

# Curriculum Vitae

## CONTACT

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Dr.-Ing. Sebastian Jiro Schlecht

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## ACADEMIC POSITIONS

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03/2018 – 02/2019	<b>Postdoctoral Researcher</b> Perception-Based Spatial Audio Signal Processing Friedrich-Alexander University Erlangen-Nürnberg Erlangen, Germany
03/2018	<b>Visting Researcher</b> Acoustics Lab Aalto University Espoo, Finland
08/2010 – 02/2019	<b>Research Consultant (20%)</b> Department Multimedia Realtime Systems Fraunhofer Institute for Integrated Circuits Erlangen, Germany
01/2012 – 09/2017	<b>Research Assistant (50%)</b> Perception-Based Spatial Audio Signal Processing Friedrich-Alexander University Erlangen-Nürnberg Erlangen, Germany
04/2007 – 06/2010	<b>Student Assistant</b> Theoretical Computer Science University of Trier, Germany

## EDUCATION

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- 01/2012 – 09/2016     **PhD in Spatial Audio Signal Processing**  
*Feedback Delay Networks in Artificial Reverberation and Reverberation Enhancement*  
Friedrich-Alexander University Erlangen-Nürnberg  
Supervisor: Prof. Dr. Emanuel Habets  
Graduated with distinction
- 10/2014 – 09/2016     **Music Theory & Ear Training**  
Private studies with Prof. Christoph Göbel  
University of Music and Theatre, Leipzig, Germany
- 09/2010 – 08/2011     **MSc in Digital Music Processing**  
Queen Mary, University of London, England  
Scholarship by the German Academic Exchange Service  
Graduated with distinction
- 07/2010     **Summer Workshops on Perceptual Audio Coding and Electronic Music Composition**  
Centre for Computer Research in Music and Acoustics  
Stanford University, California, USA  
Funded by the German Academic Exchange Service
- 04/2006 – 07/2010     **Diplom (Combined BSc / MSc) in Applied Mathematics**  
University of Trier, Germany  
Graduated with distinction
- 01/2009 – 04/2009     **3-month Internship in Japan**  
Bosch Corporation, Yokohama, Japan  
DA&CAPS Engineering Departement  
Supported by the German Academic Exchange Service
- 04/2006 – 07/2007     **Vordiplom (BSc) in Computer Science**  
University of Trier, Germany
- 09/2005 – 03/2006     **Studies in Mathematics**  
University of the Saarland, Saarbrücken, Germany
- 07/2005     **Abitur (General qualification for university entrance)**  
Theodor-Heuss-Gymnasium, Nördlingen, Germany  
Grade 1.3 (marks from 1.0 best to 4.0)
- 01/2003 – 07/2003     **School Exchange to Japan**  
Meito High School, Nagoya, Japan

## SCHOLARSHIPS

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- 09/2010 – 08/2011      **German Academic Exchange Service (DAAD)**  
1-year M.Sc. scholarship  
Queen Mary, University of London, England
- 07/2010                      **German Academic Exchange Service (DAAD)**  
4-week scholarship for summer workshop  
Stanford University, CA, USA
- 01/2009 – 04/2009      **German Academic Exchange Service (DAAD)**  
Supporting scholarship for 3-month internship  
Bosch Corporation, Yokohama, Japan

## AWARDS

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- 08/2018                      **Best Peer-Reviewed Paper**  
*Audio quality evaluation in virtual reality: Multiple stimulus ranking with behavior tracking*  
by Olli Rummukainen, Thomas Robotham, Sebastian J. Schlecht, Axel Plinge, Jürgen Herre, Emanuël A. P. Habets  
2018 AES International Conference on Audio for Virtual and Augmented Reality in Redmond, WA, USA
- 09/2018                      **Best Paper**  
*Optimized velvet-noise decorrelator*  
by Sebastian J. Schlecht, Benoit Alary, Vesa Välimäki, Emanuël A. P. Habets  
2018 International Conference on Digital Audio Effects (DAFx) in Aveiro, Portugal

