# Curriculum Vitae

Mathias Bernhard
Dr. sc. ETH Zurich
Dipl. Arch ETH / MAS CAAD

www.mathiasbernhard.ch
dbt.arch.ethz.ch

Bergackerstrasse 77
CH-3066 Stettlen

bernhard@arch.ethz.ch
+41 (0) 78 658 34 36

Github: worbit
Twitter / Instagram: w0rb1t

## Education

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|---|---|
| 2019 | Doctor of sciences (Dr. sc.) ETH Zurich, Department of Architecture<br>*Domain Transforms in Architecture - Encoding and Decoding of Cultural Artefacts*<br>supervisor: Prof. Dr. Ludger Hovestadt, Computer Aided Archiectural Design CAAD, Department of Architecture, ETH Zurich<br>co-supervisor: Prof. Dr. Olga Sorkine-Hornung, Interactive Geometry Lab IGL, Department of Computer Science, ETH Zurich |
| 2008 - 2009 | Master of Advanced Studies in Computer Aided Architectural Design MAS CAAD, ETH Zurich<br>*Influence of the Topography on Computationally Generated Urban Structures*<br>supervisor: Markus Braach and Prof. Dr. Ludger Hovestadt |
| 2004 - 2006 | Studies in architecture at ETH Zurich, Graduation: Master of Science MSc / Diploma in Architecture, supervisor: Prof. Gregor Eichinger |
| 2000 - 2004 | Studies in architecture at École Polytechnique Fédérale de Lausanne EPFL, Graduation: Bachelor of Science BSc |
| 1996 - 2000 | Maths- and Economy Highschool Berne-Kirchenfeld |

## Professional Experience

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| since 2019 | Postdoctoral reseacher at the chair for Digital Building Technologies DBT, ETH Zurich, Prof. Dr. Benjamin Dillenburger |
| 2015 - 2019 | Research and teaching assistant at DBT |
| 2017 / 2018 | Visiting lecturer for "Introduction to Python and BIM Programming for Architects" at CAS digital : Certificate of Advanced Studies, Prof. Sacha Menz, ETH Zurich |
| 2016 | Visiting lecturer for "Digital Fabrication" at the Object Design studies programme at the University of Applied Sciences Lucerne HSLU, in collaboration with Yves Ebnöther |
| 2012 - 2015 | Research and teaching assistant at the chair for Computer Aided Architectural Design caad, ETH Zurich, Prof. Dr. Ludger Hovestadt |
| 2010 - 2012 | Project architect and CAAD specialist in the interdisciplinary planning team for Arch_Tec_Lab, home of the Institute of Technology in Architecture ITA on the ETH campus Hönggerberg |
| 2009 - 2010 | Research and teaching assistant at the chair for Computer Aided Architectural Design CAAD, ETH Zurich, Prof. Dr. Ludger Hovestadt |
| since 2007 | Freelance specialist planner for computational design and digital fabrication in collaboration with various architecture and design practices |
| 2006 - 2008 | Research, teaching and technical assistant at the Rapid Architectural Prototyping Laboratory RAPLAB, ETH Zurich |
| 2002 - 2003 | Internship at Bauart Architects, Berne |

## Research

### Ongoing Research Projects

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| OpenPlans | online archive and database of building floorplans, as an augmented search engine with graphical queries, design reference system and basis for artificial intelligence and machine learning research in architecture |
| | innovative teaching project Innovedum, funded by ETH grant |
| TopoGAN | realtime topology optimization with generative adversarial networks, trained with image pairs of boundary conditions as input and topology optimization as output |

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| compas_vol | Volumetric modelling package for COMPAS, the computational design framework for architecture, engineering, fabrication and construcion (AEFC) |
| | role: lead developer, start:2018, supported by the National Centre for Competence in Research on Digital Fabrication NCCR dfab.ch, compas-dev.github.io |
| compas_terrain | Computational terrain modelling for large scale landscape design |
| | role: main developer with Ilmar Hurkxkens, start: 2018, collaboration with the chair for landscape architecture, Prof. Christophe Girot |
| Coral Reefs | 3D modelling, printing and flow channel testing of suitable geometries for artificial coral reef restoration |
| | with marine biologist Ulrike Pfreundt, Institute of Environmental Engineering IfU, Groundwater and Hydromechanics GWH, ETH Zurich |

