# Fleur Zeldenrust

nationality: Dutch
Date of birth: 09-03-1981

## Current Position

2016 – current **Assistant Professor** in computational neuroscience at the *Radboud University*, Donders Institute for Brain, Cognition and Behaviour. I work on models of sensorimotor computation: interactions between sensory perception and motor control form the foundation of how we perceive the world and respond to it.

## Research Experience

2014 – 2016 **Researcher** in Computational Neuroscience at SILS-CNS and lecturer at the BSc Psychobiology at the *University of Amsterdam*.

2015 **Post-doctoral fellow** at the Group for Neural Theory, Département d'Études Cognitives, *École Normale Supérieure, Paris*. (collaboration with B.S. Gutkin and S. Denève). Study of biophysical implications of Bayesian inference and predictive coding.

2007 – 2012 **PhD in Computational Neuroscience**, at SILS-CNS, *University of Amsterdam* and ONWAR graduate school, the Netherlands (1 September 2007 - 10 January 2012, full time, fixed term). Thesis supervisor: W.J. Wadman. Research on the coding properties of thalamocortical relay cells and hippocampal CA-3 cells (thesis: see publications).

2010 **KITP program: Emerging Techniques in Neuroscience**, *Kavli Institute for Theoretical Physics*, Santa Barbara, USA (invited, funded by KITP). Coordinators: A. Fairhall, D. Kleinfeld and F. Wolf.

2008 **Methods in Computational Neuroscience**, *Marine Biological Laboratory*, Woods Hole, USA (partially funded by MBL). Directors: A. Fairhall and M. Berry.

2004 – 2006 **MSc in Neurobiology with a Minor in Physics**. *University of Amsterdam*, the Netherlands, cum laude (31 July 2006). Thesis: 'Homeostatic Scaling of Excitability in a Neuron with Spike Timing-Dependent Plasticity'. Thesis supervisors: W.J. Wadman and M.W.H. Remme.

2001 – 2004 **'Kandidaats' (BSc) Physics and Astronomy**, *University of Amsterdam*, the Netherlands, cum laude (28 June 2004). Thesis: 'Attention-gated reinforcement learning – a closer look'. Thesis supervisor: A. van Ooyen.

2000 – 2001 **'Beta-Gamma Propedeuse'** (first year's interdisciplinary degree), *University of Amsterdam*, the Netherlands (31 August 2001). Specialization in Physics and Philosophy.

2000 – 2001 **'Propedeuse' in Physics** (first year's degree), *University of Amsterdam*, the Netherlands, cum laude (31 August 2001).

## Skills

**Programming** Matlab, Python, Brian, XPP.

**Languages** Dutch (native language), English (fluent). Spanish (intermediate) and French (intermediate).

**Memberships** OCNS, SFN, FENS, Neurofederatie

## Grants and Awards

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| 2016 | Christine Mohrmann Grant |
| 2015 | NWO Veni Grant |
| 2015 | Amsterdam Brain and Cognition Talent Grant |
| 2013 | Cosyne New Attendee Travel Grant |
| 2012 | Grant from Fondation Pierre-Gilles de Gennes pour la Recherche for 6 months of research |
| 2012 | UvA Award for graduating within the set time |
| 2012 | ONWA Award for graduating within the set time |
| 2011 | ICTO grant for writing the 'Signal Analysis for Neuroscientists' syllabus |
| 2011 | CNS Travel Award |
| 2010 | KITP Stipend, Program 'Emerging Techniques in Neuroscience', KITP, UCSB, Santa Barbara, USA |
| 2008 | MBL Scholarship Award for attending the Methods in Computational Neuroscience summer school at the *Marine Biological Laboratory*, Woods Hole, USA. |
| 2001 | *Physica aanmoedigingsprijs* (best graduated 'Propedeuse' in physics at the University of Amsterdam), Royal Holland Society of Sciences and Humanities. |
| 2001 | Education prize 'Beta-Gamma Propedeuse', for graduating top of my year and being actively involved in extracurricular activities such as discussion meetings. |
| 1999 | *Beste-leerlingprijs* (best-student prize), awarded by NNV and Stichting Physica |

