Olaf Schenk CV

1. Personal information

Università della Svizzera italiana (USI)	Email:	olaf.schenk@usi.ch
Faculty of Informatics	Phone:	+41 58 666 4850
Via Giuseppe Buffi 13, 6900 Lugano, Switzerland	Research Webpage:	http://usi.to/ovv
Nationality: German	ORCID:	0000-0001-8636-1023

2. Education & Scientific degree

University of Basel	Computer Science & Mathematics	Habilitation, 01/2010
Swiss Fed. Inst. of Technology Zurich	Information Technology & Electrical Eng.	Ph.D., 01/1996 – 06/2001
Karlsruhe Institute of Technology, Germany	Mathematics	Diploma, 10/1990–12/1995

3. Employment history

USI	Full Professor	09/2016 – present
ETH Zurich	External Lecturer	01/2020 – present
Swiss National Supercomputing Centre, ETH Zurich	Advisory Position (10%)	09/2012 – present
USI	Associate Professor	01/2012 – 08/2016
University of Basel	Senior Research Associate	01/2006 – 12/2011
IBM Thomas Watson Research Center, Yorktown, USA	Postdoctoral Fellow	01/2005 – 12/2005
University of Basel	Postdoctoral Fellow	04/2001 – 12/2004

4. Institutional responsibilities (committee member, unless stated differently, subset)

- USI: Director of *Informatics Ph.D. Program* (since 09/2016), Director of *Computational Science M.S. Program* (since 09/2015), *Committee member M.S. Programs* (since 09/2018), *Faculty Hiring Committee* (08/2016 – 10/2017); University of Basel: *Committee member BSc program on CSE* (01/2005 – 12/2011).

5. Ongoing research projects, previous SNF and other projects, and own budget (subset)

In 8 years at USI, my funding requests have been awarded over CHF 3.5 Mio including: SNF, DFG, Innosuisse, Platform for Advanced Scientific Computing (PASC), EU-FP7, and industrial funding. Full list of project is available at http://usi.to/ovv. Here is a selected subset:

Next HPC generation of approximate Bayesian inference	KAUST	07/2020 - 06/2023	405K $
Can economic policy mitigate climate-change?	SNF SINERGIA	12/2019 - 11/2023	247K CHF
Big data driven controls and performance assessment	Innosuisse	07/2019 - 06/2020	47K CHF
High performance balanced graph partitioning	SNF	04/2019 - 03/2023	247K CHF
Heterogeneous agent models on HPC platforms	PASC	07/2017 - 06/2020	150K CHF
Future Swiss electrical infrastructure	Innosuisse	07/2017 - 12/2020	390K CHF
Dual-phase steels - from micro to macro properties	SNF/DFG	01/2016 - 12/2018	178K CHF
PASC16 conference	SNF	06/2016 - 09/2016	16K CHF
Extreme-scale electrothermal simulations of nano-devices	SNF	04/2014 - 03/2017	178K CHF
Exascale algorithms and advanced comput. techniques	EU-FP7	10/2013 - 09/2016	299K €
Frequency-domain full-waveform inversion	SNF	06/2010 - 05/2012	229K CHF

6. Supervision of junior researchers

Since 2012 I advised 4 Postdocs, 10 PhD students, 13 MSc students, 8 BSc students, and served on the committee of 5 PhD students (external member) and 12 PhD students (internal member). Below is a list of advised PhD students: L. Gaedke-Merzhäuser (2020-), D. Pasadakis (2018-), A. Eftekhari (2017-), R. Janalik (2015-), J. Kardos (PhD 2020), F. Verbosio (PhD 2018), M. Rietmann (PhD 2015), J. Huber (PhD

2013), M. Sathe (PhD 2012), M. Christen (PhD 2012). Most of my PhD and postdoctoral students are now working in the Swiss industry in companies such as EY, Disney Research, NVIDIA, and Google.

