



Timothée Masquelier

Researcher in AI / Computational Neuroscience

"What I cannot create, I do not understand."

Richard Feynman, 1985.

"All models are wrong, but some are useful."

George Box, 1976.

Keywords

AI, computational neuroscience, neural networks, vision, learning.

Experience

Academia

- 2021 – now **Senior Research Scientist (*Directeur de Recherche*)**, CNRS (CERCO), Toulouse, France.
Spike-based computing and learning in brains and machines.
- 2013 – 2021 **Research Scientist (*Chargé de Recherche*)**, CNRS (CERCO), Toulouse, France.
Spike-based computing and learning in brains and machines.
- 2008 – 2012 **Postdoctoral Fellow**, *Universitat Pompeu Fabra*, Barcelona, Spain.
Neurodynamics of spontaneous activity in cortical cultures.
Supervisor: Pr. Gustavo Deco, ICREA and UPF.
- 2004 – 2008 **Ph.D. Student**, CNRS (CERCO), Toulouse, France.
Modeling object recognition in visual cortex with spiking neural networks.
Supervisor: Dr. Simon Thorpe, DR CNRS
- 2000 – 2001 **M. Sc. Student**, MIT, Cambridge, MA, USA.
Design and evaluation of a GPS-aided communication device for railroad workers.
Supervisor: Pr. Thomas B. Sheridan, MIT

Industry

- 2004 **Revenue Management Expert**, *Avianca*, Bogota, Colombia.
Audited and validated RM processes.
- 2001-2004 **R&D Engineer in Operations Research**, *Mereo*, Paris, France.
Designed and implemented a probabilistic optimization model for Revenue Management.

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1999 **Research Internship**, *SNECMA*, Villaroche, France.
Computational Fluid Dynamics. Validated a wall law model. Unsteady 3D computations.

Education

2004 – 2008 **Ph.D. in Computational Neuroscience**, *Univ. Paul Sabatier*, Toulouse 3, France.
Graduation: 02/2008.

1999 – 2001 **M. Sc. in Aeronautics and Astronautics**, *MIT*, Cambridge, MA, USA.
Graduation: 06/2001.

1996 – 1999 **General Engineering (Ingénieur Centralien)**, *Ecole Centrale Paris*, France.
Graduation: 06/1999.

1994 – 1996 **Classes Préparatoires aux Grandes Écoles**, *Lycée Saint Louis*, Paris, France.
Option M' (pure maths).

Awards / Grants (as PI)

2021 – 2024 ANR PRCE. “BrainNet” Project. 144k€ / 643k€ in total.

2021 – 2024 ANR PRCE. “DeepSee” Project. 158k€ / 711k€ in total.

2020 – 2023 ANITI & Occitanie PhD fellowship, together with T. Pellegrini (Univ. of Toulouse).

2018 – 2019 Gundishapur PHC grant, together with M. Ganjtabesh (University of Tehran).

2009 – 2010 Two-year postdoctoral fellowship from the Fyssen Foundation.

2000 MIT Robert Guenassia Award.

1999 One year fellowship from the MIT Department of Aeronautics and Astronautics.

Ph.D. Students

2012 – 2017	Saeed Reza Kheradpisheh	2020 – now	Ismail Khalfaoui
2014 – 2018	Amirreza Yousefzadeh	2021 – now	Ilyass Hammouamri
2014 – 2018	Milad Mozafari	2021 – now	Javier Cuadrado
2015 – 2018	Jacob Huth	2021 – now	Romain Pierre
2019 – 2022	Lina Bonilla	2022 – now	Ulysse Rançon

Diverse

HDR *Habilitation à Diriger des Recherches* (2017).

Ph.D. Jury A. Gruel* (2023), M. Dampfhofer* (2023), M. Vaishnav (2023), L. Cordone* (2022), A. Fois* (2022), E. Martin* (2022), N. Abderrahmane* (2020), J.M. Maro* (2020), M. Ernoult* (2020), P. Falez* (2019), O. Guinaudeau (2019), P. Martínez Cañada* (2018) (*=reviewer)

Teaching Neural networks courses at *CentraleSupélec*, *Supaéro*, *Univ. Paris 6*, *Univ. Nice*, *Univ. Tehran*.

