Michael Beck

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Highlights of Qualifications

- **Recipient of excellent thesis and best paper award**
- **More than 6 years of experience in teaching and as supervisor of students**
- **Manitoba Network: Working with 9 local industrial and academic partners**
- **Familiar with funding applications and the budget management of research projects**
- **Internationality: Student and researcher in 4 different countries at 5 universities**
- **Co-founder of R&D-oriented environmental start-up, winning $24,500 in competitions and successfully applied for $15,000 funding in academic-industrial collaboration**

Focus of Current and Past Research

- Data valuation and data efficiency in machine learning
- Machine learning in digital agriculture
- Development of a plant-database that holds millions of plant-images for ML applications
- Server-client architecture to query and download subsets of that plant-database
- Design of robotic systems for autonomous data collection and plant identification
- Development of embedded systems for ML-assisted microplastic detection and classification
- Analysis of communication networks in particular with stochastic network calculus

Education

Ph.D. (Dr. rer. nat.), Computer Science Department 2011 – 2016
University of Kaiserslautern, Germany
Research topics: Performance Analysis of communication networks, optimisation problems in wireless sensor networks, security in communication systems
Thesis *summa cum laude* and recipient of excellent thesis award:
Advances in Theory and Applicability of Stochastic Network Calculus

MSc (Dipl.-Math.) in Mathematics, Mathematics Department 2005 – 2010
University of Kaiserslautern, Germany
Major: Probability Theory
Minor: Computer Science
Thesis: *Capacity-Bounds for Average Exit-Times of Grids* (in German)

Awards

Stu Clark New Venture Championships (3rd place); 2,500 CAD — 2021

Hack Lake Winnipeg Aquahacking Contest (1st Place); 20,000 CAD — 2020
Hack Lake Winnipeg Aquahacking Contest (Semi-finalist); 2,000 CAD

Excellent Thesis Award for Ph.D. thesis; approx.1,200 CAD — 2017

Best Paper Award (at the IEEE Networks 2016); approx. 760 CAD — 2016
Towards the Analysis of Transient Phases with Stochastic Network Calculus

Academic Positions

Postdoctoral Fellow
at the Department of Physics and the Department of Applied Computer Science — 2019 – Present
University of Winnipeg, Canada

- Research-lead of the digital agriculture project TerraByte
- Support and supervise students in their research
- Machine learning applications in digital agriculture
- Design, create, and provide access to a plant database for ML training including RGB-images, hyperspectral image data, and 3-dimensional data collected in the lab and in the field
- Develop a data pipeline from image acquisition to database storage with the goal of training of deep neural networks
- Design and build robotic positioning systems and vehicles for autonomous collection of labelled plant data and identification of plants
- Present findings at international conferences and journals
- Negotiate collaborations with industry and external research partners
- Report progress and milestones to funding partners and stakeholders

at the Department of Electrical and Computer Engineering, — 2017 – 2018
University of Manitoba, Canada

- Modelling of communication networks via phase-type distributions and fractional Brownian motion in stochastic network calculus
- Loss analysis in multi-hop finite buffer queueing systems

at the Department of Computer Science, — 2016 – 2017
City University of Hong Kong, Hong Kong SAR

- Extending the software tool *Stochastic Network Calculator* for the automatic analysis of distributed systems
- Performance bounds for stochastically dependent network flows and server-elements

Teaching Experience

Lecturer 2020 – Present
Department of Applied Computer Science, University of Winnipeg, Canada
ACS 3909-050 Advanced Internet Programming (2020)
ACS 3911-001 Computer Networks (2022)

Head Teaching Assistant 2010 – 2016
Distributed Computer Systems Lab, University of Kaiserslautern, Germany
Security in Distributed Systems (2010 – 2012)
Communication Systems (2011 – 2012)
Performance Modelling of Distributed Systems (2013 – 2014),
Quantitative Aspects of Distributed Systems and Worst-Case Analysis of Distributed Systems (2014 – 2015),
Stochastic Analysis of Distributed Systems (2015 – 2016)

Teaching Assistant 2006 – 2010
Mathematics Department, University of Kaiserslautern, Germany
Courses: Mathematical Foundations for Computer Scientists, optimisation, linear algebra, and analysis

Supervision and Training of Highly Qualified Personnel

Supervised theses 2012 – 2016
Yinhua Xu (M.Sc.)
Achieving robustness in MSN by scheduling the measurements
Simon Birnbach and Sebastian Henningsen (B.Sc.)
Applying stochastic network calculus in scenarios with incomplete knowledge
Ahmed Alsaedi (M.Sc.)
Optimization methods for stochastic network calculus performance bounds

M.Sc. students 2019 – Present
Parsa Sotoodeh, co-supervision with Dr. Christopher Henry
Plant detection and classification in RGB-field-images with Deep Neural Networks

Joe Hrzich, co-supervision with Dr. Christopher Bidinosti 2020 – Present
Development of a low-cost photogrammetry station for plant point-cloud generation.