7. Teaching activities (summary since 2012)

I am offering the following core courses within the Bachelor of Computational Science & Engineering at ETH Zurich, the Master of Computational Science, the Master of Financial Technology and Computing, the Master of Artificial Intelligence, the Master of Informatics at USI: HPC Lab (ETH Zurich), Numerical Computing (USI), High Performance Computing (USI), Software Atelier: Simulation, Data Science & Computing (USI), Effective HPC & Data Analytics (USI, CSCS/ETH).

8. Memberships in panels and boards, individual scientific reviewing activities (subset)

- Associate editor ACM Transactions on Mathematical Software (since 2019), SIAM Journal on Scientific Computing (2012-2017), Guest Editor Special Issue Parallel Computing (2012, 2014, 2016, 2018)
- SIAM/ACM/IEEE Service: Editor-in-Chief Reappointment Committee for Computing in Science and Engineering (IEEE CiSE) (2019), Committee Chair SIAM/SC Career Prize (2018), Committee Chair SIAM SIAG/CSE Best Paper Prize (2018), Committee Chair SIAM SIAG/SC Best Paper Prize (2016).
- Advisory Boards: Computational Engineering M.S. at University of Erlangen-Nuremberg, Germany (since 2018), Swiss Platform for Advanced Scientific Computing Core Program (PASC) (since 2017), Project Leadership Team of PASC (2012–2016), Board Member Swiss SCCER Future Swiss Electrical Infrastructure (since 2013), International evaluation committee member Technical University of Ostrava (2020).
- Grant reviewer SNSF, ERC, PRACE, DFG, Gauss Centre, Belgium Research Foundation, ETH Zurich, Czech Science Foundation, French National Research Agency.

9. Active memberships in scientific societies

- SIAM Fellow (Class of 2020), ACM, ACM SIGHPC (Special Interest Group in High Performance Computing), Senior member IEEE, IEEE Computer Society.

10. Organization of conferences (subset)

- General Chair: SIAM Conference on Parallel Processing for Scientific Computing (2018, 700 pp.), ACM Platform for Advanced Scientific Computing Conference (2015, 250 pp.; 2016, 300 pp.; 2017, 350 pp.), International Workshop on Parallel Matrix Algorithms&Applications (2010-2018; ∼150 pp.).
- Conference Steering Committees: ACM PASC (2018-), SIAM/SIAG SC Paper Proceedings (2019-).

I served on over 80 program committees of conferences over the last ten years including all major conferences on applied/industrial mathematics and computing such as SIAM PP (2014-2020), IEEE International Parallel & Distributed Processing Symposium (2010, 2014, 2016-2020), ACM/IEEE Conference on High Performance Computing, Networking, Storage and Analysis SC (2008, 2010, 2013–2017, 2019).

11. Prizes, awards, fellowships, and honors

- SIAM Fellow (Class of 2020), recognized for advances in the development of robust parallel sparse matrix algorithms and their effective use in large-scale science and engineering applications.
- Research awards: Innovative and Novel Computational Impact of Theory and Experiment (INCITE) DOE Leadership Computing Award with Prof. J. Tromp (Princeton) (2013, 2014), IBM Faculty Award (2007).
- Honor: SIAM SIGEST Honor with Prof. M. Bollhöfer (TUB) and Prof. Römer (Univ. Warwick) (2008).
- SIAM Chair (2020-2021), Vice-Chair (2018-2019), and Program Director (2016-2017) of the SIAM special interest group on supercomputing. Nominated by a committee, elected by all SIAM members.

Major Scientific Achievements

O. Schenk is an internationally visible and recognized expert of high-performance algorithms for scientific computing. He has performed research in various renowned places as ETH Zurich, IBM Thomas Watson Research Center, KIT, and other Swiss universities (University of Basel, USI). He is leading research projects in developing numerical algorithms and libraries for large-scale parallel machines. His research concerns algorithmic and architectural problems in the field of computational mathematics, scientific computing, and HPC with a strong emphasis on applications in computational science and data analytics. He is particularly interested in computational mathematics, as well as software for computational science and data analytics applications on emerging HPC architectures. To this end, his research connects several relevant subfields of computer science with the needs of computational science and HPC. He drives research toward extreme-scale computing in computational algorithms, application software, programming, and software tools. The results of this work are typically integrated into scientific codes that demonstrate the application-targeted use of these algorithms and programming models. The goal of his research is to make advances both in algorithmic design and in programming models to tackle what will otherwise be a series of major obstacles to using crucial components of many scientific codes at exascale, namely, sparse matrix solvers, parallel nonlinear optimization solvers, finite-element solvers, and their constituents. Below, some of his research contributions are highlighted for the period 2015–2020 and some unique and important research aspects will be addressed.