## Supervision of Graduate Students

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| 2014 – current | Supervisor (Dissertation Committee) of Alireza Azarfar Donders Graduate School for Cognitive Neuroscience, Radboud University Nijmegen, the Netherlands |

## Teaching Experience

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| **Summary** | At the *University of Amsterdam* I set up a track in computational neuroscience within the BSc program 'Psychobiology'. I formulated overall learning goals and aligned existing courses (taught by teachers from different backgrounds) to these goals by making an inventory of the content and required prior knowledge and discussing this with the lecturers, so that the courses were complementary and did not show knowledge gaps. I taught (and still teach) in different courses, next to supervising students on projects (BSc and MSc level). At the Department of Neurophysiology, Donders Institute for Brain, Cognition and Behaviour,*Radboud University*, I recently set up a peer-review system for our labmeetings. At the *École Normale Supérieure* I taught a MSc level neuromodelling course, and I supervised several students on projects (BSc and MSc level). As a PhD student at the *University of Amsterdam* I worked as a TA in many courses. I assisted the students during practical assignments, graded them, and taught the students the relevant theories. Later, I was involved in training TAs, writing new syllabi and supervising students at their theses. I also worked as a teacher at an institute for exam trainings. |
| 2017 | 'Computational Cognitive Neuroscience 2': I designed, taught, supervised and corrected lectures and tutorials on unsupervised learning in this course in the BSc Psychobiology at the *University of Amsterdam*. |

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| 2014 - current | Supervising students at projects at BSc- (2) and MSc-level (2) at the *University of Amsterdam*, *Radboud University* and *HAN Hogeschool*. |
| 2014 - current | 'Neurophysiology' (learning and memory): each year I give a lecture about basic membrane properties in this course in the BSc Psychobiology at the *University of Amsterdam*. |
| 2014 - current | 'Leren en Geheugen' (learning and memory): each year I give two lectures about learning in neural networks in this course in the BSc Psychobiology at the *University of Amsterdam*. |
| 2014 - current | 'Van Perceptie tot Bewustzijn' (from perception to consciousness): each year I give two lectures about neural networks in this course in the BSc Psychobiology at the *University of Amsterdam*. |
| 2016 | Radboud Summer School in Maps in the Brain: I co-organised, gave a lecture and designed and supervised a tutorial on how to analyse spike trains. |
| 2015 | BKO (teaching qualification for Dutch universities): I received my BKO qualification May 2015. This qualification shows that I can develop courses, teach and supervise students at projects. |
| 2015 | Programming: I designed an introductory course in programming in Matlab for the BSc Psychobiology at the *University of Amsterdam*. |
| 2015 | Radboud Summer School in Neural Metrics 2.0: I co-organised, gave a lecture and designed and supervised a tutorial on how to analyse spike trains. |
| 2015 | OIST Computational Neuroscience Course : I was invited as a tutor in this Summer School in Japan: I supervised students and gave several tutorials. |
| 2015 | 'Signal Analysis': I supervised this course, gave lectures and developed assignments in the BSc Psychobiology at the *University of Amsterdam*. |
| 2014 | 'Computational Cognitive Neuroscience': I helped design the course, gave lectures and designed and supervised tutorials in this course in the BSc Psychobiology at the *University of Amsterdam*. |
| 2014 | Radboud Summer School in Neural Metrics: I gave a lecture and designed and supervised a tutorial on how to compare spike trains. |
| 2013 | Supervising students at projects at BSc- (1) and MSc-level (1) at the *École Normale Supérieure*. |
| 2013 | 'Atelier théorique modélisation computationnelle' at the *École Normale Supérieure*. An MSc-level course in neural modelling. |
| 2011 | 'Fourier analysis for neuroscientists' at the *University of Amsterdam*. I wrote the syllabus. |
| 2010 – 2011 | Supervising BSc students (3) on their their theses (four projects), in physics, neuroscience and interdisciplinary projects at the *University of Amsterdam*. |
| 2007 – 2011 | 'Advanced Neuroscience' at the *University of Amsterdam* A MSc-level course, in which the students used the 'Neurons in Action' toolbox, and had to give presentations about scientific articles. The first years I was teaching this course, later I was training TAs. |
| 2010 | 'Signal Analysis for Neurophysiology' at the *University of Amsterdam*, a BSc-level course based on Wallisch et al. 'MATLAB for Neuroscientists. An Introduction to Scientific Computing in MATLAB'. |
| 2008 – 2010 | 'Neurophysiology' at the *University of Amsterdam* An introduction into neurophysiology. The first years I was teaching this course, later I was training TAs. |
| 2006 | 'Neurons in Action' at *University of Amsterdam*, a course based on the interactive tutorial by J.W. Moore and A.E. Stuart, in which students perform patch-clamp experiments *in silico*. |
| 2006 | 'Neural Networks' at the *University of Amsterdam*, a final-year BSc-level course in the modelling and interpretation of *in silico* neural networks. |
| 2005 – 2006 | Teacher (physics and mathematics) at *Stichting Studiebegeleiding Leiden*, an institute at *Leiden University*, which provides exam trainings for secondary school students. |

