Bruno Sudret

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Professor of Risk, Safety and Uncertainty Quantification

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Education

2007 **Habilitation à diriger des recherches**, *Université Blaise Pascal*, Clermont-Ferrand, France Title: Uncertainty propagation and sonsitivity analysis in mechanical models – Contribu-

Title: Uncertainty propagation and sensitivity analysis in mechanical models – Contributions to structural reliability and stochastic spectral methods.

- 1996–1999 Ph.D thesis, Ecole Nationale des Ponts et Chaussées, Paris, France Specialty: Structural mechanics Title: Multiphase modelling of reinforced materials and structures
- 1995–1996 **One-year exchange program**, *Technical University of Munich*, Germany One year as an exchange student in the Department of Civil Engineering
- 1993–1995 **Master's degree in civil engineering**, Ecole Nationale des Ponts et Chaussées, Paris, France
- 1990–1993 Master's degree, Ecole Polytechnique, Paris, France

Employment history

- Since Aug. **Professor of Risk, Safety and Uncertainty Quantification**, Institute of Structural 2012 Engineering, ETH Zurich
- 2011-2012 **Senior researcher (***directeur de recherche***)**, Laboratoire Navier (Ecole des Ponts Paris-Tech/IFSTTAR/ CNRS (UMR 8205)), Marne-la-Vallée
- 2008-2010 **Director of Research and Strategy**, *Phimeca Engineering*, Paris Created the R&D Department of Phimeca. Defined the research strategy of the company including the research topics, the public and private partnerships and associated fundings. Wrote proposals for joint research projects funded by the French National Research Agency (ANR) and the European Community. Supervised Ph.D students through the affiliation to the *Laboratoire de Mécanique et Ingénieries* (IFMA).
- 2004-2008 **Head of a research group on structural reliability**, *EDF R&D*, Moret-sur-Loing Built and managed a research group of 5 on structural reliability and probabilistic methods for uncertainty quantification at the *Department of Materials and Mechanics of Components*.
- 2001-2003 Research engineer in structural reliability, EDF R&D, Moret-sur-Loing
 - 2000 **Post-doctoral stay**, *University of California*, Berkeley, Dept. of Civil and Environmental Engineering

Institutional responsibilities

2017-2018 Head of the Institute of Structural Engineering (IBK), ETH Zurich

Approved research projects (selection)

- 2022-2024 Innovedum, ETH Zurich, CHF 169'200 New course "Programming for Engineers", Grant #2991
- 2021-2024 European Commission, Horizon 2020 Program, 406'125 € Highly advanced probabilistic design and enhanced reliability methods for high-value, costefficient offshore wind (HIPERWIND), Grant Agreement 101006689
- 2021-2024 European Commission, Innovative Training Network (ITN), 562'550 € Grey-box models for safe and reliable intelligent mobility systems (GREYDIENT) (co-PI: Drl/g. Marelli), Grant Agreement 955393

- 2018-2021 **SNSF project**, *Swiss National Science Foundation*, Switzerland, CHF 600'000 SAMOS: SurrogAte Modelling for stOchastic Simulators (SAMOS)
- 2018-2020 ETH grant, ETH, Zurich, CHF 166'800 Efficient Computational Bayesian Inversion for Risk and Uncertainty Quantification in Engineering and the Sciences (PI: Prof. C. Schwab, (ETH-MATH))
- 2018-2020 **SNSF project**, *Swiss National Science Foundation*, Switzerland, CHF 133'465 Robust and reliable sustainability assessment for building renovation strategies (PI: Prof. G. Habert, (ETH-BAUG))

Supervision of junior researchers

- 19 master's thesis
- 17 completed Ph.D thesis 2 Post-do

4 Ph.D thesis ongoing 2 Post-docs ongoing, two senior scientists

Full information available here

Teaching activities

Programming for Engineers, Bachelor course, 100 students/year Baustatik I, Bachelor course, 100 students/year Structural Reliability and Risk Analysis, Master course, 70 students/year Uncertainty Quantification in Engineering, Master course, 80 students/year