Computational Mathematics

The first major research innovation was the design and implementation of novel sparse **selected inversion factorization algorithm** published and used e.g. in J3, J4, and applied to various applications from genomic prediction J3 and nanoelectronics device simulation in C12. He is the principal author of the sparse direct solver software PARDISO, which is a high-performance, robust, and easy to use software package for solving large sparse systems of linear equations. The software is used by thousands of users on a daily basis. A previous version is part of Intels Mathematical Kernel Library (MKL) since 2006 and the solver is not only used by leading open-source CSE software packages such as Trilinos (from Sandia National Laboratories), and PETSc (from Argonne National Laboratory), but also by leading commercial CSE companies such as Ansys, Comsol, and CST. As part of Intels MKL, the software is now installed on almost all supercomputing architectures from the TOP500 list. The selected inversion **HPC software** can be used as a serial package, in a shared-memory multiprocessor environment, or as a scalable parallel solver in a message-passing environment, where each MPI process can either be serial or multithreaded.

He also recently initiated a connection to data analytics to advance the popular data-analytics R-INLA package J9 that provides a tool for computationally **efficient Bayesian modeling**. The swift uptake of this framework for Bayesian modeling is rooted in the computational efficiency of the approach and catalyzed by the growing demand in the Big Data era. It has also been used to extend a large study published in *Nature*, which concludes that fighting malaria in Africa has prevented nearly 700 million cases since 2000 (Bhatt et al., 2015). The study based on R-INLA made it to the **BBC News**[1] where the director general of the **World Health Organisation** (WHO), Dr. Margaret Chan, was interviewed and commented on it.

Scientific Computing and High-dimensional Datasets

In terms of applied mathematics and computational finance, he recently started to analyse the problem of estimating sparse inverse covariance matrices for high-dimensional datasets using the regularized Gaussian maximum likelihood method. This problem is particularly challenging as the required computational resources increase superlinearly with the dimensionality of the dataset. In C14, he introduced a performant and scalable algorithm which builds on the current advancements of second-order, maximum likelihood methods. The routine leverages the intrinsic parallelism in the linear algebra operations and exploits the underlying sparsity of the problem. Numerical examples conducted on a 5,320 node Cray XC40 system at

[1] `http://www.bbc.com/news/health-34260339`

the Swiss National Supercomputing Center show that, in comparison to the state-of-the-art algorithms, the proposed routine provides significant strong-scaling speedup with almost ideal scalability up to thousand of computing nodes. The developed framework is used to approximate the **sparse inverse covariance matrix** for synthetic datasets with up to 100 million dimensions. Details on sparse inverse covariance matrices can be found in the papers in J7, C14, C4, J2, C8‘.