Bibliometry <http://scholar.google.com/citations?user=fkzUZ-oAAAAJ>
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Valorization Three patents licensed to BrainChip Inc. from 03/2017:
<https://patents.google.com/patent/US20190286944A1/>
<https://patents.google.com/patent/EP3324343A1/>
<https://patents.google.com/patent/EP3324344A1/>

Referee for

- Advances in Artif. Neur. Sys.
- Biol. Cybern.
- CNRS Momentum
- Cognitive Neurodynamics
- Comp. NeuroScience Meeting
- Comp. Vision and Image Understanding
- Conf. sur l'Apprentissage automatique
- Cosyne
- CRCNS
- CVPR
- ECCV
- FONDECYT
- Front. Comp. Neurosc.
- Front. Neuroinform.
- Front. Neurorobotics
- Front. Neurosc.
- Front. Perception Sci.
- ICLR
- ICML
- ICCV
- IEEE Access
- IEEE Signal Processing Letters
- IEEE Signal Processing Mag.
- IEEE Trans. Cog. and Dev. Syst.
- IEEE Trans. Emer. Topics in Comp. Intell.
- IEEE Trans. Im. Processing
- IEEE Trans. Neural Netw. Learn. Syst.
- IEEE Trans. Patt. Anal. and Mach. Intell.
- IEEE Trans. Circuits and Systems
- Int. J. Neural Syst.
- ISCAS
- J. Comput. Neurosci.
- J. Neural Eng.
- J. Neurosci.
- J. Physiol.-Paris
- J. R. Soc. Interface
- Nature Communications
- Nature Machine Intell.
- Neural Comp.
- Neural Netw.
- NeurIPS
- Neurocomputing
- Neuroscience
- Nonlinearity
- Pattern Recognition
- Phil. Trans. R. Soc. B
- PLoS Comp. Biol.
- PLoS ONE
- Research Foundation - Flanders (FWO)
- Sc. Reports
- Sensors

Publications

Peer-reviewed International Journals

1. Cuadrado, J., Rançon, U., Cottureau, B. R., Barranco, F., and Masquelier, T. (2023). Optical flow estimation from event-based cameras and spiking neural networks. *Frontiers in Neuroscience*, 17
2. Mirsadeghi, M., Shalchian, M., Kheradpisheh, S. R., and Masquelier, T. (2023). Spike time displacement-based error backpropagation in convolutional spiking neural networks. *Neural Computing and Applications*
3. Rançon, U., Cuadrado-Anibarro, J., Cottureau, B. R., and Masquelier, T. (2022). StereoSpike: Depth Learning with a Spiking Neural Network. *IEEE Access*

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4. Hammouamri, I., Masquelier, T., and Wilson, D. G. (2022). Mitigating catastrophic forgetting in spiking neural networks through threshold modulation. *Transactions on Machine Learning Research*
5. Bonilla, L., Gautrais, J., Thorpe, S., and Masquelier, T. (2022). Analyzing time-to-first-spike coding schemes: A theoretical approach. *Frontiers in Neuroscience*, 16
6. Kheradpisheh, S. R., Mirsadeghi, M., and Masquelier, T. (2022). Spiking neural networks trained via proxy. *IEEE Access*
7. Rasteh, A., Delpech, F., Aguilar-Melchor, C., Zimmer, R., Shouraki, S. B., and Masquelier, T. (2022). Encrypted Internet traffic classification using a supervised Spiking Neural Network. *Neurocomputing*
8. Kheradpisheh, S. R., Mirsadeghi, M., and Masquelier, T. (2021). BS4NN: Binarized Spiking Neural Networks with Temporal Coding and Learning. *Neural Processing Letters*
9. Chauhan, T., Masquelier, T., and Cottureau, B. R. (2021). Sub-Optimality of the Early Visual System Explained Through Biologically Plausible Plasticity. *Frontiers in Neuroscience*, 15(September)
10. Debat, G., Chauhan, T., Cottureau, B. R., Masquelier, T., Paindavoine, M., and Baures, R. (2021). Event-Based Trajectory Prediction Using Spiking Neural Networks. *Frontiers in Computational Neuroscience*, 15(May):1–16
11. Zenke, F., Bohté, S. M., Clopath, C., Comşa, I. M., Göltz, J., Maass, W., Masquelier, T., Naud, R., Neftci, E. O., Petrovici, M. A., Scherr, F., and Goodman, D. F. (2021). Visualizing a joint future of neuroscience and neuromorphic engineering. *Neuron*, 109(4):571–575
12. Mirsadeghi, M., Shalchian, M., Kheradpisheh, S. R., and Masquelier, T. (2021). STiDi-BP: Spike Time Displacement based Error BackPropagation in multilayer spiking neural networks. *Neurocomputing*, 427:131–140
13. Kheradpisheh, S. R. and Masquelier, T. (2020). Temporal backpropagation for spiking neural networks with one spike per neuron. *International Journal of Neural Systems*, 30(06):2050027
14. Mozafari, M., Ganjtabesh, M., Nowzari-Dalini, A., and Masquelier, T. (2019a). Spyketorch: Efficient simulation of convolutional spiking neural networks with at most one spike per neuron. *Frontiers in Neuromorphic Engineering*, 13(625):1–12
15. Mozafari, M., Ganjtabesh, M., Nowzari-Dalini, A., Thorpe, S. J., and Masquelier, T. (2019b). Bio-inspired digit recognition using reward-modulated spike-timing-dependent plasticity in deep convolutional networks. *Pattern Recognition*, 94:87–95
16. Tavanaei, A., Ghodrati, M., Kheradpisheh, S. R., Masquelier, T., and Maida, A. S. (2019). Deep learning in spiking neural networks. *Neural Networks*, 111:47–63
17. Chauhan, T., Masquelier, T., Montlibert, A., and Cottureau, B. R. (2018). Emergence of Binocular Disparity Selectivity through Hebbian Learning. *The Journal of Neuroscience*, 38(44):9563–9578
18. Masquelier, T. and Kheradpisheh, S. R. (2018). Optimal localist and distributed coding of spatiotemporal spike patterns through STDP and coincidence detection. *Frontiers in Computational Neuroscience*, 12:74
19. Mozafari, M., Kheradpisheh, S. R., Masquelier, T., Nowzari-Dalini, A., and Ganjtabesh, M. (2018). First-Spike-Based Visual Categorization Using Reward-Modulated STDP. *IEEE Transactions on Neural Networks and Learning Systems*, 29(12):1–13
20. Tavanaei, A., Masquelier, T., and Maida, A. (2018). Representation learning using event-based STDP. *Neural Networks*, 105:294–303
21. Huth, J., Masquelier, T., and Arleo, A. (2018). Convis: A Toolbox to Fit and Simulate Filter-Based Models of Early Visual Processing. *Frontiers in Neuroinformatics*, 12(March):1–16
22. Kheradpisheh, S. R., Ganjtabesh, M., Thorpe, S. J., and Masquelier, T. (2018). STDP-based spiking deep convolutional neural networks for object recognition. *Neural Networks*, 99:56–67
23. Masquelier, T. (2018). STDP Allows Close-to-Optimal Spatiotemporal Spike Pattern Detection by Single Coincidence Detector Neurons. *Neuroscience*, 389:133–140