## INVITED TALKS

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- 11/2018                      **Artificial Reverberation**  
Ableton AG, Berlin, Germany
- 03/2018                      **Feedback Delay Networks - Inside the Matrix**  
Acoustics Lab  
Aalto University, Espoo, Finland
- 10/2015                      **Immersive Audio Signal Processing and Effects**  
Convention Audio Engineering Society (AES)  
New York, NY, USA

## TEACHING

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10/2018 – 2020	<b>Thesis Advisor</b> Benoit Alary, PhD student at Acoustics Lab under supervision Prof. Vesa Välimäki Aalto University, Espoo, Finland
03/2018	<b>Virtual Acoustics</b> Guest Lecturer in a lecture series of Prof. Frank Wefers Friedrich-Alexander University Erlangen-Nürnberg, Germany
2015 & 2018	<b>Seminar on Audio Processing</b> Supervision of seminar paper Friedrich-Alexander University Erlangen-Nürnberg, Germany
09/2007 – 07/2010	<b>Student Assistant</b> Assistant in theoretical computer science course University of Trier, Germany

## MUSIC & DESIGN POSITIONS

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09/2018 – 10/2018	<b>Get Well Soon</b> Violin, The Horror European Tour (2018)
08/2014 – 12/2017	<b>Mighty Oaks</b> Violin & Keys, European Tours: Higher Place (2017), Dreamers (2017), Golden Road (2014) and Festivals
08/2013 – 05/2016	<b>LötKrft Design Collective</b> Founder, Electronics & Interaction Design
11/2011 – 07/2017	<b>David Lemaitre</b> Violin & Electronics, European Tours: Aquatics (2011), Valediction (2012), Latitude (2013) and Festivals, La Sud South America Tour (2016)
09/2010 – 10/2011	<b>Sullum Voe</b> Violin, Selected concerts: Whitechapel Gallery (London), Centre Pompidou (Paris), Gareth Pugh's Pitti Debut (Florence)
07/2006 – 08/2010	<b>The Shanes</b> Violin, Germany Tours: Polka over Serbja (2007), Squandering Youth (2009)
01/2007 – 10/2008	<b>Paul Juon Piano Trio</b> Violin 2nd Prize Charles Hennen Concours, Heerlen, Netherland 3rd Prize "Jugend musiziert" national final round

04/1998 – 09/2008

**Swabian Youth Symphony Orchestra**

Concertmaster, Principal 2nd Violin, Principal Viola

**ARTISTIC & DESIGN WORKS**

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2010 – 2017

**Studio Recordings (Selection)**

Like Lovers, Everything All The Time Forever, 2019

Charlotte Brandi, The Magician, 2018

Mighty Oaks, Storm, 2017

Fern, Fern, 2017

Der Weg einer Freiheit, Stellar, 2015; Finisterre, 2017

Fayzen, Gerne allein, 2017

Laith Al-Deen, Bleib unterwegs, 2016

A Tale of Golden Keys, Everything Went Down As Planned, 2016

Abby, Welcome Home, 2011; Friends&Enemies, 2013; Hexagon, 2015

Berge, Vor uns die Sintflut, 2015

Nico Suave feat. X. Naidoo, Unvergesslich, 2014

Ray Wilson (Genesis), LiveTracks, 2014

David Lemaitre, Latitude, 2013

Max Prosa, Rangoon, 2013

Marla Blumenblatt, Immer die Boys, 2013

We invented Paris, We Invented Paris, 2011

2013 – 2016

**Light & Interaction design** with LötKrf

Like Lovers, Lights & Interaction, 2016

We Invented Paris, Lights, 2015

David Lemaitre, Lights & Instruments, 2013

08/2011

**Gonda** by Ursula Mayer

Original Film Score, Composition & Performance, 2011

01/2011

**Pitti Debut** by Gareth Pugh

Video & Live Fashion Show, Composition & Performance, 2011

**PROGRAMMING**

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- Matlab (Expert)
- C++, Audio Plugin Development (Advanced)
- PureData/MaxMSP, Ableton Live (Advanced)
- Arduino, L<sup>A</sup>T<sub>E</sub>X (Intermediate)

