

Curriculum vitae

Name	Michael Muskulus
Birthday	04 November 1974
Birthplace	Sorengo (Switzerland)
Nationality	German
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Education

08/04-present	Leiden University PhD position in NWO project VIEWS (Computational Life Sciences) Supervisor: Prof. Verduyn-Lunel, Prof. Rozenberg
08/99-03/04	Universität Hamburg Diploma in theoretical physics, grade 2 ("good") Master thesis: Scattering in noncommutative field theory Supervisor: Prof. Fredenhagen Subsidiary subject: philosophy
10/97-08/99	Universität Hamburg Vordiplom, grade 1 ("very good") Subsidiary subject: oceanography
09/85-06-94	Carl-Lämmle-Gymnasium Laupheim Abitur ("A-level"), grade 1.5 ("very good")

Research Interests

Originally trained as a theoretical physicist, after my studies I was offered a position at the Max Planck Institute for Meteorology, where I have helped develop software for the tracking and analysis of distinct meteorological phenomena that are responsible for large scale flooding in Europe, making use of Kalman filtering and nonparametric statistical tests.

Coming to the Netherlands for my PhD studies, I have turned to work on dynamical systems and theoretical computer science. The interdisciplinary VIEWS project, by which I am employed, studies formal models of computation in a biological setting, so-called membrane systems. Mathematically, these can be considered (equivalence classes of) Markov chains over a denumerable state space. Equipped with a stochastic transition measure, these models are also encountered in stochastic chemical dynamics, as stochastic approximations of systems of ordinary differential equations. I work in cooperation with Italian researchers who try to model distinct biological processes of gene regulation and protein interactions. Apart from this, I have worked on formal properties of a model of gene-assembly processes in ciliates, which is another class of models studied in VIEWS.

More recently, I have devoted most of my time to the study of distance measures for attractors of dynamical systems that originate in the theory of optimal mass transportation. Although readily defined, it is nontrivial to compute these measures for even moderately large datasets. So far, I have written software that allows to compute these distances, and I am using this to study time series data from fields as diverse as physiology (lung diseases), neuroscience (MEG data analysis) and computing networks (performance evaluation). For example, kernel discriminant analysis on the pair-by-pair distance matrices allows robust classification of lung diseases for a population of patients (publication in preparation). With regards to this, I am also considering the use of curvature information from attractors, applications of computational homology, and specialized matching in bipartite graphs and lattices.

On the theoretical side, I am interested in modeling the respiratory and other oscillatory systems, bifurcation analysis, and stochastic (delay) differential equations.

Publications

- Muskulus, M.; Verduyn-Lunel, S.: Residual Wasserstein distances in the analysis of time series and dynamical diseases, submitted.
- Muskulus, M.; Verduyn-Lunel, S.: The Analysis of Dynamical Diseases by Optimal Transportation Distances. *ERCIM News* **73** (2008), 16–17.
- Brijder, R.; Hoogeboom, J. H.; Muskulus, M.: Strategies of loop recombination in ciliates. *Discrete Applied Mathematics*, (2008), in press.
- Li, H.; Muskulus, M.: Analysis and modeling of job arrivals in a production grid. *ACM SIGMETRICS Performance Evaluation Review* **34** (2007), 59–70.

- Muskulus, M.; Houweling, S.; Rozenberg, G.; Besozzi, D.; Cazzaniga, P.; Pescini, D.; Brijder, R.: Cycles and communicating classes in membrane systems and molecular dynamics. *Theoretical Computer Science* **372** (2006), 242–266.
- Muskulus, M.; Brijder, R.: Complexity of biocomputation: Symbolic dynamics in membrane systems. *Int. J. Found. Comp. Sci.* **17** (2006), 147–165.
- Jacob, D.; Goettel, H.; Jungclaus, J.; Muskulus, M.; Podzun, R.; Marotzke, J.: Slowdown of the thermohaline circulation causes enhanced maritime climate influence and snow cover over Europe. *Geophysical Research Letters* **32** (2005), L21711.
- Muskulus, M.; Jacob, D.: Tracking cyclones in regional model data: The future of Mediterranean storms. *Advances in Geosciences* **2** (2005), 13–19.

Conference papers & Chapters in books

- Muskulus, M.: Three approaches to extend the Heston model. In: Mathematics in Industry. European Study Group with Industry (SWI2007), Utrecht, The Netherlands. Eds.: Vellekoop, M.; et.al; (2007), 93–100.
- Li, H.; Muskulus, M.; Wolters, L.: Modelling correlated workloads by combining model based clustering and a localized sampling algorithm. In: International Conference on Supercomputing (2007), 64–72.
- Li, H.; Heusdens, R.; Muskulus, M.; Wolters, L.: Analysis and synthesis of pseudo-periodic job arrivals in grids: A matching pursuit approach. In: Cluster computing and the grid (CCGRID), (2007), 183–196.
- Li, H.; Muskulus, M.; Wolters, L.: Modelling job arrivals in a data-intensive grid. In: JSSPP (2006), 210–231.
- Brijder, R.; Hoogeboom, H. J.; Muskulus, M.: Applicability of loop recombination in ciliates using the breakpoint graph. In: Computational Life Sciences II (CompLife 2006). Eds.: Berthold, R.; et.al. *Lecture Notes in Computer Science* **4216** (2006), 97–106.
- Muskulus, M.; Brijder, R.: First steps towards a geometry of computation. In: Third Brainstorming Week on Membrane Computing. Eds.: Gutierrez-Naranjo, M. A.; et.al. Fenix Editora, Sevilla (2005).
- Muskulus, M.: An observation on the Sevilla complexity. In: Cellular Computing (Complexity Aspects). Fenix Editora, Sevilla (2005).