## Completed Projects

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| Smart Slab | lightweight concrete slab in the DFAB House, fabricated with 3D printed formwork<br>role: design software development for form generation, finite element analysis, software interoperability pipeline, start: 2016, end 2019, NCCR dfab and EMPA, dfabhouse.ch |
| Axolotl | Volumetric modelling plug-in for Rhino Grasshopper, role: lead developer, concept, design, programming |
| Incidental Space | Swiss pavilion for the Venice Architecture Biennale 2016, architect: Christian Kerez, curator: Sandra Oehy |
| | role: virtual reality application for the planning process, visibility analysis for light source distribution |
| Arch_Tec_Lab | research in the architectural planning, fabrication and construction of the future<br>role: architect, computational and parametric design specialist, start 2010, end 2016, client: ETH Zurich |
| Gugelmann Galaxy | a novel approach to curation, browsing and online presentation of art collections<br>role: lead developer, initial prototype in collaboration with Jorge Orozco, Nikola Marinčić and Sonja Gasser, 2015 - 2016 |

## Work Samples

The following list contains a selection of projects I realised beside my research activity, as a freelance architect and computational design specialist, in collaboration with architecture and design practices. They all have in common an initial design idea by the architect, whose realisation and successful digital fabrication would not have been possible without the aid of bespoke software tools, custom-tailored to the clients' and projects' needs.

**Les Ateliers** : CNC milled exhibition booth cladding panels for Basel World ("world's foremost show for watches, jewellery, precious stones and related industries"), role: design software tool development and manufacturer specific post-processor, with Dany Waldner AG, 2016 - 2017

**Corails Chandieu** : CNC laser cut aluminium façade panels, role: design software tool development, with group8 architects Geneva, 2009 - 2010

**Office building Seetalplatz Lenzburg** : screen printed glass façade panels, design software tool development, with Frei Architekten AG, 2008 - 2009

**NZZ canteen** : CNC die-cut interior cladding panels, automation of production data generation, with Karen Rohwedder, 2007 - 2008

**ARCH / SCAPES** : Swiss pavilion for the 7th international architecture biennial in Sao Paulo, design software tool development, with HHF Architekten GmbH and ZMIK Designers, Basel, 2007

## Teaching Experience

### ETH Zurich - Digital Building Technologies DBT

The master of advanced studies program MAS in Architecture and Digital Fabrication (masdfab.com) is jointly organised by Gramazio Kohler Research (GKR) and the chair for Digital Building Technologies (DBT). It is the educational program of the National Centre for Competence in Research (NCCR) Digital Fabrication.

**Teaching at doctoral level**

PhD seminar 2019: title: *Introduction to Computational Research in Architecture, Engineering, Fabrication and Construction*, with Tom Van Mele (Block Research Group BRG), Romana Rust and Gonzalo Casas (Gramazio Kohler Research GKR), introduction to the compas framework with modules on form finding, robotic fabrication, volumetric modelling and 3d printing

**Supervision of 6 final thesis**

MAS dfab 2019: title: *Computational Clay Coral City - An investigation in robotic aggregation of clay for the design and fabrication of engineered coral reefs*, students: Eleni Skevaki and Nicolas Feihl, supervision: Mathias Bernhard, Marie Griesmar (artist, ETH Library Lab), David Jenny and Jesus Medina (GKR)

MAS dfab 2019: title: *Generative Modelling with Design Constraints - Reinforcement Learning for Furniture Generation*, student: Yuta Akizuki, supervision: Mathias Bernhard, Marirena Kladeftira, Reza Kakooee and Benjamin Dillenburger

MAS dfab 2018: title: *Numerical Sculpting of in place Wire Arc Additive Manufacturing connections*, student: Ioanna Mitropoulou, supervision: Inés Ariza (GKR) and Mathias Bernhard

MAS dfab 2017: title: *Acoustic Mirrors*, students: Marirena Kladeftira and Maria Pachi, supervision: Benjamin Dillenburger, Demetris Shammas and Mathias Bernhard

Bachelor in civil engineering 2017: title: *3D-printed Concrete Canoe*; students: Moritz Studer, Oliver Wach and Kathrin Ziegler; supervision: PCBM: Prof. Dr. Robert J. Flatt, Nicolas Ruffray, Heinz Richner, Dr. Timothy Wangler, DBT: Prof. Dr. Benjamin Dillenburger, Andrei Jipa, Mathias Bernhard

Bachelor in civil engineering 2016: title: *3D Sand-Printed High Performance Fibre-Reinforced Concrete Hybrid Structures*, students: Neil Montague de Taisne and Felix Stutz, supervision: PCBM: Prof. Dr. Robert J. Flatt, Nicolas Ruffray, DBT: Prof. Dr. Benjamin Dillenburger, Mathias Bernhard