Alexander Krosney, co-supervision with Dr. Christopher Bidinosti
Using generative adversarial networks to morph plant images onto field backgrounds

Research assistants 2019 – Present
Dilbar Randhawa, co-supervision with Dr. Christopher Henry
Data Pipeline from data generators to an online data portal and backup systems

Cara Godee, co-supervision with Dr. Christopher Henry and
Dr. Christopher Bidinosti
Operating a growing chamber and robotic image acquisition systems

Other Work Experience

Chief Technology Officer and member of the Board of Directors 2020 – 2022
Particuleye Technologies Inc., Winnipeg, Canada

- Apply for funding from sources that support industry-academia collaborations, direct funding for small businesses, research-intensive, or clean-tech businesses
- Manage a research budget and research-related purchases
- Lead the design and development of a low-cost, yet lab-grade tool for image-based microplastic detection in water samples
- Communicating with laboratory technicians about their needs and discussing possible solutions in microplastic analysis
- Negotiating, protecting, and executing the strategy for intellectual property, trade secrets, and trademarks

Managing TerraByte's homepage 2020 – Present

Reviewer in Peer-Reviewed Conferences 2010 – Present
IEEE INFOCOM, EAI ValueTools, IFIP Networking, IEEE Communication Letters, ACM ToMPECS

Member of Executive Committee 2012
16th International GI/ITG Conference on Measurement, Modelling and Evaluation of Computing Systems and Dependability and Fault Tolerance (MMB & DFT)

Editor 2012
16th MMB & DFT Workshop Proceedings

Projects Involvement

Machine learning techniques to count and classify microplastics in a flowing water sample 2021
Mitacs Accelerate Entrepreneur Program. A project between University of Manitoba, Particuleye Technologies Inc., Northforge, and Mitacs; total award of $15,000

TerraByte Project at the University of Winnipeg, Canada 2019 – Present
George Weston Limited - Seeding Food Innovation SFI18-0276
Mitacs - Accelerate IT25876
Mitacs - Accelerate IT27180
Mitacs - Accelerate IT4120

Western Economic Diversification Canada - Regional Innovation Ecosystem Program 15453

A First Course in Stochastic Network Calculus 2013 – 2019
Stand-alone introduction to Stochastic Network Calculus. Used as supplementary material in lectures

Stochastic Network Calculator 2013 – 2019
First and only open source tool for analyzing feed-forward networks via Stochastic Network Calculus. Includes GUI, symbolic engine, and automated optimization of the results. Written in Java.

CaFloTra 2012 – 2016
A Calculus for network Flow Transformations (DFG funded)

SeNeCa 2010 – 2016
Developing a calculus for performance analysis of wireless sensor networks (DFG funded)

Further Experiences and Community Involvement

Basic Drone Accreditation 2021
Winnipeg, Canada

MobilizeU, 8-week Knowledge Mobilisation Course 2021
York University, Memorial University of Newfoundland, University of Winnipeg

Team Founder of Particuleye Technology for the Hack Lake Winnipeg 2020
Aquahacking Contest

Member of students' union 2005 – 2009
University of Kaiserslautern, Germany

Spokesman of students' union 2007 – 2009
University of Kaiserslautern, Germany

Semester Abroad at the Indian Institute of Technology Madras 2007
Chennai, India

Civilian service at local governmental administration 2004 – 2005
Kusel, Germany

High School Student Exchange with the Innisdale Secondary School 2001
Barrie, Canada