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| 2003 – 2004 | Tutor to first-year physics students at the *University of Amsterdam*. I assisted students with their assignments, but also helped them to deal with practical problems. |
| 2002 – 2004 | 'Mathematics for Economics' at the *University of Amsterdam*, a BSc-level course in basic mathematics. |
| 2002 | 'Physics of Waves and Oscillations' at the *University of Amsterdam*, a BSc-level course in physics. |
| 2001 | Mentor to first-year 'Beta-Gamma' (interdisciplinary BSc) students, *University of Amsterdam*. I assisted students with their assignments, but also helped them to deal with practical problems. |

## Management skills

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| 2001 - current | **Developer, teacher and coordinator** of a track in computational neuroscience and several courses in the BSc-programs Psychobiology, Biomedical Sciences and the MSc-programs Neurobiology and Cogmaster (see Teaching Experience for an overview). I taught in and developed courses for up to 300 students, and organised courses with up to 40 students. Moreover, I made sure that several courses taught by different teachers were complementary and did not show knowledge gaps. This did not only involve the teaching itself, but also supervising other teachers, and making sure the courses would run smoothly. |
| 2014 - 2016 | **Co-organiser** of the yearly Radboud Summer school (see: Teaching Experience), which was limited to about 20 international students. |
| 2010 – current | **Supervision** of 10 BSc-, MSc- and graduate students (see: Teaching Experience for an overview). |
| 2005 – 2006 | As a **Head-teacher** at *Stichting Studiebegeleiding Leiden*, an institute at *Leiden University*, which provides exam trainings for secondary school students, I was not only responsible for teaching in classes of up to 30 students, but also for supervising groups of up to 6 assistent-teachers. |
| 2002 – 2011 | **Secretary and co-founder of Stichting Proefjes** (Little Experiments Foundation). This foundation was initially funded by R. Dijkgraaf to introduce scientific topics and methods to children age 8-12. I co-founded it with fellow students, and managed until I moved to Paris (board-member, organising workshops for teachers and children and supervising internships). By now the foundation attracts more than 600000 visitors a year. |

