

# Malcolm A. MacIver

## Northwestern University

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Northwestern Center for Robotics and Biosystems  
National Institute for Theory and Mathematics in Biology (theme leader)  
Northwestern University Interdepartmental Neuroscience Program  
Northwestern University Institute on Complex Systems

### Education

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2001 PhD Neuroscience, University of Illinois and the Beckman Institute of Advanced Science and Technology, Urbana IL  
1996 Course work only of dual Ph.D. in cognitive science and philosophy, Indiana University, Bloomington IN  
1992 MA Philosophy, University of Toronto  
1991 BSc Double major in computer science and philosophy, University of Toronto, graduated with High Distinction  
1986 AEE Electrical Engineering Technician, Confederation College, Thunder Bay, Ontario Canada

### Professional Experience

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2024-present Theme Leader for Prediction and Anticipation, National Institute for Theory and Mathematics in Biology  
2022-present Professor (Joint between Dept. of Mechanical Engineering & Dept. of Biomedical Engineering), Dept. of Neurobiology (Courtesy), Dept. of Computer Science, (Courtesy), Northwestern University  
2016-present Professor (Joint between Dept. of Mechanical Engineering & Dept. of Biomedical Engineering), and Dept. of Neurobiology by Courtesy, Northwestern University  
2010-2016 Associate Professor (Joint between Dept. of Mechanical Engineering & Dept. of Biomedical Engineering), and Dept. of Neurobiology by Courtesy, Northwestern University  
2003-2010 Assistant Professor (Joint between Dept. of Mechanical Engineering & Dept. of Biomedical Engineering), and Dept. of Neurobiology by Courtesy, Northwestern University  
2001-2003 Postdoctoral Fellow, Division of Engineering and Applied Science, Computation

and Neural Systems Program, and Center for Neuromorphic Systems Engineering, California Institute of Technology, Pasadena CA

### Honors and Awards

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- 2026 Keynote, workshop on Dolphins, Decision-Making, Robots and AI. Lund University, Sweden.
- 2025 Plenary speaker, RLDM (Reinforcement Learning and Decision Making), Dublin Ireland.
- 2025 Keynote speaker, Natural Philosophy Symposium, Johns Hopkins University, Baltimore USA.
- 2022 Keynote speaker, Computational Cognitive Neuroscience 2022
- 2018 US Embassy science ambassador visit to New Zealand, with lectures and round-table discussions in Dunedin, Wellington, and Auckland.
- 2017 Keynote speaker, German Zoological Society 110th Annual Meeting. Bielefeld, Germany.
- 2014 Symposium speaker for American Association for the Advancement of Science session on biologically inspired robotics, Chicago IL
- 2014 Plenary Speaker at the International Congress of Neuroethology, August 2014, Sapporo Japan.
- 2013 TEDx Caltech “The Brain” closing speaker, “Can We Expand Our Consciousness with Neuroprosthetics?” Jan 18, 2013.
- 2009 Received Presidential Early Career Award for Science and Engineering from Barack Obama at the White House
- 2009 Recipient, National Science Foundation CAREER Award
- 2006 Invited Distinguished Evening Lecturer, MBL at Woods Hole Summer Course in Neural Systems and Behavior
- 2003 Invited Panelist, *Issues at the Intersection of Art and Science*, Center for Neuromorphic Systems Engineering at Caltech and the Art Center's Alyce de Roulet Williamson Gallery, Pasadena CA
- 2003 Recipient, Center for Neuromorphic Systems Engineering NEURO Art Installation Development Award for **Body Electric**
- 2001 Best Exhibit, Beckman Institute for Advanced Science Open House
- 1999 Selected to attend the Telluride Neuromorphic Engineering Workshop
- 1997 Beckman Institute for Advanced Science and Technology Research Assistantship
- 1995 Scholarship to Attend the Princeton Lectures on Biophysics
- 1994 McDonnell Summer Institute in Cognitive Neuroscience Scholarship
- 1993 Cognitive Science Summer Research Fellowship, Indiana University
- 1992 Summer internship, Artificial Intelligence, Canadian National Research Council  
*Developed automatic natural language explanations of military jet engine faults*
- 1991 Graduated with High Distinction (University-wide graduating class GPA Award)