Extreme Scale High-Performance Computing

In many application areas, there is a great interest in solving **nonlinear optimization** problems of extremely large sizes. For example, if the constraints of the problem correspond to discretized PDEs, then the accuracy of a solution with respect to this infinite-dimensional problem is directly related to the size of the largest discrete approximate problem that can be solved. The storage and factorization of explicit derivative matrices is intractable, so researchers and practitioners are often forced to seek alternatives to existing optimization techniques. The recent extension of **interior point optimization solvers** for large-scale nonconvex optimization problems can be considered as another important research contribution. These optimization algorithms are matrix-free since they do not require the factorization of derivative matrices. Instead, they use iterative linear system solvers, but they can still handle nonconvexity in the optimization problem. Within this context, he recently proposed with my colleagues from Argonne National Laboratory in B1, J8, a scalable software framework for solving two-stage stochastic optimization problems under an uncertainty paradigm. The stochastic programming requires thousands of simultaneous scenarios, giving problems with billions of variables that need to be solved in an operationally defined time interval. The large-scale numerical experiments performed on the Titan XK7 machine from Oak Ridge National Laboratory and Piz Daint XC30 machine from the Swiss National Supercomputing Centre show that the developments in B1, J6 make it possible to solve realistically sized examples from power grid control with thousands of scenarios in times that are considerably under one hour. To the best of his knowledge, this was not possible prior to the research summarized in B1. These techniques are now used within the DOE Exascale Project "ExaSGD – Optimizing Stochastic Grid Dynamics at Exascale" which is one of the application projects in the US Exascale Computing Program, sponsored by the US Department of Energy effort of bringing exascale computing to science and engineering applications. Details on the research on **large-scale numerical optimization** can be found in the papers, e.g., in J6, J8, C9, and in the patents P1 and P2

Service Activities and Community Engagement

As part of his service activities for the research community he is delighted to transfer his research into teaching activities. For example, he was influential as an organizer in the set-up of the annual USI-CSCS Summer School on Efficient High-Performance Computing and Data Analytics and the Gene Golub SIAM Summer School on High-Performance Data Analytics. Both summer schools attracted high-qualified applications of over 150 PhD students each from all over the world in 2019. The short videos [2] could serve as an attractive way to disseminate the content of the program to a wider audience. He also has been coordinating the Swiss Platform for Advanced Scientific Computing (PASC)[3]. He played an instrumental role in initiating the new PASC conference series (as a chair for the first four conferences from 2014–2017 and now as a steering committee member). The PASC conference is now supported by ACM. In 2019, the conference set a new attendance record with 430 scientists, industry representatives, and experts present. Finally, he strongly supports the statement that "Without a close collaboration between applied mathematicians, computer scientists, and application scientists, we will not be able to develop a computational science discovery environment capable of exploiting the computational resources that will be available at the exascale (Quote from DOE report "Applied Mathematics Research for Exascale Computing", March 2014).

[2] http://youtu.be/3enmB6hzBGM and https://youtu.be/ZBlXAaBHBUc (produced by Multimedia Services of ETH Zurich)
[31] http://www.pasc-ch.org/

Olaf Schenk Research Output List (last five years)

Full publication list is available at http://usi.to/ovv

1. Peer-reviewed publications in international scientific journals

[J10] C. Alappat, G. Hager, O. Schenk, J. Thies, A. Basermann, A. Bischop, H. Fehske, G. Wellein. A Recursive Algebraic Coloring Technique for Hardware-Efficient Symmetric Sparse Matrix-Vector Multiplication. **ACM Transactions on Parallel Computing**, accepted, in press.

[J9] J. van Niekerk, H. Bakka, H. Rue, and O. Schenk. New frontiers in Bayesian modeling using the INLA package in R. **Journal of Statistical Software**, accepted, in press.

[J8] J. Kardos, D. Kourounis, and O. Schenk. Two-Level Parallel Augmented Schur Complement Interior-Point Algorithms for the Solution of Security Constrained Optimal Power Flow Problems. **IEEE Transactions on Power Systems**, 1340 - 1350, Volume: 35 , Issue: 2 , March 2020. DOI: https://doi.org/10.1109/TPWRS.2019.2942964

[J7] M. Bollhöfer, A. Eftekhari, S. Scheidegger, and O. Schenk. Large-scale sparse inverse covariance matrix estimation. **SIAM Journal on Scientific Computing**, 41(1):A380–A401, 2019. DOI: 10.1137/17M1147615

[J6] D. Kourounis, A. Fuchs, and O. Schenk. Towards the next generation of multiperiod optimal power flow solvers. **IEEE Transactions on Power Systems**, 33(4):4005–4014, July 2018. DOI: 10.1109/TPWRS.2017.2789187