Memberships in panel, boards / Scientific reviewing

- Since 2017 Member of the Editorial Board, Probabilistic Engineering Mechanics
- Since 2017 Member of the Editorial Board, Structural Safety
- Since 2015 Member of the Editorial Board, Reliability Engineering and System Safety
- 2018-2019 **Member of the Department Strategy Commission**, Department of Civil, Environmental and Geomatic Engineering, ETH Zurich
- 2015-2019 Member of the Scientific and Technological Council, IRT System X, Palaiseau (France)
- Since 2012 **Reviewer for** ~15 scientific journals, (with priority to the three mentioned above) and research proposals for funding bodies in UK, Czech Republic, Chile, etc.

Active memberships in scientific societies

- Since 2004 Member of the Joint Committee on Structural Safety
- Since 2009 **Member of the Scientific Committee**, *GDR-MascotNUM (Stochastic methods for the analysis of numerical codes)*, Paris, France
- 2007-2015 **Member of the Board of Directors**, International Civil Engineering Risk and Reliability Association (CERRA), Berkeley, CA

Organization of conferences

- 2015 **Technical Co-Chair of ESREL'2015**, 25th European Safety and Reliability Conference, ETH Zurich, 650 participants
- 2018 **Chair of the 19th IFIP WG7.5 Conference**, *Reliability and Optimization of Structural Systems*, ETH Zurich, 35 participants

Prizes and Awards

- 2000 **Best Ph.D thesis of Year 1999**, *Ecole Nationale des Ponts et Chaussées*, awarded by the Foundation of the *Ecole Nationale des Ponts et Chaussées*, Paris, France
- 2005 **Jean Mandel Prize**, National distinction awarded by the Ecole des Mines ParisTech and the Association Française de Mécanique (*AFM*) every second year to a young researcher in mechanics under 35 for a substantial contribution in an original field of mechanics

Major scientific achievements

Publications (summary)

- 1 book, 2 edited books, 4 monographs, 13 book chapters
- 124 articles in peer-reviewed national and international journals
- 241 papers and talks at international conferences with and without proceedings
- 46 papers in national conferences with proceedings
- 75 invited talks (plenary lectures, keynotes, summer schools) since 2012

Research impact (citations and h-index)

(As of February 1st, 2024)

	Google scholar	Web of Science
<i>h</i> -index	58	41
Number of citations	19,644	8,471

Invited lectures

- 2023 **Semi-plenary lecture**, 5th International Conference on Uncertainty Quantification in Computational Sciences and Engineering (UNCECOMP'2023), Athens (Greece), June 13.
- 2023 **Keynote lecture**, 14th International Conference on Applications of Statistics and Probability in Civil Engineering (ICASP14), Dublin (Ireland), July 11.
- 2022 **Plenary lecture**, XLIII Ibero-Latin American Congress on Computational Methods in Engineering (CILAMCE 2022), Foz do Iguaçu (Brazil), November 22.
- 2021 **Plenary lecture**, 4th Int. Conf. Uncertainty Quantification in Computational Sciences and Engineering (UNCECOMP), streamed from Athens (Greece), June 30.
- 2019 **Plenary lecture**, 14ème Colloque National en Calcul des Structures, Giens (France), May 13.
- 2019 **Semi-plenary lecture**, 3rd Int. Conf. Uncertainty Quantification in Computational Sciences and Engineering (UNCECOMP), Crete Island (Greece), June 25.
- 2018 **Keynote lecture**, 3rd Int. Conf. on Vulnerability, Risk Analysis and Management (ICVRAM2018), Florianopolis (Brazil), April 9.

Software

The Chair of Risk, Safety and Uncertainty Quantification develops a general-purpose software for uncertainty quantification called UQLab (www.uqlab.com). The software gathers in a unique framework (developed in the Matlab environment) state-of-the-art methods for probabilistic modelling (copula theory), statistical inference, construction of surrogate models (polynomial chaos expansion, Kriging, low-rank tensor approximations, support vector machines), sensitivity analysis, Bayesian calibration and inversion, structural reliability and reliability-based design optimization.