## Statement of Core Areas of Effort

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My research program seeks to explain the evolutionary origins and neural mechanisms of planning by integrating computational modeling, embodied AI, neuroscience, robotics, and animal behavior. During a sabbatical a decade ago in paleontology, I reconstructed how vision changed during the water-to-land transition. This demonstrated a remarkable change in the space of visual sensation, one that does not admit of reactive control strategies. Consequently, my lab has transitioned from bioinspired robotics and computational neuroethology of electric fish to using robotics and AI for simulating and measuring planning in mammals in novel ways that were not technically feasible in the past.

To pursue this goal, over the past eight years I've developed an entirely new paradigm, a robot-rodent interaction arena in a spatially complex arena, for examining strategic behavior with high density neural recordings in rodents. This is yielding a treasure trove of data and eliciting great interest from funders (\$5M since 2018, in 2026 \$10M of proposals were ranked #3 out of 5 expected awards from NIH; see Near-Term Funding Pipeline). We are nearing completion of two manuscripts from the paradigm focused on behavior, and the first of a series of papers on exciting hippocampal findings is underway. The first study, outlining the method and some behavioral results, was published in 2024.

A characteristic of my work is interweaving theory, computation, robotics, evolutionary/comparative methods, and experiment to address relatively unsimplified natural behaviors from multiple perspectives. Similarly, in my training of graduate students and postdocs I have emphasized integrating these diverse approaches. I have trained 6 postdocs and 14 graduate students (12 Phds, 4 current trainees). One is Associate Professor of Mechanical Engineering (biofluidynamics) at Florida Atlantic University, one is Associate Professor of Applied Math (computational biology) at the University of Auckland, one is about to start a Transition to Independence postdoc at the Medical University of Vienna with Thomas Klausberger after a postdoc with David Redish, another is a postdoc at the RIKEN Center for Computational Science in Japan. Eight graduates and three postdocs are in top technical/managerial positions at Google, Microsoft, Apple, Intuitive Surgical (robotic surgery), HDT Robotics, and Murata Vios (medical diagnostics).

I am dedicated to mentoring students to be “full stack” neuroscientist-engineers who are as conversant in math and computer science as they are with behavior, evolution, and neurophysiology. I emphasize training in communication, both to other scientists and to the broader public through involvement in cultural productions discussed further below. In addition to mentoring my trainees to be well-rounded, I've brought integrative computational approaches to the larger community of graduate students in engineering and neuroscience through a number of graduate level classes, including Neuromechanics, where students learn to connect insect nervous systems to mechatronic devices, and Computational Neuroethology and Neuromechanics, where students traverse key literature in these domains while building computer simulations of both the biomechanics and sensory acquisition capabilities of a leading model system.

I have been very active in engaging the wider public in the scientific work of the lab. This began before my first position, while still a postdoc at Caltech, where I competed for and obtained \$10K in funding for a collaboration with an internationally known interactive installation artist, Simon Penny. Our work, *Body Electric*, was shown at the *Williamson Gallery* in Pasadena. It enabled participants to move through a darkened space and interact with hidden floating objects that could only be detected through a virtualized form of electrosense, with electric images painted on a rendering of the participant's body. Since then my efforts to combine art and science have continued and involved an internationally exhibited piece in which a dozen different species of weakly electric fish formed a "choir" of sonified electric fields under control of the participant/conductor (*scale: New York Times*, A Beijing Exhibition on Art for the 'Post-Human Era'). Further work has included science consulting and script advising for TV shows (*Caprica*, prequel to *Battlestar Galactica*) and movies (*Tron Legacy*, *Terminator Genisys*, *Avengers: Age of Ultron*, among others), and the development of an animated short ([\*Our short-sighted inner fish\*](#)) detailing our discovery of a very significant "grade shift" over the water to land transition 400 million years ago where eye size tripled over a short period. Finally, I have frequently participated in an annual Robot Block Party at the Museum of Science and Industry, giving the public an opportunity to learn about and interact with our bio-inspired robots. In all of these efforts I involve my graduate students and undergraduates in the laboratory to train them in how to make basic science research meaningful for the public.