Transferable Skills

Technical Skills

- Training, applying, and evaluating convolutional neural networks on GPUs for plant classification problems using Keras and Tensorflow (Python)
- Database management for image-, and meta-data information of plants (MongoDB)
- Developing the only open source software tool for the analysis of communication systems, including a GUI, a symbolic engine, and automated optimisation of the results (Java)
- Performing discrete-event simulations and statistical evaluations (R, Python)
- Programming of and interfacing with Arduino microcontrollers and Raspberry Pi single board computers to control actuators and sensors in robotic and embedded systems (Python, C++)
- Creating and programming of Wireless Sensor Networks (ZigBee)
- Designing and maintaining web-presence for the TerraByte project and Particuleye Technologies (HTML, CSS, JS, Node)
- User interfaces for embedded systems (Python)
- Server-client architecture for querying and downloading data from Compute Canada's Object Storage (S3, MongoDB, Flask, Celery)
- Creating and maintaining guidelines, documents, and wiki systems for courses. Using Learning Management Systems (Nexus) for lectures.
- Designing and 3d-printing custom made parts (AutoCAD, Slic3r)

Administrative and Organisational Skills

- Managing a research budget, quoting research-related expenses, and applying for funding
- Negotiating deliverables with industrial and academic partners in collaborations
- Supervising technicians and teaching assistants in research projects and lectures
- Presenting results at international conferences to expert and non-expert audiences
- Coordinating the exam process for class sizes ranging from 20 – 150 students, including their scheduling, supervision, conflict resolution, and transmission to the administrative system
- Assessing and protocolling students' performance in more than 50 oral exams
- Preparing and giving classes with up to 150 students as substitute and main lecturer
- Supervising students in their term papers and visualization assignments
- Supervision of 4 theses, providing the students with a research task under a strict deadline; one of these led directly to being published at the IEEE Infocom conference
- Writing of lecture notes and scripts

Publications Peer-Reviewed Journals and Online Collections

Michael A. Beck, Chen-Yi Liu, Christopher P. Bidinosti, Christopher J. Henry, Cara M. Godee, Manisha Ajmani **An extensive lab- and field-image dataset of crops and weeds. Version 2.0**. In progress

Parsa Sotoodeh, Christopher Henry, **Michael Beck**, Christopher Bidinosti, Alexander Krosney **Plant localization in unlabelled field-images using convolutional neural networks**. In progress

Alexander Krosney, Christopher Henry, **Michael Beck**, Christopher Bidinosti, Parsa Sotoodeh **Visual Transformation of Indoor-Grown Plants to Field-Grown Plants**. In progress.

Sakib Mostafa, Debajyoti Mondal, **Michael Beck**, Christopher Bidinosti, Christopher Henry, Ian Stavness **Visualizing Feature Maps for Model Selection in Convolutional Neural Networks**, Frontiers in Artificial Intelligence, Volume 5, 2022.

Michael A. Beck, Chen-Yi Liu, Christopher P. Bidinosti, Christopher J. Henry, Cara M. Godee, Manisha Ajmani **An embedded system for the automated generation of labeled plant images to enable machine learning applications in agriculture**, PLOS One collection on Plant Phenomics and Precision Agriculture, 2021

Michael A. Beck, Chen-Yi Liu, Christopher P. Bidinosti, Christopher J. Henry, Cara M. Godee, Manisha Ajmani **Weed seedling images of species common to Manitoba, Canada**, Dryad public dataset, 2020

Michael A. Beck, Jens B. Schmitt **Generalizing Window Flow Control in Bivariate Network Calculus to Enable Leftover Service in the Loop**, selected for and published in the special issue of Performance Evaluation, Volume 114, 2017, pp. 45-55

Publications Peer-Reviewed Conference Papers

Michael A. Beck, Chen-Yi Liu, Christopher P. Bidinosti, Christopher J. Henry, Cara M. Godee, Manisha Ajmani **An extensive lab- and field-image dataset of crops and weeds for computer vision tasks in agriculture**, 7th workshop on Computer Vision in Plant Phenotyping and Agriculture (CVPPA), 2021

Sakib Mostafa, Debajyoti Mondal, **Michael Beck**, Christopher Bidinosti, Christopher Henry, Ian Stavness **Visualizing Feature Maps for Model Selection in Convolutional Neural Networks**, 7th workshop on Computer Vision in Plant Phenotyping and Agriculture (CVPPA), 2021

Paul Nikolaus, Sebastian Henningsen, **Michael A. Beck**, Jens Schmitt **Integrating Fractional Brownian Motion Arrivals into the Statistical Network Calculus**, In the 30th International Teletraffic Congress, 2018, pp. 37-42