## CONFERENCES

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09/2018	Digital Audio Effects (DAFx) Aveiro, Portugal, Poster
08/2018	Conference Audio Engineering Society (AES) Tokyo, Japan, Talk
09/2017	Digital Audio Effects (DAFx) Edinburgh, UK, Poster
05/2017	Quality of Multimedia Experience (QoMEX) Erfurt, Germany, Poster
03/2017	Conference Audio Engineering Society (AES) Erlangen, Germany, Participant
01/2017	Convention Audio Engineering Society (AES) Berlin, Germany, Participant
10/2016	Ableton Loop Berlin, Germany, Participant
11/2015	Convention Audio Engineering Society (AES) New York, USA, Invited Workshop
09/2015	Conference Audio Engineering Society (AES) Montreal, Canada, Talk
07/2015	Convention Audio Engineering Society (AES) Warsaw, Poland, Talk
10/2012	Convention IEEEI, Eilat Israel, Talk
09/2012	Workshop on Acoustic Signal Enhancement (IWAENC) Aachen, Germany, Poster

## PUBLICATIONS

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For the selected publications, the journal papers were developed and written by the first author (90%) while Prof. Habets edited the manuscript (10%).

## Selected Publications

- [1] S. J. Schlecht and E. A. P. Habets, “Feedback delay networks: Echo density and mixing time,” *IEEE/ACM Trans. Audio, Speech, Lang. Proc.*, vol. 25, no. 2, pp. 374–383, 2017.
- [2] S. J. Schlecht and E. A. P. Habets, “On lossless feedback delay networks,” *IEEE Trans. Signal Process.*, vol. 65, no. 6, pp. 1554–1564, Mar. 2017.
- [3] S. J. Schlecht and E. A. P. Habets, “The stability of multichannel sound systems with time-varying mixing matrices,” *J. Acoust. Soc. Amer.*, vol. 140, no. 1, pp. 601–609, Jul. 2016.

## Journals

- [4] B. Alary, A. Politis, S. J. Schlecht, and V. Välimäki, “The directional feedback delay network,” *Journal of the Audio Engineering Society*, submitted, 2018.
- [5] O. S. Rummukainen, S. J. Schlecht, and E. A. P. Habets, “Self-translation induced minimum audible angle,” *J. Acoust. Soc. Amer.*, vol. 144, no. 4, EL340–EL345, Oct. 2018.
- [6] S. J. Schlecht and E. A. P. Habets, “Modal decomposition of feedback delay networks,” *IEEE Trans. Signal Process.*, submitted, 2018.
- [7] S. J. Schlecht and E. A. P. Habets, “Time-varying feedback matrices in feedback delay networks and their application in artificial reverberation,” *J. Acoust. Soc. Amer.*, vol. 138, no. 3, pp. 1389–1398, Sep. 2015.

## Conferences

- [8] O. Rummukainen, T. Robotham, S. J. Schlecht, A. Plinge, J. Herre, and E. A. P. Habets, “Audio quality evaluation in virtual reality: Multiple stimulus ranking with behavior tracking,” in *Proc. Audio Eng. Soc. Conf.*, Redmond, WA, USA, 2018, pp. 1–10.
- [9] S. J. Schlecht, B. Alary, V. Välimäki, and E. A. P. Habets, “Optimized velvet-noise decorrelator,” in *Proc. Int. Conf. Digital Audio Effects (DAFx)*, Aveiro, Portugal, 2018, pp. 1–8.
- [10] S. J. Schlecht and E. A. P. Habets, “Sign-agnostic matrix design for spatial artificial reverberation with feedback delay networks,” in *Proc. Audio Eng. Soc. Conf.*, Tokyo, Japan, 2018, pp. 1–10.