### Contribution to Science with select references

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#### **A. Developing a New Paradigm for the Neurophysiology of Planning and Embodied AI.**

Building on the paleontological work and earlier interest how sensory volume to motor volume ratios relate to neural control, using leading models of planning in artificial intelligence, I've provided the first computational evidence for a selective benefit of planning in a common naturalistic behavior, terrestrial predator-prey interactions. Specifically, the utility of planning varies as a function of visual range and habitat complexity. Remarkably, planning is no better than habitual/reactive/innate routines in many common environments. The work strongly suggests a negligible utility to planning in underwater habitats, and high utility in savannah-like terrestrial habitats when combined with long range vision. This work has led, with Dan Dombeck, to development of a new paradigm for investigation of planning in rodents. Whereas many prior tasks for studying planning in non-human mammals were highly simplified and resulted in behavioral indicators of planning rapidly diminishing with automaticity, computational and behavioral evidence suggests that the presence of a less predictable robotic pseudo-predator provides a context where automaticity is slowed or absent. We have collected 30 TB of neuropixel 2 probe data in the past months and are preparing multiple papers on the results currently. We are applying the paradigm to humans undergoing recordings to localize epileptic seizure locus to build a bridge between human planning and rodent planning. In a novel neuroeconomics application of the theory, we have designed a market-based mechanism to overcome temporal discounting constraints on motivation for distant threats. Finally, we have

started work on understanding the energy efficiency and learning rate gap between AI and animals. I lobbied for Embodied AI to be in Northwestern Engineering's new strategic plan, and now am part of a steering committee to guide the University's development and investment strategy.

MacIver, M.A. [Neuroethology: From Morphological Computation to Planning](#) (2009). In: *The Cambridge Handbook of Situated Cognition*, Robbins P. & Aydede, M. (eds). Cambridge University Press: Chapter 26, 480-504.

Mugan, U. and MacIver, M.A. (2020) Spatial planning with long visual range benefits escape from visual predators in complex naturalistic environments. *Nature Communications*, 16;11(1):3057. (PMCID: PMC7298009).

Hunt, L.T, Daw, N.D, Kaanders, P., MacIver, M.A., Mugan, U., Procyk, E., Redish, A.D., Russo, E., Scholl, J., Stachenfeld, K., Wilson, C.R.E., and Kolling, N. (2021). Formalising planning and information search in naturalistic decision-making. *Nature Neuroscience* 24(8):1051-1064. (PMID: 34155400).

Espinosa, G., Wink, G.E., Lai, A.T., Dombeck, D. A., and M. A. MacIver (2022) Achieving mouse-level strategic evasion performance using real-time computational planning. arXiv. <https://arxiv.org/abs/2211.02700>

Cerf, M., Matz, S. C., & MacIver, M. A. (2023). Participating in a climate prediction market increases concern about global warming. *Nature Climate Change*, 13(6). <https://doi.org/10.1038/s41558-023-01679-4>

Cerf, M., Matz, S. C., & MacIver, M. A. (2023). Participating in a climate futures market increases support for costly climate policies. *Nature Climate Change*, 13(6). <https://doi.org/10.1038/s41558-023-01677-6>

Lai, A.T., Espinosa, G., Wink, G.E., Angeloni, C. F., Dombeck, D. A., and MacIver, M.A. (2024). A robot-rodent interaction arena with adjustable spatial complexity for ethologically relevant behavioral studies. *Cell Reports* Jan 25;43(2):113671. doi: 10.1016/j.celrep.2023.113671.