## Collaborations

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| **local** | In my reasearch, I combine theoretical neuroscience and experimental data. Therefore, I collaborate both with the theoretical departments (P. Tiesinga, B. Kappen, F. Battaglia), the experimental departments (T. Celikel, B. Englitz, W. Scheenen) and with people in the artificial intelligence department (M. van Gerven) |
| **national** | Currently, I collaborate with W.J. Wadman at SILS-CNS, University of Amsterdam: we study adaptive firing under well-controlled in vitro (acute brain slices) conditions. This group has much experience with in vitro setups and pharmacological manipulations, and we will keep working together on questions of single cell/small network neural coding. I recently started a collaboration with dr. Steven Scholte at the Cognitive Neuroscience Group in Amsterdam, who is an expert on the combination of fMRI experiments and machine learning. |
| **international** | The Group for Neural Theory, École Normale Supérieure in Paris, has an outstanding reputation in the field of theoretical modelling, both in the fields of biophysics/dynamical systems (B. Gutkin) and Bayesian inference (S. Denève). I am collaborating with both. |

## International Experience

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| 2015 | **OIST Computational Neuroscience Course** : I was invited as a tutor in this Summer School in Japan: I supervised students and gave several tutorials. |
| 2012 - 2014 | **Postdoctoral fellow** at the Group for Neural Theory, Département d'Études Cognitives, *École Normale Supérieure, Paris*. (collaboration with B.S. Gutkin and S. Denève). Study of biophysical implications of Bayesian inference and predictive coding. |
| 2010 | **KITP program: Emerging Techniques in Neuroscience**, *Kavli Institute for Theoretical Physics*, Santa Barbara, USA (invited, funded by KITP). Coordinators: A. Fairhall, D. Kleinfeld and F. Wolf. |
| 2008 | **Methods in Computational Neuroscience**, *Marine Biological Laboratory*, Woods Hole, USA (partially funded by MBL). Directors: A. Fairhall and M. Berry. |

## Other Experience

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| 2016 - current | **Editor** for the Frontiers Research Topic 'Burst coding: from cell to cognition', including writing a review article. |
| 2014 - current | **Reviewer** for amongst others Physics Letters A and Frontiers in Computational Neuroscience |
| 2015 - 2016 | **Maternity leave** (8 months) for my twins born on 26 January 2016. |
| 2015 | **Editor** for Stichting Proefjes, Arno Verweij wrote a 'Proefjesboek. I helped editing the text and content of the book. |
| 2013 | **Volunteer** at the yearly CNS meeting in Paris (787 attendees). |
| 2002 – 2011 | **Secretary and co-founder of Stichting Proefjes** (Little Experiments Foundation). This foundation was initially funded by R. Dijkgraaf to introduce scientific topics and methods to children age 8-12. The foundation runs a website with do-it-yourself experiments for children. I was working in the board, developing materials for the website, giving workshops for teachers and children and supervising internships. By now, the website has more than 200 experiments online, published a book and made tv-show with the same name on national television. |
| 2010 | **Chair** at the 10th INCF and Neuroinformatics workshop, The Hague |
| 2007 – 2010 | **Editor at NiNa (New Physics) and co-author** of the 'Leven en Natuurkunde' (Life and physics) module. The New Physics project rewrote the standard final exam program for secondary schools. Next to writing and editing modules I gave several workshops at teacher conferences and at a school for secondary education. |

## Publications

### Journal Articles

- *F. Zeldenrust, P. Chameau and W. J. Wadman.* **Spike and burst coding in thalamocortical relay cells**, PLOS Computational Biology, 14:2, 2018
- *E. Satuvuori, M. Mulansky, N. Bozanic, I. Malvestio, F. Zeldenrust, K. Lenk, and T. Kreuz*
  **Measures of spike train synchrony for data with multiple time scales**
  Journal of Neuroscience Methods, 287:25-38, 2017
- *F. Zeldenrust, S. de Knecht, W. J. Wadman, S. Denève and B. Gutkin.* **Estimating the information extracted by a single spiking neuron from a continuous input time series.**
  Frontiers in Computational Neuroscience,11:49, 2017

- *B.S. Gutkin and F. Zeldenrust.* **Spike-frequency adaptation**, Scholarpedia, 9(2): 30643, 2014.
- *F. Zeldenrust, P.J.P. Chameau and W.J. Wadman.* **Reliability of spike and burst firing in thalamocortical relay cells**, Journal of Computational Neuroscience, 2013.
- *F. Zeldenrust and W.J. Wadman.* **Modulation of spike and burst rate in a minimal neuronal circuit with feed-forward inhibition**, Neural Networks, 40:1–17, 2013.
- *F. Zeldenrust and W.J. Wadman.* **Two forms of feedback inhibition determine the dynamical state of a small hippocampal network**, Neural Networks, 22:1139–1158, 2009.