[J5] M. Rietmann, M. Grote, D. Peter, and O. Schenk. Newmark local time stepping on high-performance computing architectures. **Journal of Computational Physics**, 334:308 – 326, 2017. DOI: 10.1016/j.jcp.2016.11.012

[J4] F. Verbosio, A. De Coninck, D. Kourounis, and O. Schenk. Enhancing the scalability of selected inversion factorization algorithms in genomic prediction. **Journal of Computational Science**, 22:99 – 108, 2017. DOI: 10.1137/130921283

[J3] A. De Coninck, B. De Baets, D. Kourounis, F. Verbosio, O. Schenk, S. Maenhout, and J. Fostier. Needles: Toward large-scale genomic prediction with marker-by-environment interaction. **Genetics**, 203(1):543–555, 2016. DOI: 10.1534/genetics.115.179887

[J2] J. Brumm, D. Mikushin, S. Scheidegger, and O. Schenk. Scalable high-dimensional dynamic stochastic economic modeling. **Journal of Computational Science**, 11:12 – 25, 2015. DOI: j.jocs.2015.07.004

[J1] D. Kourounis and O. Schenk. Constraint handling for gradient-based optimization of compositional reservoir flow. **Computational Geosciences**, 19(5):1109–1122, Oct 2015. DOI: 10.1007/s10596-015-9524-5

[J0] C. Lengauer, M. Bolten, R. D. Falgout, and O. Schenk. Advanced Stencil-Code Engineering (Dagstuhl Seminar 15161). **Dagstuhl Reports**, 5(4):56–75, 2015. DOI: 10.4230/DagRep.5.4.56

2. Edited Proceedings and Journal Special Issues

[M4] E. Agullo, P. Arbenz, L. Giraud, and O. Schenk. Special issue on parallel matrix algorithms and applications (PMAA16). **Parallel Computing**, 74:1 – 2, 2018. DOI: 10.1016/j.parco.2018.01.003

[M3] Christian Lengauer, Matthias Bolten, Robert Falgout, and O. Schenk. Special issue: Advanced stencil-code engineering. **Concurrency and Computation: Practice and Experience**, 29(17):e4142, 2017. e4142 cpe.4142. DOI: 10.1002/cpe.4142

[M2] P. Arbenz, L. Grigori, R. Krause, and O. Schenk. Special issue on parallel matrix algorithms and applications (PMAA14). **Parallel Computing**, 57:135 – 136, 2016. DOI: 10.1016/j.parco.2015.10.004

[M1] P. Arbenz, L. Grigori, R. Krause, and O. Schenk. Special issue on parallel matrix algorithms and applications (PMAA14). **Parallel Computing**, 49:99 – 100, 2015. DOI: 10.1016/j.parco.2016.08.003

3. Peer-reviewed publications in conference proceedings

[C14] A. Eftekhari, M. Bollhöfer, and O. Schenk. Distributed memory sparse inverse covariance matrix estimation on high-performance computing architectures. In **Proceedings of the International Conference for High Performance Computing, Networking, Storage, and Analysis**, SC '18, pages 20:1–20:12, Piscataway, NJ, USA, 2018. IEEE Press. DOI: https://dl.acm.org/citation.cfm?id=3291683

[C13] S. Donfack, P. Sanan, O. Schenk, B Reps, and W. Vanroose. A high arithmetic intensity krylov subspace method based on stencil compiler programs. In Tomáš Kozubek, Martin Čermák, Petr Tichý, Radim Blaheta, Jakub Šístek, Dalibor Lukáš, and Jiří Jaroš, editors, **High Performance Computing in Science and Engineering**, pages 1–18, Cham, 2018. Springer International Publishing. DOI: 10.1007/978-3-319-97136-01

[C12] M. Luisier, F. Ducry, M. Hossein, Bani-Hashemian, S. Brck, M. Calderara, and O. Schenk. Advanced algorithms for ab-initio device simulations. In **2018 International Conference on Simulation of Semiconductor Processes and Devices (SISPAD)**, pages 62–66, Sep. 2018. DOI: 10.1109/SISPAD.2018.8551711