Han, S., Espinosa, G., Huang, J., MacIver, M.A., Dombeck, D.A., and B.C. Stadie. (2025). Of mice and machines: A comparison of learning between real world mice and RL agents. *ICML 2025*, Vancouver British Columbia Canada. <https://arxiv.org/abs/2505.12204>

**B. Neuropaleontology.** I discovered a key shift in visual systems and their capacity at the water-to-land transition 380 million years ago. I showed that eye sizes tripled over the span of the transition, and created computational visual ecology simulations showing that the total visual space that could be inspected increased by approximately one million-fold. Corroboration of the hypothesis of the work, that a massive visual field expansion preceded the transition to land, rather than being caused by it, has since been found by leading paleontologists, such as in the discovery of *Parmastega*.

MacIver, M.A., Schmitz, L., Mugan, U, Murphey, T.D, and Mobley, C. D. (2017). Massive increase in visual range preceded the origin of terrestrial vertebrates. *Proc. Natl. Acad. Sci. U.S.A.*, 114(12): E2375-E2384. (PMCID: PMC5373340). [Three minute animated explainer](#).

MacIver, M.A., Finlay, B.L. (2022). The neuroecology of the water-to-land transition and the evolution of the vertebrate brain. *Philos Trans R Soc Lond, B, Biol Sci* (PMCID: PMC8710882).

**C. Thermodynamics and Information Theory of Active Sensing** I have co-developed (with Todd D. Murphey) a new theory of active sensing, called energy-constrained proportional betting, and validated it across a disparate set of species and sensory modalities. It combines in the same formal method the energy costs of sensing and the information benefits of sensing, and predicts small movements that animals make with their sensory organs when signals approach the threshold of discriminability.

MacIver, M.A., Patankar, N. A., Shirgaonkar, A. A. (2010). Energy-information trade-offs between movement and sensing. *PLoS Computational Biology* 6(5): e1000769. doi:10.1371/journal.pcbi.1000769. PMID: 20463870

Miller, L. M., Y. Silverman, M. A. MacIver, and T. D. Murphey (2015). Ergodic Exploration of Distributed Information, *IEEE Transactions on Robotics*, 32(1), 36-52. [Video explainer](#).

Chen, C., Murphey, T.D., and MacIver, M.A. (2020). Tuning movement for sensing in an uncertain world. *eLife*, 9: e52371. [Video 1: Behaviors](#); [Video 2: Computational model & theory](#).

**D. Bioinspired Sensing Robotics** I developed the first technological system to implement the form of sensing used by weakly active electrosensory organisms. This pioneering work is now being built upon by several laboratories in Europe, Asia, and the US. [Video overview](#). I organized the first international workshop on artificial electrosense. Technical findings were built upon by the Boyer group and contributed to the electrosense company ELWAVE in France.

Solberg, J. R., Lynch, K. M., & MacIver, M. A. (2008). Active electrolocation for underwater target localization. *International Journal of Robotics Research*, 27(5), 529-548.

Bai, Y., J. B. Snyder, Peshkin M., and MacIver, M.A. (2015). Finding and identifying underwater objects with active electrosense. *International Journal of Robotics Research*, 34(10):1255-1277.

Bai, Y., Neveln I.D., Peshkin M., and MacIver, M. A. (2016). Enhanced detection performance in electrosense through capacitive sensing. *Bioinspiration and Biomimicry*, 11(5):055001 (PMID: 27501202).

**E. Bioinspired Propulsion Robotics** I have characterized key principles of the generation of propulsion from median fins found in weakly electric fish along with many other organisms such as cuttlefish. We have also performed flow structure characterization, and examined stability and maneuverability implications. Some of the more important findings have included discovery of convergent evolution of mechanical optimal locomotion (all undulatory swimmers swim with a ratio of 20:1 of wavelength to amplitude, and that this maximizes thrust); that inwardly

counterpropagating traveling waves are often used by these swimmers to simultaneously enhance maneuverability and stability; and that flow structures emanating from these fins have unique features compared to tail-flapping type swimmers. Broader implications include a) the first time an animal propulsor has been characterized to an extent sufficient for high performance, well-controlled robotic implementation; b) quantitative modeling of traveling waves—a key substrate of many modes of animal movement—and their potential neural basis. Key findings of this work have been used by a US company deploying undulating fins for propulsion and energy harvesting, Pliant Energy Systems.