24. Ashtiani, M. N., Kheradpisheh, S. R., Masquelier, T., and Ganjtabesh, M. (2017). Object Categorization in Finer Levels Relies More on Higher Spatial Frequencies and Takes Longer. *Frontiers in Psychology*, 8(July)
25. Deneux, T., Masquelier, T., Bermudez, M. A., Masson, G. S., Deco, G., and Vanzetta, I. (2017). Visual stimulation quenches global alpha range activity in awake primate V4: a case study. *Neurophotonics*, 4(3):031222
26. Kheradpisheh, S. R., Ghodrati, M., Ganjtabesh, M., and Masquelier, T. (2016c). Humans and Deep Networks Largely Agree on Which Kinds of Variation Make Object Recognition Harder. *Frontiers in Computational Neuroscience*, 10(August):1–15
27. Kheradpisheh, S. R., Ghodrati, M., Ganjtabesh, M., and Masquelier, T. (2016b). Deep Networks Can Resemble Human Feed-forward Vision in Invariant Object Recognition. *Scientific reports*, 6(August):32672
28. Portelli, G., Barrett, J. M., Hilgen, G., Masquelier, T., Maccione, A., Di Marco, S., Berdondini, L., Kornprobst, P., and Sernagor, E. (2016). Rank order coding: a retinal information decoding strategy revealed by large-scale multielectrode array retinal recordings. *Eneuro*, 3(June):1–18
29. Kheradpisheh, S. R., Ganjtabesh, M., and Masquelier, T. (2016a). Bio-inspired unsupervised learning of visual features leads to robust invariant object recognition. *Neurocomputing*, 205:382–392
30. Masquelier, T., Portelli, G., and Kornprobst, P. (2016). Microsaccades enable efficient synchrony-based coding in the retina: a simulation study. *Scientific Reports*, 6:24086
31. Masquelier, T. (2014). Oscillations can reconcile slowly changing stimuli with short neuronal integration and STDP timescales. *Network: Computation in Neural Systems*, 25(1-2):85–96
32. Masquelier, T. and Deco, G. (2013). Network Bursting Dynamics in Excitatory Cortical Neuron Cultures Results from the Combination of Different Adaptive Mechanism. *PLoS ONE*, 8(10):e75824
33. Masquelier, T. (2013). Neural variability, or lack thereof. *Frontiers in Computational Neuroscience*, 7:1–7
34. Serrano-Gotarredona, T., Masquelier, T., Prodromakis, T., Indiveri, G., and Linares-Barranco, B. (2013). STDP and STDP variations with memristors for spiking neuromorphic learning systems. *Frontiers in neuroscience*, 7(February):2
35. Masquelier, T. (2012). Relative spike time coding and STDP-based orientation selectivity in the early visual system in natural continuous and saccadic vision: a computational model. *Journal of computational neuroscience*, 32(3):425–441
36. Gilson, M., Masquelier, T., and Hugues, E. (2011). STDP allows fast rate-modulated coding with Poisson-like spike trains. *PLoS Computational Biology*, 7(10):e1002231
37. Masquelier, T., Albantakis, L., and Deco, G. (2011). The timing of vision - how neural processing links to different temporal dynamics. *Frontiers in psychology*, 2:151
38. Zamarreño-Ramos, C., Camuñas-Mesa, L., Perez-Carrasco, J., Masquelier, T., Serrano-Gotarredona, T., and Linares-Barranco, B. (2011). On spike-timing-dependent-plasticity, memristive devices, and building a self-learning visual cortex. *Frontiers in Neuroscience*, (MAR)
39. Deco, G., Buehlmann, A., Masquelier, T., and Hugues, E. (2011). The role of rhythmic neural synchronization in rest and task conditions. *Front Hum Neurosci*, 5:4
40. Masquelier, T., Hugues, E., Deco, G., and Thorpe, S. J. (2009b). Oscillations, phase-of-firing coding, and spike timing-dependent plasticity: an efficient learning scheme. *The Journal of neuroscience*, 29(43):13484–93
41. Masquelier, T., Guyonneau, R., and Thorpe, S. J. (2009a). Competitive STDP-Based Spike Pattern Learning. *Neural Comput*, 21(5):1259–1276
42. Masquelier, T., Guyonneau, R., and Thorpe, S. J. (2008). Spike timing dependent plasticity finds the start of repeating patterns in continuous spike trains. *PLoS ONE*, 3(1):e1377