[C11] C. O. Malley, D. Kourounis, G. Hug, and O. Schenk. Finite volume methods for transient modeling of gas pipelines. In **2018 IEEE International Energy Conference (ENERGYCON)**, pages 1–6, June 2018. DOI: 10.1109/ENERGYCON.2018.8398787

[C10] F. Verbosio, J. Kardos, M. Bianco, and O. Schenk. Highly scalable stencil-based matrix-free stochastic estimator for the diagonal of the inverse. In **2018 30th International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD)**, pages 410–419, Sep. 2018. DOI: 10.1109/CAHPC.2018.8645868

[C9] C. O'Malley, L. Roald, D. Kourounis, O. Schenk, and G. Hug. Security assessment in gas-electric networks. In **2018 Power Systems Computation Conference (PSCC)**, pages 1–7, June 2018. DOI: 10.23919/PSCC.2018.8442923

[C8] S. Scheidegger, D. Mikushin, F. Kubler, and O. Schenk. Rethinking large-scale economic modeling for efficiency: Optimizations for GPU and Xeon Phi clusters. In **2018 IEEE International Parallel and Distributed Processing Symposium (IPDPS)**, pages 610–619, May 2018. DOI: 10.1109/IPDPS.2018.00070

[C7] T. Simpson, D. Pasadakis, D. Kourounis, K. Fujita, T. Yamaguchi, T. Ichimura, and O. Schenk. Balanced graph partition refinement using the graph p-laplacian. In **Proceedings of the Platform for Advanced Scientific Computing Conference**, PASC '18, pages 8:1–8:11, New York, NY, USA, 2018. ACM. DOI: 10.1145/3218176.3218232

[C6] F. Verbosio, J. Kardos, M. Bianco, and O. Schenk. Highly scalable stencil-based matrix-free stochastic estimator for the diagonal of the inverse. In **2018 30th International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD)**, pages 410–419, Sep. 2018. DOI: 10.1109/CAHPC.2018.8645868

[C5] M. Wittmann, G. Hager, R. Janalik, M. Lanser, A. Klawonn, O. Rheinbach, O. Schenk, and G. Wellein. Multicore performance engineering of sparse triangular solves using a modified roofline model. In **2018 30th International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD)**, pages 233–241, Sep. 2018. DOI: 10.1109/CAHPC.2018.8645938

[C4] A. Eftekhari, S. Scheidegger, and O. Schenk. Parallelized dimensional decomposition for large-scale dynamic stochastic economic models. In **Proceedings of the Platform for Advanced Scientific Computing Conference**, PASC '17, pages 9:1–9:11, New York, NY, USA, 2017. ACM. DOI: 10.1145/3093172.3093234

[C3] L. Říha, T. Brzobohatý, A.Markopoulos, T. Kozubek, O. Meca, O. Schenk, and Wim Vanroose. Efficient implementation of total FETI solver for graphic processing units using schur complement. In Tomáš Kozubek, Radim Blaheta, Jakub Šístek, Miroslav Rozložník, and Martin Čermák, editors, **High Performance Computing in Science and Engineering**, pages 85–100, Cham, 2016. Springer International Publishing. DOI: 10.1007/978-3-319-40361-6

[C2] A. D. Coninck, D. Kourounis, F. Verbosio, O. Schenk, B. D. Baets, S. Maenhout, and J. Fostier. Towards parallel large-scale genomic prediction by coupling sparse and dense matrix algebra. In **2015 23rd Euromicro International Conference on Parallel, Distributed, and Network-Based Processing**, pages 747–750, March 2015. DOI: 10.1109/PDP.2015.94

[C1] M. Rietmann, D. Peter, O. Schenk, B. Uar, and M. Grote. Load-balanced local time stepping for large-scale wave propagation. In **2015 IEEE International Parallel and Distributed Processing Symposium**, pages 925–935, May 2015. DOI: 10.1109/IPDPS.2015.10

4. Contributions to books

[B2] M. Bollhöfer, O. Schenk, R. Janalik, S. Hamm, and K. Gullapalli. State-of-The-Art Sparse Direct Solvers. In **Parallel Algorithms in Computational Science & Engineering - Parallelism as Enabling Technology in CSE Applications**, Birkhauser. In press, https://arxiv.org/abs/1907.05309.