Sefati, S., I. Neveln, E. Roth, T. Mitchell, J. B. Snyder, M. A. MacIver, E. S. Fortune, and Cowan, N. J. (2013). Mutually opposing forces during locomotion can eliminate the tradeoff between maneuverability and stability. *Proceedings of the National Academy of Sciences*, 110 (47) 18798-18803. PMID: 24191034

Bale, R. A., Shirgaonkar, A. A., Neveln, I. D., Bhalla, A. P. S., MacIver, M. A., Patankar, N.A. Separability of drag and thrust in undulatory animals and machines (2014). *Scientific Reports* (4), <http://dx.doi.org/10.1038/srep07329>. PMID: 25491270

Neveln, I. D., Bale, R., Bhalla, A. P. S., Curet, O. M., Patankar, N. A., MacIver, M. A. (2014) Undulating fins produce off-axis thrust and flow structures. *Journal of Experimental Biology*, 217, 201-213. PMID: 24072799

Bale, R., A. P. S. Bhalla, I. D. Neveln, M. A. MacIver, and N. A. Patankar (2015). Convergent evolution of mechanically optimal locomotion in aquatic invertebrates and vertebrates. *PLoS Biology*. PMID: 25919026

**F. Sensory and Hindbrain Processing During Predator-Prey Dynamics in Larval Zebrafish and Weakly Electric Fish.** I have used a combination of technologies to explore the behavioral and reticulospinal basis of predator-prey responses in larval zebrafish (in collaboration with David McLean) and weakly electric fish. We showed the difference in kinematics between Mauthner and non-Mauthner driven responses during looming stimuli, and key details of distributed reticular formation activation and spinal control. I showed the complementarity of sensory and motor volumes in predatory behavior of electric fish. The work also showed how electric fish trade off mechanical costs of movement with an increase in sensory volume. Finally, in early work modeling electrosensory input during predation, we showed that input was highly focal, in contrast to standard physiology stimulation paradigms that were full-body. The result has led to the discover that active electrosense is processed in two pathways with very different properties: one pathway dedicated to full body stimuli, which occur during communication behaviors, and one pathway dedicated to prey-related focal stimuli, which occur during prey capture behaviors.

Nelson, M.E., MacIver, M.A. (1999) Prey capture in the weakly electric fish *Apteronotus albifrons*: Sensory acquisition strategies and electrosensory consequences. *Journal of Experimental Biology*, 202(10):1195-1203. PMID: 10201661

- MacIver, M.A., Sharabash, N. M., Nelson, M.E. (2001) Prey-capture behavior in gymnotid electric fish: motion analysis and effects of water conductivity. *Journal of Experimental Biology*, 204(3): 543-557. PMID: 11171305
- Nelson, M.E., MacIver, M.A., Coombs, S. (2002) Modeling electrosensory and mechanosensory images during the predatory behavior of weakly electric fish. *Brain, Behavior, and Evolution* 59(4): 199-210.
- Snyder, J.B., Nelson, M.E., Burdick, J. W., MacIver, M.A. (2007). Omnidirectional sensory and movement volumes in electric fish. *PLoS Biology* 5(11): e301. PMID: 18001151
- Patterson, B.W., Abraham, A.O., MacIver, M.A., & McLean, D. L. (2013). Visually guided gradation of prey capture movements in larval zebrafish. *Journal of Experimental Biology*, 216, 3071-3083. PMID: 23619412
- Bhattacharyya, K.D., McLean, D. L. & MacIver, M.A. (2017). Visual threat assessment and reticulospinal encoding of calibrated responses in larval zebrafish. *Current Biology* 27, 2751–2762.
- Bhattacharyya, K.D., McLean, D. L. & MacIver, M.A. (2021). Intersection of motor volumes predicts the outcome of ambush predation of larval zebrafish. *Journal of Experimental Biology*. 224, jeb235481. PMID: 33649181
- Jay, M., MacIver, M.A., & McLean, D. L. (2023). Spinal basis of direction control during locomotion in larval zebrafish. *Journal of Neuroscience*. May 31; 43(22): 4062-4075. <https://doi.org/10.1523/jneurosci.0703-22.2023>.