43. Masquelier, T. and Thorpe, S. J. (2007). Unsupervised learning of visual features through spike timing dependent plasticity. *PLoS Comput Biol*, 3(2):e31

Peer-reviewed Conference Proceedings

1. Khalfaoui-Hassani, I., Pellegrini, T., and Masquelier, T. (2023b). Dilated Convolution with Learnable Spacings: beyond bilinear interpolation. In *ICML Workshop: Differentiable Almost Everything*
2. Pellegrini, T., Khalfaoui-Hassani, I., Labbé, E., and Masquelier, T. (2023). Adapting a ConvNeXt model to audio classification on AudioSet. In *Interspeech*
3. Khalfaoui-Hassani, I., Pellegrini, T., and Masquelier, T. (2023a). Dilated convolution with learnable spacings. In *ICLR*
4. Zhu, Y., Yu, Z., Fang, W., Xie, X., Huang, T., and Masquelier, T. (2022). Training Spiking Neural Networks with Event-driven Backpropagation. In *NeurIPS*
5. Fang, W., Yu, Z., Chen, Y., Huang, T., Masquelier, T., and Tian, Y. (2021a). Deep Residual Learning in Spiking Neural Networks. In *NeurIPS*
6. Fang, W., Yu, Z., Chen, Y., Masquelier, T., Huang, T., and Tian, Y. (2021b). Incorporating Learnable Membrane Time Constant to Enhance Learning of Spiking Neural Networks. In *IEEE/CVF ICCV*
7. Pellegrini, T. and Masquelier, T. (2021). Fast threshold optimization for multi-label audio tagging using Surrogate gradient learning. In *IEEE ICASSP*
8. Pellegrini, T., Zimmer, R., and Masquelier, T. (2021). Low-activity supervised convolutional spiking neural networks applied to speech commands recognition. In *IEEE Spoken Language Technology Workshop*
9. Soltani Zarrin, P., Zimmer, R., Wenger, C., and Masquelier, T. (2020). Epileptic Seizure Detection Using a Neuromorphic-compatible Deep Spiking Neural Network. In *8th International Work-Conference on Bioinformatics and Biomedical Engineering*
10. Yousefzadeh, A., Masquelier, T., Serrano-Gotarredona, T., and Linares-Barranco, B. (2017). Hardware implementation of convolutional STDP for on-line visual feature learning. In *Proceedings - IEEE International Symposium on Circuits and Systems*
11. Tavanaei, A., Masquelier, T., and Maida, A. S. (2016). Acquisition of visual features through probabilistic spike-timing-dependent plasticity. In *2016 International Joint Conference on Neural Networks (IJCNN)*, pages 307–314. IEEE
12. Masquelier, T. and Thorpe, S. J. (2010). Learning to recognize objects using waves of spikes and Spike Timing-Dependent Plasticity. In *The 2010 International Joint Conference on Neural Networks (IJCNN)*, pages 1–8. IEEE
13. Masquelier, T. and Thorpe, S. (2006). Face feature learning with Spike Timing Dependent Plasticity. *Proc. of the 1st French conference on computational neuroscience (NeuroComp)*

Toulouse, France, June 21, 2023

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