

Matthieu Louis

Position: Professor of Systems Neuroscience
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Career highlights

- Professor, Department of Molecular, Cellular & Developmental Biology, UCSB (**2026-present**)
- Associate Professor, Department of Molecular, Cellular & Developmental Biology, UCSB (**2020-2026**)
- Affiliated Professor, Interdisciplinary Program in Quantitative Biosciences (IPQB/BMSE), UCSB (**2018-present**)
- Affiliated Professor, Department of Physics, UCSB (**2017-present**)
- Visitor Scientist, Howard Hughes Medical Institute – Janelia Research Campus (**2007-2021**)
- Assistant Professor, Department of Molecular, Cellular & Developmental Biology, UCSB (**2016-2020**)
- Group Leader, EMBL-CRG Systems Biology Research Unit, Center for Genomic Regulation, Barcelona, Spain (**2008-2016**)
- Postdoctoral training in Sensory Neuroscience, Laboratory of Neurogenetics and Behavior at The Rockefeller University (**2003-2007**). Advisor: Dr. Leslie B. Vosshall
- Ph.D. in Bioinformatics and Systems Biology (University of Cambridge, UK) Predoctoral fellow at the EMBL-EBI (**1999-2003**). Advisor: Dr. Liisa Holm
- BA/MA in Theoretical Physics (Université Libre de Bruxelles, Belgium, **1995-1999**)

Summary of research interests

My lab aims to reverse-engineer the algorithms that control odor-driven navigation (chemotaxis) in the *Drosophila* larva, using molecular neurogenetics, *in vivo* electrophysiology, optogenetic virtual sensory realities and EM tracing. We also study the computational principles and neural circuits underlying multisensory integration. By combining modeling and synthetic neuroscience with comparisons across *Drosophila* species, we test and refine our understanding of how sensorimotor functions emerge and evolve.

Selected publications

1. Tadres, D., Riedl, J., Eden, A., Bontempo, A.E., Lin, J., Reid, S.F., Roehrich, B., Williams, K., Sepunaru, L. and **Louis, M.** (2025). *Sensation of electric fields in the Drosophila melanogaster larva*, Current Biology 35, 1848-1860.
2. Tadres, D., Wong, P.H., To, T., Moehlis, J. and **Louis, M.** (2022). *Depolarization block in olfactory sensory neurons expands the dimensionality of odor encoding*, Science Advances 8, eade7209.
3. Tadres, D. and **Louis, M.** (2020). *PiVR: an affordable and versatile closed-loop platform to study unrestrained sensorimotor behavior*, PLoS Biology 18, e3000712.

4. Tastekin, I., Khandelwal, A., Tadres, D., Fessner, N.D., Truman, J.W., Zlatic, M., Cardona, A. and **Louis, M.** (2018). *Sensorimotor pathway controlling stopping behavior during chemotaxis in the Drosophila melanogaster larva*, eLife 7, e38740.
5. Kim, D., Alvarez, M., Lechuga, L. and **Louis, M.** (2017). *Species-specific modulation of food-search behavior by respiration and chemosensation in Drosophila larvae*, eLife 6, e27057.
6. Schulze, A. *, Gomez-Marin, A. *, Rajendran, V., Lott, G., Musi, M., Ahammad, P., Deogade, A., Sharpe, J., Riedl, J., Jarriault, D., Trautman, E., Werner, C., Venkadesan, M., Druckmann, S., Jayaraman, V. and **Louis, M.** (2015). *Dynamical feature extraction at the sensory periphery guides chemotaxis*, eLife 4, e06694. [* equal contribution]
7. Tastekin, I. *, Riedl, J. *, Schilling-Kurz, V., Gomez-Marin, A., Truman, J.W. and **Louis, M.** (2015). *Role of the subesophageal zone in the sensorimotor control of orientation in the Drosophila larva*, Current Biology 25, 1448. [* equal contribution]
8. Gomez-Marin, A., Stephens, G.J. and **Louis, M.** (2011). *Active sampling and decision making in Drosophila chemotaxis*, Nature Communications 2, 441.
9. Buchler, N. and **Louis, M.** (2008). *Molecular titration and ultrasensitivity in regulatory networks*, Journal of Molecular Biology 384, 1106-1119.
10. **Louis, M.**, Huber, T., Benton, R., Sakmar, T. and Vosshall, L.B. (2008). *Bilateral olfactory sensory input enhances chemotaxis behavior*, Nature Neuroscience 11, 187-199.

Preprints

- Tadres, D., Wong, P., Lopez-Matas, M., Khosalim, N., Phillips, M., Moehlis, J. and **Louis, M.** (2025). *Neuronal silencing through depolarization block underlies odor discrimination*, bioRxiv, <https://doi.org/10.64898/2025.12.11.693839>.
- Wong, P., Braun, A., Malagarriga, D., Moehlis, J., Moreno-Bote, R., Pouget, A. and **Louis, M.** (2023). *Computational principles of adaptive multisensory combination in the Drosophila larva*, bioRxiv, <https://doi.org/10.1101/2023.05.04.539474>.
- Fink, E., Rollins, K. and **Louis, M.** (2021). *Inter-species comparison of the orientation algorithm directing larval chemotaxis in the genus Drosophila*, bioRxiv, <https://doi.org/10.1101/2021.09.17.460740>.

Selected service and organization

- Academic editor for PLoS Computational Biology (**2021-present**) and eLife (**2021-2024**)
- Director of the IQB² (Interdisciplinary Quantitative Bioscience at the Bench) Graduate Course, UCSB (**2021-present**)
- Organization of the KITP Neurophysics workshops & summer schools at UCSB on “Neural Computations for Sensory Navigation” (**2018**), “Neurophysics of Locomotion” (**2022**) and “Neurophysics of Active Sensing” (**2025**)
- Organization of the HHMI Janelia conference on “Navigational Algorithms and Neural Circuit Computations Directing Olfactory Search Across Species” (**2023**)