The first beta version (V0.9) of the software was released on July 1st, 2015. The open source version 1.0 was released on April 28, 2017. After 7 years of release, more than 6,800 researchers from 95 countries have downloaded and used UQLab. Version V2.0 has been published on February 1st, 2022 fully open source. A cloud-based version of UQLab, called UQ[py]Lab (https://uqpylab.uq-cloud.io/), is now available in a beta version, and allows users to access all the functionalities of UQLab with the python language. More than 500 users are already registered as beta testers.

To foster the dissemination of good practices in applied uncertainty quantification, the Chair launched a community website called UQWorld (https://uqworld.org/) in May 2019. This forum allows

beginners and experts to exchange ideas, ask/answer technical questions, showcase software, etc. The site currently attracts more than 20,000 pageviews per month.

Key publications

The full list of publications can be downloaded here

Book and book chapters (selection)

Sudret, B. (2022). Baustatik – Eine Einführung, Springer, DOI: 10.1007/978-3-658-35255-4.

Le Gratiet, L., Marelli, S. and Sudret, B. (2016). *Metamodel-based sensitivity analysis: Polynomial chaos expansions and Gaussian processes*. Handbook on Uncertainty Quantification, R. Ghanem, D. Higdon, H. Owhadi (Eds.), Springer.

Sudret, B. (2015). *Polynomial chaos expansions and stochastic finite element methods*. Reliability-based design in geotechnical engineering: computations and applications, chapter 6 (K.K. Phoon, J. Ching (Eds.)), pp. 265–300. Taylor and Francis.

Sudret, B. (2011). *Probabilistic design of structures submitted to fatigue*, Fatigue of materials and structures, chapter 5 (C. Bathias and A. Pineau (Eds)), pp. 223–263. Wiley & Sons.

Most cited contributions (more than 300 citations each according to Google Scholar)

Sudret, B. (2008). Global sensitivity analysis using polynomial chaos expansions. *Reliab. Eng. Sys. Safety*, **93**, pp. 964–979.

Blatman, G. and Sudret, B. (2011). Adaptive sparse polynomial chaos expansion based on Least Angle Regression. *J. Comput. Phys.*, **230**, pp. 2345–2367.

Sudret, B. and Der Kiureghian, A.(2000) *Stochastic finite element methods and reliability: a state-of-the-art report*, University of California, Berkeley (173 pages).

Blatman, G. and Sudret, B. (2010). An adaptive algorithm to build up sparse polynomial chaos expansions for stochastic finite element analysis. *Prob. Eng. Mech.*, **25**, pp. 183–197.

Marelli, M. and Sudret, B. (2015). UQLab: A framework for uncertainty quantification in Matlab. *Proc. 2nd Int. Conf. on Vulnerability, Risk Analysis and Management (ICVRAM2014), Liverpool, United Kingdom), American Society of Civil Engineers, pp. 2554–2563.*

Berveiller, M., Sudret, B. and Lemaire, M. (2006). Stochastic finite elements: a non intrusive approach by regression. *Eur. J. Comput. Mech.*, **15**(1-3), pp. 81–92.

Dubourg, V., Sudret, B. and Deheeger, F. (2013). Metamodel-based importance sampling for structural reliability analysis. *Prob. Eng. Mech.*, **33**, pp. 47–57.

Andrieu-Renaud, C., Sudret, B. and Lemaire, M. (2004). The PHI2 method: a way to compute time-variant reliability. *Reliab. Eng. Sys. Safety*, **84**, pp. 75–86.

Sudret, B. (2007) Uncertainty propagation and sensitivity analysis in mechanical models – *Contributions to structural reliability and stochastic spectral methods,* Habilitation à diriger des recherches, Université Blaise Pascal, Clermont-Ferrand.

Dubourg, V., Sudret, B. and Bourinet, J.-M. (2011). Reliability-based design optimization using Kriging surrogates and subset simulation. *Struct. Multidisc. Optim.*, **44**(5), pp. 673–690.

Blatman, G. and Sudret, B. (2010). Efficient computation of global sensitivity indices using sparse polynomial chaos expansions. *Reliab. Eng. Sys. Safety*, **95**, pp. 1216–1229.