Talks & Posters

- Solidification in alloys. Analysis seminar, Leiden, March 2008.
- Muskulus, M.; Slats, A.M.; van der Plas, D.T.; Verduyn-Lunel, S.; Sterk, P.J.: Discrimination of asthma and COPD by reconstructing unbiased probability distributions (attractors) from the dynamics of respiratory impedance. **American Thoracic Society (ATS) International Conference**, Toronto, May 2008.
- Game theory for beginners: On lazy students, poker and group dynamics. Invited talk for student society "De Leidse Flesch", Leiden, November 2007.
- Classification of lung diseases and residual transportation cost. Analysis seminar, Leiden, September 2007.
- Estimating differences between probability densities and time series. Analysis seminar, Leiden, December 2006.
- Markov Chains: An introduction for pedestrians. LIACS PhD talk, Leiden, January 2006.

- Metabolism-Repair-Systems, Artificial Chemistry and Complex Networks: An Introduction to Theories of (Self-) Organization. LIACS PhD Talk, Leiden, May 2005.
- VIEWS on Membranes and Ciliates: Interdisciplinary Research in Natural Computing. NWO Computational Life Sciences Meeting, Utrecht, February 2005.
- Dynamics of P systems. LIACS PhD Talk, Leiden, November 2004.
- Tracking cyclones in regional model data: The future of Mediterranean storms. **6th Plinius Conference on Mediterranean storms (PLC6)**, Mediterranean Sea, October 2004.
- Tracking cyclones in regional model data: The future of Vb cyclones. **4th Annual Meeting of the European Meteorological Society (EMS4)**, Nice (France), September 2004.

Other

- Muskulus, M.: Speltheorie voor beginners. *Eureka!* **20** (2008), 8–10.

Teaching activities

- Lecturer: Mathematical Principles of Development (2nd year LST students), spring 2008.
- Lecturer: Workshop on Synergetics (PhD students), spring 2008.
- Lecturer: Mathematics 1A (1st year MST students), autumn 2007.
- Lecturer: Mathematics of Development (2nd year LST students), spring 2007.
- Course Assistant: Analysis III (2nd year students), autumn 2006/2005.
- Course Assistant: Mathematics of Development (2nd year LST students), spring 2006.
- Course Assistant: Basic mathematics for biologists (1st trimester), spring 2005.
- Course Assistant: Mathematics for physicists I-IV, 1999-2003.

Practical experience

- Summer student at CERN, Geneva (Switzerland). Processing of CHORUS experimental data, 2001.
- Second AMBOS/AMREB cruise (oceanography). Qingdao-Qingdao (P.R.China), 1999. Sampling of sea water (hydrographic profiles).
- First AMBOS/AMREB cruise. Qingdao-Qingdao (P.R.China), 1998.

Administrative work

- Member of Organizing Committee: Seventh Workshop on Membrane Computing WMC7, Leiden, 2006.
- Refereed papers for: *Theoretical Computer Science*, *Advances in Geosciences*, *Proceedings of the Royal Society A*, *Journal of Zhejiang University SCIENCE A*.

Further Training

- 63rd Study Group Mathematics with Industry (SWI2008). University of Twente, January 2008.
- 58th Study Group Mathematics with Industry (SWI2007). Utrecht University, January 2007.
- Space, Time and the Organization of Life. Summer school for Computational Life Sciences. Conferentiecentrum Kapellerput, June 2006.

- Control Theory with Modeling Applications to Physiology and Medicine. Summer school. Graz (Austria), July-August 2005.
- NWO/Science's Next Wave Talentendag. Slot Zeist, April 2005.
- 12th Workshop Quantum Field Theory, Leipzig, 2003.
- 11th Workshop Quantum Field Theory, Göttingen, 2002.
- 2nd Summerschool for Theoretical Physics, Freiburg, 2002.
- 10th Workshop Quantum Field Theory, Berlin, 2002.
- Summer University for Plasma Physics, Max Planck Institute for Plasma Physics, Berlin 2000.

Computer Skills

Programming languages	C++, C, Fortran, Perl, Python, Matlab
Operating systems	Gentoo Linux (administration)
Statistical computing	R (package for time series analysis, in preparation)
Applications	LaTeX, ITK (MRI image analysis)

Languages

German: native speaker
English: fluently written & spoken
Dutch: fluently spoken, sufficiently written
French: basic knowledge

Foreign Experience

08/00-09/00	5 weeks in Iceland
06-97-09/97	10 weeks in India & Nepal
11/96-02/97	3 months in New Zealand

Community Service

10/94-01/96	Landkreis Friesland, Abt. Rettungsdienst Trained as ambulance personnel ("Rettungssanitäter")
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Further Skills

Driving license (1993)

Further Interests

Rock Climbing (UIAA VI)
ING Marathon Amsterdam 2005 (4h 10min)
Go (Japanese board game, 3 kyu)
Nethack (Ascended to demigoddess-hood)

Michael Muskulus
Leiden, April 18, 2008.