Michael A. Beck, Jens B. Schmitt **Generalizing Window Flow Control in Bivariate Network Calculus to Enable Leftover Service in the Loop**, In Proceedings of the 10th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2016), 2016, p. 1

Michael A. Beck **Towards the Analysis of Transient Phases with Stochastic Network Calculus**, In the 17th IEEE International Network Strategy and Planning Symposium (IEEE Networks 2016), 2016, pp. 164-169
Recipient of Best Paper Award

Michael A. Beck **Stochastic Worst Case Analysis of Window Flow Controlled Systems**, In the 55th IEEE Conference on Decision and Control (IEEE CDC 2016), 2016, pp. 4402-4407

Michael A. Beck, Jens B. Schmitt **Window Flow Control in Stochastic Network Calculus – The General Service Case**, In Proceedings of the 9th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2015), 2015, pp. 25-32

Michael A. Beck, Sebastian A. Henningsen, Simon B. Birnbach, Jens Schmitt **Towards a Statistical Network Calculus – Dealing with Uncertainty in Arrivals**, In the 33rd IEEE International Conference on Computer Communications (IEEE INFOCOM 2014), 2014, pp. 2382-2390

Michael A. Beck, Jens Schmitt **The DISCO Stochastic Network Calculator Version 1.0 – When Waiting Comes to an End**, In Proceedings of the 7th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2013), 2013, pp. 282-285

Michael A. Beck, Jens Schmitt **On the Calculation of Sample-Path Backlog Bounds in Queueing Systems over Finite Time Horizons**, In Proceedings of the 6th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2012), 2012, pp. 148-157

Wint Yi Poe, **Michael A. Beck**, Jens Schmitt **Achieving High Lifetime and Low Delay in Very Large Sensor Networks using Mobile Sinks**, In the 8th IEEE International Conference on Distributed Computing in Sensor Systems (IEEE DCOSS 2012), 2012, pp. 17-24

Wint Yi Poe, **Michael A. Beck**, Jens Schmitt **Planning the Trajectories of Multiple Mobile Sinks in Large-Scale, Time-Sensitive WSNs**, In the 7th IEEE International Conference on Distributed Computing in Sensor Systems (IEEE DCOSS 2011), 2011, pp. 1-8

Other Publications

Michael A. Beck, Christopher P. Bidinosti, Christopher J. Henry, Manisha Ajmani **Investigating classification learning curves for automatically generated and labelled plant images**, arXiv: 2205.10955, 2022

Michael A. Beck **TerraByte Client – A download tool to access TerraByte's field- and lab-data**. Available at: https://github.com/UWDigitalAg/TerraByte_Client, 2022

Michael A. Beck, Christopher P. Bidinosti, Christopher J. Henry, Manisha Ajmani **The TerraByte Client: providing access to terabytes of plant data**, arXiv:2203.13691, 2022

Michael A. Beck, Chen-Yi Liu, Christopher P. Bidinosti, Christopher J. Henry, Cara M. Godee, Manisha Ajmani **An extensive lab- and field-image dataset of crops and weeds for computer vision tasks in agriculture**, CyVerse public Dataset, doi.org/10.25739/rwcw-ex45, 2021

Michael A. Beck, Chen-Yi Liu, Christopher P. Bidinosti, Christopher J. Henry, Cara M. Godee, Manisha Ajmani **Presenting an extensive lab- and field-image dataset of crops and weeds for computer vision tasks in agriculture**, arXiv: 2108.05789, 2021

Michael A. Beck, Chen-Yi Liu, Christopher P. Bidinosti, Christopher J. Henry, Cara M. Godee, Manisha Ajmani **An embedded system for the automated generation of labeled plant images to enable machine learning applications in agriculture**, arXiv:2006.01228, 2020

Michael A. Beck, Sebastian Henningsen **Technical Report The Stochastic Network Calculator**, arXiv:1707.07739, 2017

Michael A. Beck, Jens B. Schmitt **Window Flow Control in Stochastic Network Calculus**, Technical Report 391/15, University of Kaiserslautern, 2015

Michael A. Beck, Sebastian A. Henningsen, Simon B. Birnbach, Jens Schmitt **Towards a Statistical Network Calculus – Dealing with Uncertainty in Arrivals**, Technical Report, University of Kaiserslautern, 2013