- [11] O. Rummukainen, S. J. Schlecht, A. Plinge, and E. A. P. Habets, “Evaluating binaural reproduction systems from behavioral patterns in a virtual reality—A case study with impaired binaural cues and tracking latency,” in *Audio Engineering Society Convention 143*, New York, NY, USA: Audio Engineering Society, Oct. 2017, pp. 1–8.
- [12] O. Rummukainen, S. J. Schlecht, A. Plinge, and E. A. P. Habets, “Evaluation of binaural reproduction systems from behavioral patterns in a six-degrees-of-freedom wayfinding task,” in *Quality of Multimedia Experience (QoMEX), 2017 Ninth International Conference on*, Erfurt, Germany: IEEE, Jun. 2017, pp. 1–3.
- [13] S. J. Schlecht and E. A. P. Habets, “Accurate reverberation time control in feedback delay networks,” in *Proc. Int. Conf. Digital Audio Effects (DAFx)*, Edinburgh, UK, Aug. 2017, pp. 337–344.
- [14] S. J. Schlecht and E. A. P. Habets, “Practical considerations of time-varying feedback delay networks,” in *Proc. Audio Eng. Soc. Conv.*, Warsaw, Poland, May 2015, pp. 1–9.
- [15] S. J. Schlecht and E. A. P. Habets, “Reverberation enhancement systems with time-varying mixing matrices,” in *Proc. Audio Eng. Soc. Conf.*, Montreal, Canada, Jul. 2015, pp. 1–8.
- [16] S. J. Schlecht and E. A. P. Habets, “Connections between parallel and serial combinations of comb filters and feedback delay networks,” in *International Workshop on Acoustic Signal Enhancement (IWAENC)*, Aachen, Germany, 2012, pp. 1–4.
- [17] S. J. Schlecht and E. A. P. Habets, “Reverberation enhancement from a feedback delay network perspective,” in *Convention of Electrical & Electronics Engineers in Israel (IEEEI)*, Eilat, Israel: IEEE, 2012, pp. 1–5.

## Patent

- [18] S. J. Schlecht, E. A. P. Habets, A. Silzle, C. Borß, H. Stenzel, and B. Neugebauer, “Apparatus and method for generating output signals based on an audio source signal, sound reproduction system and loudspeaker signal,” WO 2016/071206 A1, 2015.

## Thesis

- [19] S. J. Schlecht, “Feedback delay networks in artificial reverberation and reverberation enhancement,” PhD thesis, Erlangen, Germany, Oct. 2017.
- [20] S. J. Schlecht, “Source-filter separation for bowed string instruments and its application for advanced audio effects,” Master’s thesis, London, UK, Aug. 2011.
- [21] S. J. Schlecht, “Options and limits of feedback delay networks for artificial reverberation of audio signals,” Master’s thesis, Trier, Germany, Jun. 2010.



Since my youth, I have got a keen interest in mathematics and music, which I have explored ever since from various angles and which constitutes the overarching theme of my professional career. I have followed both interests somewhat independently during my secondary education and diploma studies at the Universities of Saarbrücken and Trier, Germany. However, since my studies at Queen Mary, University of London, UK, and the subsequent PhD studies at the Friedrich-Alexander University Erlangen-Nürnberg, Germany, I have strived for a more integrated practice of music and mathematics. I have come to appreciate the field of sound and music computing as an inherently interdisciplinary work as the ultimate recipient is a human listener. While my formal training is of a mathematical and technical nature, I believe that my artistic work as a musician complements and informs this practice valuably.

Whenever possible, I have strived for an understanding and development of a work from the mathematical structure to the impression on a person and vice versa. In this sense, my efforts are divided into four categories: signal processing, psychoacoustics, implementation, and performance. My main interests within signal processing is system theory of feedback delay networks, stability & losslessness conditions, spectral and temporal analysis and perception-driven sound synthesis. In psychoacoustics, I studied auditory localization and room acoustic perception for spatial audio reproduction and virtual & augmented reality applications. Implementation work include efficient and real-time processing, meaningful user-interfaces and high-quality parameter tuning. The main focus in musical performance was popular and electronic music performance and composition as well as design of controller, interaction and light elements. In the following, I give a chronological overview on some key motivations and ideas.

I started my musical education in violin and piano performance at the age of five and seven, respectively, and composition and music theory in classical and popular music styles at the age of twelve. I was part of the Swabian Youth Symphony Orchestra as a violinist and violist for ten years. As a founding member of a youth theater group, I have written and arranged music for multiple productions. During my university studies, I have performed with a classical piano trio and participated in national and international competitions.