### Full List of Articles in Preparation & Peer Reviewed Journal Articles

\*Asterisk indicates Co-Corresponding Author

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JXX Angeloni, C. F., \*Dombeck, D.A., and M.A. \*MacIver. Nonlocal hippocampal events during predatory interactions.

JXX Lai, A.T., Espinosa, G., Wink, G.E., Angeloni, C. F., \*Dombeck, D. A., and M. A. \*MacIver. An active visual behavior in mice and RL agents that varies with environmental complexity.

JXX Wink, G.E., Lai, A.T., Angeloni, C. F., \*Dombeck, D. A., and M. A. \*MacIver. The effect of a robotic psuedo-predator's strategy on rodent decision-making: From ambush to territorial patrol.

JXX Wright, J.T., Frank, A. Christine L., Gajjar V., Johnson O., MacIver, M.A., Mills, D., Novakova, J.N., Profitiliotis, G., Siegler, N., Smith, H., Sneed E., and V. Timmaraju. SAG-25 WG4: Integrating Technosignatures into Astrobiology.

J38. Lai, A.T., Espinosa, G., Wink, G.E., Angeloni, C. F., \*Dombeck, D. A., and M. A. \*MacIver. (2024) A robot-rodent interaction arena with adjustable spatial complexity for

ethologically relevant behavioral studies. *Cell Reports* [Jan 25;43\(2\):113671. doi: 10.1016/j.celrep.2023.113671.](#)

J37 Jay, M., MacIver, M.A., & McLean, D. L. (2023). Spinal basis of direction control during locomotion in larval zebrafish. *Journal of Neuroscience*. May 31; 43(22): 4062-4075. <https://doi.org/10.1523/jneurosci.0703-22.2023>

J36 Cerf, M., Matz, S. C., & MacIver, M. A. (2023). Participating in a climate prediction market increases concern about global warming. *Nature Climate Change*, 13(6). <https://doi.org/10.1038/s41558-023-01679-4>. Invited policy brief: Cerf, M., Matz, S. C., & MacIver, M. A. (2023). Participating in a climate futures market increases support for costly climate policies. *Nature Climate Change*, 13(6). <https://doi.org/10.1038/s41558-023-01677-6>

J35 MacIver, M.A., Finlay, B.L. (2022) The neuroecology of the water-to-land transition and the evolution of the vertebrate brain. *Philosophical Transactions of the Royal Society B*. <https://doi.org/10.1098/rstb.2020.0523>.

J34 Hunt, L.T, Daw, N.D, Kaanders, P., MacIver, M.A., Muga, U., Procyk, E., Redish, A.D., Russo, E., Scholl, J., Stachenfeld, K., Wilson, C.R.E., and Kolling, N. (2021) Formalising planning and information search in naturalistic decision-making. *Nature Neuroscience*, <https://doi.org/10.1038/s41593-021-00866-w>.

J33 Bhattacharyya, Kiran D. and McLean, David L. and MacIver, M. A. (2021) Intersection of motor volumes predicts the outcome of ambush predation of larval zebrafish. *Journal of Experimental Biology* Mar 1;224(Pt 5):jeb235481. <https://doi.org/10.1242/jeb.235481>.

J32 Muga, U. and MacIver, M.A. (2020) Spatial planning with long visual range benefits escape from visual predators in complex naturalistic environments. *Nature Communications*. [Video explainer](#).

J31 Chen, C. Murphey, T.D, and MacIver, M.A. (2020) Tuning movement for sensing in an uncertain world, *eLife*. Videos: [Behaviors](#), [Application of theory to a robot](#).

J30 Bhattacharyya, Kiran D. and McLean, David L. and MacIver, M. A. (2017) Visual threat assessment and reticulospinal encoding of calibrated responses in larval zebrafish. *Current Biology* 27, 2751–2762.