Michael A. Beck **A First Course in Stochastic Network Calculus**, Course notes at the University of Kaiserslautern, 2013

Michael A. Beck, Jens Schmitt **On the Calculation of Sample-Path Backlog Bounds in Queueing Systems over Finite Time Horizons**, Technical Report, University of Kaiserslautern, 2012

Wint Yi Poe, **Michael A. Beck**, Jens Schmitt **Achieving High Lifetime and Low Delay in Very Large Sensor Networks using Mobile Sinks**, Technical Report 385/11, University of Kaiserslautern, 2011

Wint Yi Poe, **Michael A. Beck**, Jens Schmitt **Planning the Trajectories of Multiple Mobile Sinks in Large-Scale, Time-Sensitive WSNs**, Technical Report 381/11, University of Kaiserslautern, 2011

Professional Presentations

Michael A. Beck **TerraByte – UofW's Digital Agriculture Project**, University of Winnipeg's Applied Computer Science Seminar, 2021, Winnipeg Canada

Michael A. Beck **TerraByte – UofW's Digital Agriculture Project**, Presentation at joint-workshop between University of Winnipeg and the Norwegian University of Science and Technology, 2021

Michael A. Beck **TerraByte – UofW's Digital Agriculture Project**, University of Winnipeg's Physics Colloquium, 2021, Winnipeg Canada

Michael A. Beck **EAGL-I: Embedded Autonomous Generator of Labeled Images**, Presentation at the 4th international Phenome conference, 2020

Michael A. Beck **Digital Agriculture at the University of Winnipeg**, Skywalk Talk Series, 2019, Winnipeg Canada

Jonathan Ziprick, **Michael A. Beck** **Automated Generation and Labelling of Image Data Sets**, Presentation at the High Performance Computing Conference, 2019, Winnipeg, Canada

Michael A. Beck, Sebastian Henningsen, Qian Xu, Jianping Wang, Kui Wu, Xian Liu **An Integrated Tool of Applying Stochastic Network Calculus for Network Performance Analysis**, Demo at the 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 2017, Atlanta, USA

Michael A. Beck, Jens B. Schmitt **Generalizing Window Flow Control in Bivariate Network Calculus to Enable Leftover Service in the Loop**, Presentation at the 10th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2016), 2016, Taormina, Italy

Michael A. Beck **Towards the Analysis of Transient Phases with Stochastic Network Calculus**, Presentation at the 17th IEEE International Network Strategy and Planning Symposium (IEEE Networks 2016), 2016, Montreal, Canada

Michael A. Beck **Window Flow Controller and Subadditivity**, Presentation at the 3rd Workshop on Network Calculus, 2016, Münster, Germany

Michael A. Beck **Stochastic Worst Case Analysis of Window Flow Controlled Systems**, Presentation at the 55th IEEE Conference on Decision and Control (IEEE CDC 2016), 2016, Las Vegas, USA

Michael A. Beck, Jens B. Schmitt **Window Flow Control in Stochastic Network Calculus – The General Service Case**, Presentation at the 9th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2015), 2015, Berlin, Germany

Michael A. Beck **Window Flow Control in Network Calculus**, Invited Talk, In Dagstuhl Reports Volume 5.3, Seminar 15112 - Network Calculus, 2015, Dagstuhl, Germany

Michael A. Beck, Sebastian A. Henningsen, Simon B. Birnbach, Jens Schmitt **Towards a Statistical Network Calculus – Dealing with Uncertainty in Arrivals**, Presentation at the 33rd IEEE International Conference on Computer Communications (IEEE INFOCOM 2014), 2014, Toronto, Canada

Michael A. Beck, Jens Schmitt **The DISCO Stochastic Network Calculator Version 1.0 – When Waiting Comes to an End**, Presentation at the 7th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2013), Torino, Italy

Michael A. Beck, Jens Schmitt **On the Calculation of Sample-Path Backlog Bounds in Queueing Systems over Finite Time Horizons**, Presentation at the 6th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2012), 2012, Cargese, France

Wint Yi Poe, **Michael A. Beck**, Jens Schmitt **Achieving High Lifetime and Low Delay in Very Large Sensor Networks using Mobile Sinks**, Presentation at the 8th IEEE International Conference on Distributed Computing in Sensor Systems (IEEE DCOSS 2012), 2012, Hangzhou, China

References

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