**Teaching at master of advanced studies level, MAS**

Lecture and exercise; title: *Introduction to Python programming, computational geometry and 3D printing*; trimester 1 of a one-year full time program (2016 - 2019)

Lecture and exercise, title: *Smart Brick – volumetric modelling* (2017 - 2019)

**Teaching at master level, department of architecture**

Lecture and exercise, title: *Advanced Computational Design Course* (procedural modelling, evolutionary algorithms, machine learning), obligatory elective, 3h/week, 2019w

Landscape Architecture Studio, title: *Robotic Landscape*, with Ilmar Hurkxkens, Prof. Christophe Girot, chair of landscape architecture, and Gramazio Kohler Research, 2018

**Workshop**

Lecture and exercise; title: *Performative Porosity - Volumetric Modeling for Building Envelopes*, Nov. 2019 / Mar. 2020, University of São Paulo (USP), Brasil

### University of Applied Sciences Lucerne HSLU - Object Design

Teaching at bachelor level: lecture and design studio: *Digital Fabrication* (3D modelling, CNC milling, 3D printing), 2 d/week, autumn semester 2016, with Yves Ebnöther

### ETH Zurich - Architecture and Building Process

Teaching at post-graduate level, certificate of advanced studies CAS: lecture

and exercise, *Introduction to Python and BIM Programming for Architects, Builders and Constructors* (2017, 2018)

### ETH Zurich - Computer Aided Architectural Design CAAD

**Final thesis supervision**

Diploma complementary course, title: *Urban Data Streams*, 2015

Elective course thesis, title: *Arkiwi - architectural database*, students: Baur and Chevremont, 2015

**Teaching at master of advanced studies level, MAS**

Fabrication module, title: *Design to Production* (RhinoScript programming, CNC milling and cutting, robotic fabrication) 2010 - 2012

Programming module, titles *Monstrocity* and *Scenic Landscape* (procedural design, shape grammars, mesh subdivision in Processing)

**Teaching at bachelor and master level**

Lecture and exercise, *CAAD theory* and *CAAD practice*, elective courses, 2009 - 2014

### University of Applied Sciences FHNW - Hyperwerk Basel

Bachelor thesis supervision, title: *Animal Anima*, student: Lena Jermann, co-supervision: Mischa Schaub, 2008

### ETH Zurich - Rapid Architectural Prototyping Laboratory RAPLAB

Various seminar- and project-weeks on digital fabrication and computational design, taught to bachelor-, master- and post-graduate students as well as building industry professionals

## Scientific Services

Reviewer for the international scientific publication *3D Printing and Additive Manufacturing 3DP+*

Reviewer for the international scientific conference *RobArch*, 2018, Zurich

## Exhibitions

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| 2019 | How to Build a House: Architectural Research in the Digital Age, the DFAB HOUSE at Swissnex, San Francisco and Cooper Union, New York |
| 2019 | AI Art Gallery, NeurIPS Workshop on Machine Learning for Creativity and Design |
| 2018 | 3D-Druck: Wie eine Technologie unser Leben verändert, Museum Stamparia, Strada |
| 2017 | Architektur aus dem 3D Drucker, Scientifica: Zurich Science Days, ETH Zurich |
| 2016 | Incidental Space, Swiss pavilion at the Venice architecture biennial |
| 2016 | AMX – additive manufacturing exhibition, Lucerne |
| 2016 | The Making of Incidental Space, ETH Zurich |
| 2016 | Advances in Architectural Geometry AAG, Zurich |
| 2015 | Gugelmann Galaxy at LangerSonntag, Swiss National Library, Berne |
| 2007 | ARCH/SCAPES, Swiss pavilion at the Sao Paulo architecture biennial |

## Public Talks

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| 2020.04 | guest webinar at the Computational Design in Architecture course (ARC 374) at Princeton University, School of Architecture, invited by Prof. Dr. Ștefana Parascho |
| 2020.02 | lecture "Computational Design for 3D Printed Architecture at the Additive Days 2020, Sofia, Bulgaria |
| 2019.12 | lecture for Baukaderschule, Gewerbliches Berufs- und Weiterbildungszentrum St. Gallen at DFAB House, NEST, EMPA Dübendorf |

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| 2019.02 | lecture at the Winterapéro of Burkhardt+Partner AG architects, cinema westside, Berne |
| 2018.09 | lecture and tour guide at the OpenHouse day, DFAB House, NEST, EMPA Dübendorf |
| 2016.09 | lecture "Complex Architectural Elements" at AMX, the Additive Manufacturing Expo at Messe Lucerne |