**Conference Proceedings**

- *F. Zeldenrust, B.S. Gutkin and S. Denève.* **Functional interpretation of biophysical properties of spiking neurons**, BMC Neuroscience, 2013.
- *F. Zeldenrust, S. Denève and B.S. Gutkin.* **Matching encoding and decoding with spiking neurons**, Cosyne Abstracts), , Salt Lake City USA, 2013.
- *F. Zeldenrust, B. S. Gutkin, S. Denève.* **Functional implications of biophysical properties of spiking neurons**, Champalimaud Neuroscience Symposium, p. 54, 2012.
- *F. Zeldenrust, P.J.P. Chameau and W.J. Wadman.* **Information coding by single spikes and bursts in thalamocortical relay**, BMC Neuroscience, 12 (1): P367, 2011.
- *F. Zeldenrust, P.J.P. Chameau and W.J. Wadman.* **Neural coding in thalamocortical relay cells**, Program No. 552.5. 2010 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience, 2010. Online.
- *F. Zeldenrust and W.J. Wadman.* **Modelling feedback and feed-forward inhibition in a local hippocampal network**, FENS Abstracts vol 5, 192.61, 2010.
- *F. Zeldenrust and W.J. Wadman.* **Inhibitory feedback in a small CA3-network**, BMC Neuroscience, 10 (1): 119-120, 2009.
- *F. Zeldenrust, M. Remme and W. J. Wadman.* **Homeostatic Scaling of Excitability in a Neuron with Spike Timing-Dependent Plasticity**, CNS, 2006

**PhD thesis**

- *F. Zeldenrust.* **Neural coding with spikes and bursts. Characterizing neurons and networks with noisy input**,2012.

**Journal Articles in preparation**

- *F. Zeldenrust, W.J. Wadman, B. Englitz*
  **Why do neurons burst?**
  To be submitted to Frontiers in Computational Neuroscience, Research Topic on Burst coding: from cell to cognition.
  Summary: Review on the functional coding properties of bursts.
- *C. Huang, B. Englitz, A. Reznik, F. Zeldenrust and T. Celikel.*
  **Information Transfer and Recovery in the Somatosensory Cortex**
  Submitted to Neuron.
  Summary: We quantify the information that is lost when a neuron translates graded responses (EPSPs) into action potentials. We show how this information can be recovered using in silico networks of spiking excitatory and inhibitory neurons.
- *C. Huang, F. Zeldenrust , B. Englitz , M. Ginger , A. Frick and T. Celikel* **Network representation of touch in silico**, To be submitted to eLife
  Summary: We present our computational model of a somatosensory cortical column and begin addressing the network mechanisms of touch processing in silico.

- *F. Zeldenrust, S. Denève and B.S. Gutkin.* **Matching encoding and decoding with spiking neurons** Summary: We analytically derive a GLM that can be interpreted as a recurrent network of neurons that optimally tracks a continuously varying input. This framework gives a functional interpretation to type 1 and 2 neurons, trial-to-trial variability and the relation between input and output filters.