[B1] J. Kardos, D. Kourounis, and O. Schenk. Parallel Structure Exploiting Interior Point Methods. In **Parallel Algorithms in Computational Science & Engineering - Parallelism as Enabling Technology in CSE Applications**, Birkhauser. In press, https://arxiv.org/abs/1907.05420.

5. Patents and licenses

[P2] D. Kourounis and O. Schenk: *Method to Accelerate the Processing of Multiperiod Optimal Power Flow Problems*, February 2020, EU Patent, Published as EP3602325A1;WO2018177529A1.

[P1] D. Kourounis and O. Schenk: *Method to Accelerate the Processing of Multiperiod Optimal Power Flow Problems*, January 2020, USA Patent, Published as US2020042569A1.

6. Oral contributions to international conferences (only invited (semi-)plenary talks)

[I7] *Advancing high performance direct solvers with applications in large-scale power grid optimization,*, keynote talk, **ParNum Conference**, Dubrovnik, Croatia, 10/2019.

[I6] *Towards scalable selected inversion factorization algorithms*, keynote talk, **2018 Conference on Fast Direct Solvers**, Purdue University, USA, 11/2018.

[I5] *Towards extreme scalable selected inversion algorithm for Green's function calculation in nanoelectronic device simulation*, keynote talk, **ISC 2017 High Performance Computing Conference**, Session on Algorithms for Extreme Scale in Practice, Frankfurt, Germany, 07/2017.

[I4] *Algorithms for extreme scale in practice*, keynote talk, **HPCSE17**, Ostrava, Czech Republic, 05/2017.

[I3] *Initiatives to advance research and education in computational science in Switzerland,*, keynote talk, **International Symposium on Research and Education of Computational Science (RECS)**, Tokyo, Japan, 12/2016.

[I2] *Extreme-scale stochastic optimizations: HPC, numerics and applications*, keynote talk, **Annual Meeting of Applied Mathematics: Frontier Aspects of Applied Mathematics**, Taipei, Taiwan, 12/2015.

[I1] *Performance engineering for large-scale stochastic optimizations on petascale architectures*, keynote talk, JST/CREST International Symposium on Post Petascale System Software, **ISP2S2**, UBC, Vancouver, 12/2014.

7. Outreach activities

None

8. General contributions to science

None

9. Other artefacts with documented use

The following selected mathematical HPC software have been actively developed in Olaf Schenk's research group during the last 5 years:

[A4] PARDISO — Sparse Matrix Solver Software (main author: Olaf Schenk). The fastest multi-threaded sparse direct matrix solver software for arbitrary matrices. The software has been integrated into the Intel Math Kernel Library, it is used on a daily basis by > ten thousands of users and it is installed on every supercomputer from the TOP500 list. One paper related to the software cited >1300. Available from http://www.pardiso-project.org (papers: B2, J3, J4).

[A3] BELTISTOS — Multiperiod optimal power flow problem (MPOPF) becomes intractable prohibiting, forecasting, and planning over long time periods. BELTISTOS (main author: Drosos Kourounis, Olaf Schenk) is particularly designed for MPOPF problems. Available from http://www.beltistos.com. (papers: B1, J6, J8).

[A2] SQUIC — **S**parse **QU**adratic Approximation **I**nverse **C**ovariance Matrix Estimation. The groups of M. Bollhöfer and O. Schenk are continuously pursueing the development of the original QUIC software package (developers: Hsieh, Sustik, Dhillon, Ravikumar) in the direction of large-scale sparse matrix computation for high-performance computing. (papers: J7, C14).

[A1] In addition, Olaf Schenk's research group is contributing to other well-known high-performance computing software projects in computational science such as e.g. SPECFEM (papers: J5,C1)).