## Other

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| Languages | German (native), English (fluent), French (fluent), Spanish (basic) |
| Software | Rhino3D, Grasshopper, RhinoCAM, SurfCAM, Unity3D, Revit, VectorWorks, Abaqus, KeyShot, Adobe Creative Suite (ID, AI, PS), MS Office |
| Programming | Python (scikit learn, scikit image, Keras, Tensorflow), Java, Processing (Java and Python), C#, Javascript (p5js, three.js, d3.js), VectorScript, PHP, mySQL |
| Hardware | industrial sand binderjet 3D printer (VX1000), FDM 3D printer, CNC mill, laser cutter, cutting plotter, robotic arm (Kuka, ABB, UR), virtual reality (Oculus DK2, HTC Vive, Google Cardboard) |
| Awards | June 2017: 1$^{st}$ prize in Technology and Innovation for skelETHon at the 16th German Concrete Canoe Regatta in Cologne, InformationsZentrum Beton GmbH |
| Memberships | sia – Swiss Engineers and Architects Association (2007 - 2018) |
| | COMPAS developers, github.com/compas-dev |
| Hobbies | drums and percussion, fitness, running, hiking with my labrador Paula |

## List of Publications

Bernhard, Mathias. 2019. "Domain Transforms in Architecture - Encoding and Decoding of Cultural Artefacts." ETH Zurich. https://doi.org/10.3929/ethz-b-000381227.

Bernhard, Mathias, Michael Hansmeyer, and Benjamin Dillenburger. 2018. "Volumetric Modelling for 3D Printed Architecture." In AAG - Advances in Architectural Geometry, edited by Lars Hesselgren, Axel Kilian, Olga Sorkine Hornung, Samar Malek, Karl-Gunnar Olsson, and Christopher John Kenneth Williams, 392–415. Göteborg, Sweden: Klein Publishing GmbH. https://research.chalmers.se/en/publication/504188.

Bernhard, Mathias. 2016. "Gugelmann Galaxy: An Unexpected Journey through a Collection of Schweizer Kleinmeister." Edited by Harald Klinke and Liska Surkemper. International Journal for Digital Art History Visualizin (2): 95–113. https://doi.org/10.11588/dah.2016.2.23250.

Bernhard, Mathias, Nikola Marinčić, Jorge Orozco, and Sonja Gasser. 2015. "Schweizer Kleinmeister: An Unexpected Journey." opendata.ch. 2015. http://make.opendata.ch/wiki/project:schweizer_kleinmeister:an_unexpected_journey.

Bernhard, Mathias, Nikola Marinčić, and Jorge Orozco. 2015. "ANY-FOLD: On Curation, Literacy & Space." Trans curated (27): 84–87.

Bernhard, Mathias. 2013. "Frequency Analysis of Wood Textures." In ECAADe 31 - Computation and Performance, edited by Rudi Stouffs and Sevil Sariyildiz, 1:597–603. Delft, NL.

Bernhard, Mathias. 2013. "Frequencies of Wood - Designing in Abstract Domains." In Design Modelling Symposium. Berlin.


Akizuki, Yuta, Mathias Bernhard, Reza Kakooee, Marirena Kladeftira, and Benjamin Dillenburger. 2020. "Generative Modelling with Design Constraints: Reinforcement Learning for Furniture Generation." In CAADRIA. Bangkok, Thailand. (unpublished)

Mitropoulou, Ioanna, Inés Ariza, Mathias Bernhard, Benjamin Dillenburger, Fabio Gramazio, and Matthias Kohler. 2019. "Numerical Sculpting - Volumetric Modelling Tools for in Place Spatial Additive Manufacturing." In DMSB - Impact: Design with All Senses. Springer.

Kladeftira, Marirena, Maria Pachi, Mathias Bernhard, Demetris Shammas, and Benjamin Dillenburger. 2019. "Design Strategies for a 3D Printed Acoustic Mirror." In Intelligent & Informed: Proceedings of the 24th International Conference of the Association for Computer-Aided Architectural Design Research in Asia (CAADRIA 2019), 1:123–32. Wellington, New Zealand: https://www.research-collection.ethz.ch:443/handle/20.500.11850/340650.

Hurkxkens, Ilmar, and Mathias Bernhard. 2019. "Computational Terrain Modeling with Distance Functions for Large Scale Landscape Design." Journal of Digital Landscape Architecture, no. 4.