J29 \*MacIver, M.A., \*Schmitz, L., Muga, U, Murphey, T.D, and Curtis D. Mobley (2017). Massive increase in visual range preceded the origin of terrestrial vertebrates. *Proceedings of the National Academy of Sciences*, 114(12):E2375-E2384. doi: 10.1073/pnas.1615563114 [Link to Open Access PDF](#).

**Video explainer/outreach:** <https://youtu.be/I19usgWHJLc>.

**Commentary:** Evolution, an Irresistibly Clear View of Land, by Dan-E. Nilsson. *Current Biology*, 2017, <http://dx.doi.org/10.1016/j.cub.2017.05.082>. Response by MacIver & Schmitz: [http://www.cell.com/current-biology/comments/S0960-9822\(17\)30648-6](http://www.cell.com/current-biology/comments/S0960-9822(17)30648-6).

J28 Krakauer, J.W., Ghazanfar, A.A., Gomez-Marín A., MacIver, M.A., and David Poeppel (2017). Neuroscience Needs Behavior: Correcting a Reductionist Bias. *Neuron*, 93(3): 480-490.

J27. Fang, S., Peshkin, M. and MacIver, M. A. (2016) Human-in-the-loop active

- electrosense. *Bioinspiration & Biomimetics*, vol 12, issue 1, pp. 014001, 12/2016, doi:10.1088/1748-3190/12/1/014001.
- J26. Bai, Y., Neveln I.D., Peshkin M., and MacIver, M. A. (2016) Enhanced detection performance in electrosense through capacitive sensing. *Bioinspiration & Biomimetics*. doi:10.1088/1748-3190/11/5/055001.
- J25. Miller, L. M., Y. Silverman, M. A. MacIver, and T. D. Murphey (2016). Ergodic Exploration of Distributed Information. *IEEE Transactions on Robotics*, 32(1), 36-52. [Link to video](#) explaining the algorithm.
- J24. Bale, R., A. P. S. Bhalla, I. D. Neveln, M. A. MacIver\*, and N. A. \*Patankar (2015). Convergent evolution of mechanically optimal locomotion in aquatic invertebrates and vertebrates. *PLOS Biology* 2015, DOI: 10.1371/journal.pbio.1002123.
- J23. Bai, Y., J. B. Snyder, M. A. Peshkin, and M. A. MacIver, Finding and identifying underwater objects with active electrosense (2015). *The International Journal of Robotics Research*. DOI: 10.1177/0278364915569813.
- J22. Bale, R. A., Shirgaonkar, A. A., Neveln, I. D., Bhalla, A. P. S., MacIver, M. A., Patankar, N.A. Separability of drag and thrust in undulatory animals and machines (2014). *Scientific Reports* (4), doi:10.1038/srep07329.
- J21. Neveln, I. D., Bale, R., Bhalla, A. P. S., Curet, O. M., Patankar, N. A., MacIver, M. A. (2014) Undulating fins produce off-axis thrust and flow structures. *Journal of Experimental Biology*, 217, 201-213.
- J20. Sefati, S., I. Neveln, E. Roth, T. Mitchell, J. B. Snyder, M. A. MacIver, E. S. Fortune, and Cowan, N. J. (2013). Mutually opposing forces during locomotion can eliminate the tradeoff between maneuverability and stability. *Proceedings of the National Academy of Sciences*, 110 (47) 18798-18803.
- J19. Neveln, I. D., Bai, Y., Snyder, J. B., Solberg, James R., Curet, O. M., Lynch, Kevin M., & MacIver, M. A. (2013). Biomimetic and bio-inspired robotics in electric fish research. *Journal of Experimental Biology*, 216, 2501-2514.
- J18. Patterson, B.W., Abraham, A.O., MacIver, M.A., & McLean, D. L. (2013). Visually guided gradation of prey capture movements in larval zebrafish. *Journal of Experimental Biology*, 216, 3071-3083.
- J17. Ruiz-Torres, R., Curet, O. M., Lauder, G. V., & MacIver, M.A. (2012). Kinematics of the ribbon fin in hovering and swimming of the electric ghost knifefish. *Journal of Experimental Biology*, 216, 823-834.
- J16. Curet, O.M., Patankar, N. A., Lauder, G.V., MacIver, M. A. (2011) Mechanical properties of a bio-inspired robotic knifefish with an undulatory propulsor. *Bioinspiration & Biomimetics*, Jun;6(2):026004. Epub April 7, 2011, doi:10.1088/1748-3182/6/2/026004.
- J15. Curet, O.M., Patankar, N. A., Lauder, G.V., MacIver, M. A. (2011) Aquatic maneuvering with counter-propagating waves: a novel locomotive strategy. *Journal of the Royal Society*

