
- [9] Martin Gasser, Arthur Flexer, and Thomas Grill. On Computing Morphological Similarity of Audio Signals. In *Proceedings of the 8th Sound and Music Computing Conference*, Padova, Italy, 2011.
- [10] Arthur Flexer, Martin Gasser, and Dominik Schnitzer. Limitations of Interactive Music Recommendation Based on Audio Content. In *Proceedings of the Audio Mostly Conference on Interaction With Sound*, Piteå, Sweden, 2010.
- [11] Arthur Flexer, Dominik Schnitzer, Martin Gasser, and Tim Pohle. Combining Features Reduces Hubness in Audio Similarity. In *Proceedings of the 11th International Society for Music Information Retrieval (ISMIR'10)*, Utrecht, Netherlands, 2010.
- [12] Dominik Schnitzer, Arthur Flexer, Gerhard Widmer, and Martin Gasser. Islands of Gaussians: The Self Organizing Map and Gaussian Music Similarity Features. In *Proceedings of the 11th International Society for Music Information Retrieval (ISMIR'10)*, Utrecht, Netherlands, 2010.
- [13] Martin Gasser, Arthur Flexer, and Dominik Schnitzer. Hubs and Orphans: An Explorative Approach. In *Proceedings of the 7th Sound and Music Computing Conference (SMC'10)*, Barcelona, Spain, 2010.
- [14] Martin Gasser and Arthur Flexer. FM4 Soundpark Audio-Based Music Recommendation in Everyday Use. In *Proceedings of the 6th Sound and Music Computing Conference (SMC'09)*, Porto, Portugal, 2009.
- [15] Arthur Flexer, Dominik Schnitzer, Martin Gasser, and Gerhard Widmer. Playlist Generation using Start and End Songs. In *Proceedings of the 9th International Conference on Music Information Retrieval (ISMIR'08)*, Philadelphia, USA, 2008, 2008.
- [16] Martin Gasser, Arthur Flexer, and Gerhard Widmer. StreamCatcher: Integrated Visualization of Music Clips and Online Audio Streams. In *Proceedings of the 9th International Conference on Music Information Retrieval (ISMIR 2008)*, Philadelphia, PA, USA, 2008.
- [17] Martin Gasser, Elias Pampalk, and Martin Tomitsch. A Content-Based User-Feedback Driven Playlist Generator and its Evaluation in a Real-World Scenario. In *Proceedings of the Audio Mostly 2007 Conference on Interaction with Sound*, 2007.
- [18] Christopher Harte, Mark Sandler, and Martin Gasser. Detecting Harmonic Change in Musical Audio. In *Proceedings of Audio and Musical Computing for Multimedia Workshop 2006 (in conjunction with ACM Multimedia)*, Santa Barbara, California, 2006.
- [19] Elias Pampalk and Martin Gasser. An Implementation of a Simple Playlist Generator Based on Audio Similarity Measures and User Feedback. In *Proceedings of the 7th International Conference on Music Information Retrieval (ISMIR 2006)*, Victoria, Canada, 2006.
- [20] Helmut Doleisch, Michael Mayer, Martin Gasser, Peter Priesching, and Helwig Hauser. Interactive Feature Specification for Simulation Data on Time-Varying Grids. In *Proceedings of Conference Simulation and Visualization 2005 (SimVis 2005)*, pages 291–304, Magdeburg, Germany, Mar. 3–4 2005.
- [21] Helmut Doleisch, Michael Mayer, Martin Gasser, Roland Wanker, and Helwig Hauser. Case Study: Visual Analysis of Complex, Time-Dependent Simulation Results of a Diesel Exhaust System. In *Proceedings of the 6th Joint IEEE TCVG – EUROGRAPHICS Symposium on Visualization (VisSym 2004)*, pages 91–96, Konstanz, Germany, May 19–21 2004.

- [22] Robert Kosara, Helmut Doleisch, Martin Gasser, and Helwig Hauser. The SimVis System for Interactive Visual Analysis of Flow Simulation Data. In *Proceedings of the 2004 Conference "Virtual Product Development (VDP) in Automotive Engineering"*, Graz, Austria, 2004.
- [23] Martin Gasser. Fast Focus+Context Visualization of Large Scientific Data. In *Proceedings of the Central European Seminar on Computer Graphics*, Budmerice, Slovakia, 2004.
- [24] Helmut Doleisch, Martin Gasser, and Helwig Hauser. Interactive Feature Specification for Focus+Context Visualization of Complex Simulation Data. In *Proceedings of the 5th Joint IEEE TCVG - EUROGRAPHICS Symposium on Visualization (VisSym 2003)*, pages 239–248, Grenoble, France, May 2003.