Meibodi, M.A., A. Jipa, R. Giesecke, D. Shammas, M. Bernhard, M. Leschok, K. Graser, and B. Dillenburger. 2018. "Smart Slab: Computational Design and Digital Fabrication of a Lightweight Concrete Slab." In Recalibration on Imprecision and Infidelity - Proceedings of the 38th Annual Conference of the Association for Computer Aided Design in Architecture, ACADIA 2018.

Kladeftira, M., D. Shammas, M. Bernhard, and B. Dillenburger. 2018. "Printing Whisper Dishes: Large-Scale Binder Jetting for Outdoor Installations." In Recalibration on Imprecision and Infidelity - Proceedings of the 38th Annual Conference of the Association for Computer Aided Design in Architecture, ACADIA 2018.

Kladeftira, Marirena; Shammas, Demetris; Bernhard, Mathias; Dillenburger, Benjamin. 2018. "Printing Whisper Dishes. Large Scale Binder Jetting

for Outdoor Installations." In ACADIA 2018: Re/Calibration: On Imprecision and Infidelity, edited by Andrew John Anzalone, Phillip; Del Signore, Marcella; Wit, 328–35. Mexico City, Mexico.

Ruffray, Nicolas, Mathias Bernhard, Andrei Jipa, Mania Meibodi, Neil de Taisne, Felix Stutz, Timothy Wangler, Robert Flatt, and Benjamin Dillenburger. 2017. "Complex Architectural Elements From Hpfrc and 3D Printed Sandstone." In RILEM Symposium on Ultra-High Performance Fibre-Reinforced Concrete, edited by François Toutlemonde and Jacques Resplendino, 1:135–44. Montpellier, France: Association Française de Génie Civil (AFGC).

Jipa, Andrei, Mathias Bernhard, Nicolas Ruffray, Timothy Wangler, Robert Flatt, Benjamin Dillenburger, and Mathias Bernhard. 2017. "SkelETHon Formwork 3D Printed Plastic Formwork for Load-Bearing Concrete Structures." XXI Congreso Internacional de La Sociedad Iberoamericana de Gráfica Digital 3 (12): 345–52. https://doi.org/10.5151/sigradi2017-054.

Jipa, Andrei, Mathias Bernhard, and Benjamin Dillenburger. 2017. "Submillimeter Formwork. 3D Printed Plastic Formwork for Concrete Elements." In TxA Emerging Design + Technology, edited by Kory Bieg, 9. Austin, Texas, USA: Texas Society of Architects.

Aghaei-Meibodi, Mania, Mathias Bernhard, Andrei Jipa, and Benjamin Dillenburger. 2017. "The Smart Takes from the Strong." In Fabricate, edited by Bob Sheil, Achim Menges, Ruairi Glynn, and Skavara Marilena, 210–17. London: UCL Press. https://doi.org/https://doi.org/10.14324/111. 9781787350014.

Aghaei Meibodi, Mania, Mathias Bernhard, Andrei Jipa, and Benjamin Dillenburger. 2017. "The Smart Takes from the Strong 3D Printing Stay-in-Place Formwork for Cocrete Slab Construction." In FABRICATE, edited by Achim Menges, Bob Sheil, Ruairi Glynn, and Marilena Skavara, 3:210–17. Stuttgart: UCL Press.

Jipa, Andrei, Benjamin Dillenburger, and Mathias Bernhard. 2017. "SkelETHon Formwork 3D Printed Plastic Formwork for Load-Bearing Concrete Structures." In XXI Congreso Internacional de La Sociedad Iberoamericana de Gráfica Digital, 3:345–52. São Paulo: Blucher.

Wangler, Timothy, Ena Lloret, Lex Reiter, Norman Hack, Fabio Gramazio, Matthias Kohler, Mathias Bernhard, et al. 2016. "Digital Concrete: Opportunities and Challenges." RILEM Technical Letters 1 (October): 67. https://doi.org/10.21809/rilemtechlett.2016.16.

Jipa, Andrei, Mathias Bernhard, Benjamin Dillenburger, and Mania Aghaei-Meibodi. 2016. "3D-Printed Stay-in-Place Formwork for Topologically Optimized Concrete Slabs." In TxA Emerging Design + Technology, 96–107. https://doi.org/10.3929/ETHZ-B-000237082.

Girot, Christophe, Mathias Bernhard, Yves Ebnöther, Pia Fricker, Alexandre Kapellos, and James Melsom. 2010. "Towards a Meaningful Usage of Digital CNC Tools within the Field of Large-Scale Landscape Architecture." In Future Cities: 28th ECAADe Conference Proceedings, 371–78. Zurich, Switzerland: ETH Zurich.