## Presentations

**Selected scientific posters and oral presentations**

- *F. Zeldenrust.* **Information transfer in inhibitory and excitatory neurons in barrel cortex**, EITN Conference on Cortical codes, 2018 (invited)
- *F. Zeldenrust.* **Estimating the information extracted by a single spiking neuron from a continuous input time series**, Workshop on Methods of Information Theory in Computational Neuroscience, Annual Computational Neuroscience Meeting 2017
- *F. Zeldenrust.* **A large-scale model of sensorimotor computation**, Big Data Analytics Forum, Beijing, 2016 (invited talk)
- *F. Zeldenrust.* **Coding in neural networks**, SILS-CNS Seminar, University of Amsterdam, 2015 (invited talk)
- *F. Zeldenrust.* **Optimal spiking in real neurons?**, Neural Networks Symposium, Donders Institute for Brain, Cognition and Behaviour, Nijmegen 2014 (invited talk)
- *F. Zeldenrust.* **Sensory representations in spiking networks: matching encoding and decoding**, UPMC, Paris, France 2014 (invited talk)
- *F. Zeldenrust.* **Sensory representations in spiking networks: matching encoding and decoding**, Life Sciences Seminar, CWI, Amsterdam 2013 (invited talk)
- *F. Zeldenrust.* **Sensory representations in spiking networks: matching encoding and decoding**, Neural Networks Symposium, Donders Institute for Brain, Cognition and Behaviour, Nijmegen 2013 (invited talk)
- *F. Zeldenrust.* **Reliability of spike and burst coding in the thalamus**, SILS-CNS research day, 2011 (talk)
- *F. Zeldenrust.* **The reliability of thalamocortical relay cells**, École Normale Supérieure, Group for Neural Theory, Paris, 2011 (talk)
- *F. Zeldenrust, P.J.P. Chameau and W.J. Wadman.* **Information coding by single spikes and bursts in thalamocortical relay**, Computational Neuroscience and the Dynamics of Disease States, Lorentz Center, Leiden, 2011 (poster)
- *F. Zeldenrust.* **Characterizing Neurons in Networks with Noisy Input**, New York University, Center for Neural Science, 2010 (talk)
- *F. Zeldenrust.* **Characterizing Neurons in Networks with Noisy Input**, Kavli Institute for Theoretical Physics, Emerging Techniques in Neuroscience program, Santa Barbara, 2010 (talk)
- *F. Zeldenrust.* **Every neuron its own code: information transfer in thalamocortical relay cells**, CWI Modelling, Analysis and Computing seminar, Amsterdam, 2010 (talk)
- *F. Zeldenrust.* **Every neuron its own code: characterizing input-output relations without bias**, SILS research day, theme Systems Biology, Amsterdam, 2010 (talk)
- Chair at the 10th INCF and Neuroinformatics workshop, Den Haag (invited)
- *F. Zeldenrust.* **Neural coding: how does inhibition influence spiking behaviour?**, 10th INCF and Neuroinformatics Workshop, Den Haag, 2010 (talk)
- *F. Zeldenrust and W.J. Wadman*, **Two forms of feedback inhibition determine the dynamical state of a small hippocampal network**, Brain Waves workshop, Lorentz Center, Leiden (poster)

**Popular presentations**

- *F. Zeldenrust.* **De hersenen: een enorme machine zonder gebruiksaanwijzing** (the brain: a huge machine without instructions), Playful Science, Zaventem, 2011
- *F. Zeldenrust.* **Biofysica van de hersenen** (Biophysics and the brain), Science Symposium, Raayland college, Venray, 2011
- *F. Zeldenrust.* **Biofysica van de hersenen** (Biophysics and the brain), WND conference, Noordwijkerhout, 2009
- *F. Zeldenrust.* **Natuurkunde en neuroscience** (Physics and neuroscience), keynnote speaker teacher meeting NiNa, 2009
- *F. Zeldenrust.* **De hersenen: een enorme machine zonder gebruiksaanwijzing** (the brain: a huge machine without instructions), finals Very Short Introduction Contest, Amsterdam, 2009.
- *Guest appearance on national television* I appeared on the children's program **Blinq** in 2005 to explain the physics behind experiments from the Proefjes-website.
- *F. Zeldenrust.* **Enthousiasme is besmettelijk**, Opening academic year of the University of Amsterdam, 2003.