During my secondary education, I have participated three times in the national mathematics competition. My final school term paper was on the axiomatic foundation of geometry, which encouraged me to pursue my formal studies in applied mathematics and computer science at the Universities of Saarbrücken and Trier, Germany. Particular emphasis during my studies was on theoretical computer science and discrete mathematics as a student assistant in the group of Prof. Fernau. At this time, I self-studied books on music and mathematics mostly from a music theory perspective however with little insight. Determined to find a better connection, I applied for an internship at the Audio and Multimedia division of the Fraunhofer Institute of Integrated Circuits (IIS), Erlangen, Germany. The topic of the placement was on signal processing algorithms for the synthesis of room acoustics. This work struck an attractive balance between physics, psychoacoustics, and musical performance practice, which proved influential subsequently. I continued to write my diploma thesis on this topic and returned later to extend this work during my Ph.D. studies at the Friedrich-Alexander University Erlangen-Nürnberg, Germany.

To pursue my interests in the field of sound and music computing, I decided to study digital music processing at Queen Mary, University of London, UK, where I have learned a broad spectrum of research subjects ranging from mathematical modeling of signals and musical structures to electronic performance and effect design. To this date, I regard this research area as most inspiring and rewarding. While my academic interest shifted towards the study of sound, on the other end, my musical practice in London incorporated increasingly technical and electronic aspects. For instance, the idea of my master thesis with Dr. Anssi Klapuri on advanced pitch shifting was directly derived from a musical idea.

In 2012, I accepted a position as an assistant researcher in the Perception-Based Spatial Audio Signal Processing group at the International Audio Laboratories Erlangen of the Friedrich-Alexander University Erlangen-Nürnberg headed by Prof. Dr. ir. E.A.P. Habets. To account for my other interests, I split my time between 2012-2017 as following: assistant researcher (50%), development consultant at Fraunhofer IIS (20%) and studio and touring musician (30%). In 2013, my daughter Philippina Schlecht was born.

My Ph.D. topic was spatial audio processing with an emphasis on artificial reverberation. In particular, my research efforts have been directed towards the intersection of mathematical fil-

ter design, efficient algorithms and perceptual aspects. The Ph.D. thesis provides fundamental results in the theory and design of artificial reverberation with feedback delay networks (FDNs) and electro-acoustic reverberation enhancement systems (RESs).

At the Fraunhofer IIS, I was the lead developer of the post-production tool *IIS 3D Reverb* for multichannel audio, which has been featured on multiple trade shows, in the standardization of MPEG-H and is currently in use for VR/AR research. The development team included four student programmers, one senior developer and two Tonmeisters. A patent protects part of the algorithm.

As a musician, I performed over two hundred concerts around Europe and South America in major concert venues such as Columbiahalle (Berlin), Philharmonie (Cologne, Dortmund & Stuttgart), Paradiso (Amsterdam), Centre Pompidou (Paris), Teatro Municipal (La Paz) and Gareth Pugh's Pitti Debut (Florence) and major open-air festivals including Rock am Ring and Rock im Park (Nuremberg), Lollapalooza (Berlin), Frequency Festival, St Gallen Festival, Donauinselfest (Vienna) and Zurich Open Air.

More recently, my research effort was directed towards topics in 6-degree-of-freedom virtual and mixed reality applications including auditory localization, and panning, acoustic environment with fellow researchers Dr. Olli Rummukainen and Dr. Axel Plinge. With the Acoustics Lab of Prof. Välimäki at Aalto University, Finland, I'm currently working on spatial reproduction topics such as decorrelation and non-isotropic artificial reverberation. There, I was appointed to be the thesis advisor of Ph.D. student Benoit Alary. Now, I am also applying for funding by the German Research Foundation (DFG) with the topic of "Analysis and Synthesis of Small Room Acoustics," which aims at recreating the acoustic impression for augmented reality applications.

The present proposal for a research visit at the Acoustics and Audio Group of Prof. Bilbao at the University of Edinburgh aims at a physically informed perspective of sound synthesis, in particular, virtual room acoustics. I seek to extend my methodologies in Finite-Difference Time-Domain Methods while drawing simultaneously on previously acquired knowledge of signal processing, system theory, and psychoacoustics. The DAAD funding would provide me with the unique opportunity to gain more international experience and visibility, and strengthen my academic profile.