- Interface*, July 6; 8(60):1041-50 Epub Dec 22, 2010, doi: 10.1098/rsif.2010.0493. **Cover.**
- J14. MacIver, M.A., Patankar, N. A., Shirgaonkar, A. A. (2010) Energy-information trade-offs between movement and sensing. *PLoS Computational Biology* 6(5): e1000769. doi:10.1371/journal.pcbi.1000769.
- J13. Curet, O.M., AlAli, I. K., MacIver, M.A., Patankar, N. A. (2010) A versatile implicit iterative approach for fully resolved simulation of self-propulsion. *Computer Methods in Applied Mechanics and Engineering*, doi:10.1016/j.cma.2010.03.026.
- J12. Shirgaonkar, A. S., MacIver, M. A., Patankar, N. A. (2009) A new mathematical formulation and fast algorithm for fully resolved simulation of self-propulsion. *Journal of Computational Physics*, 228, 2366-2390.
- J11. Postlethwaite, C. M., Psemeneke, T. M., Selimkhanov\*, J., Silber, M., MacIver, M. A. (2009) Optimal movement in the prey strikes of weakly electric fish: A case study of the interplay of body plan and movement capability. *Journal of the Royal Society Interface*. Published online Oct 8, 2008; doi:10.1098/rsif.2008.0286; published in journal 2009. \*Undergraduate researcher.
- J10. Shirgaonkar, A. A., Curet, O.M., Patankar, N. A., MacIver, M. A. (2008) The hydrodynamics of ribbon-fin propulsion under impulsive motion. *Journal of Experimental Biology* 211: 3490-3503.
- J09. Solberg, J. R., Lynch, K. M., & MacIver, M. A. (2008). Active electrolocation for underwater target localization. *International Journal of Robotics Research*, 27(5), 529-548.
- J08. Snyder, J.B., Nelson, M.E., Burdick, J. W., MacIver, M.A. (2007) Omnidirectional sensory and movement volumes in electric fish. *PLoS Biology* 5(11): e301.
- J07. Nelson, M.E. and MacIver, M.A. (2006) Sensory acquisition in active sensing systems. *Journal of Comparative Physiology A* 192: 573-586.
- J06. MacIver, M.A., Fontaine, E., Burdick, J. W. (2004) Designing future underwater vehicles: principles and mechanisms of the weakly electric fish. *IEEE Journal of Oceanic Engineering* 29(3):651-659.
- J05. Nelson, M.E., MacIver, M.A., Coombs, S. (2002) Modeling electrosensory and mechanosensory images during the predatory behavior of weakly electric fish. *Brain, Behavior, and Evolution* 59(4): 199-210.
- J04. MacIver, M.A., Nelson, M.E. (2001) Towards a biorobotic electrosensory system. *Autonomous Robots* 11, 263–266.
- J03. MacIver, M.A., Sharabash, N. M., Nelson, M.E. (2001) Prey-capture behavior in gymnotid electric fish: motion analysis and effects of water conductivity. *Journal of Experimental Biology*, 204(3): 543-557.
- J02. MacIver, M.A., Nelson, M.E. (2000) Body modeling and model-based tracking for neuroethology. *Journal of Neuroscience Methods*, 95(2):133-143.

J01. Nelson, M.E., MacIver, M.A. (1999) Prey capture in the weakly electric fish *Apteronotus albifrons*: Sensory acquisition strategies and electrosensory consequences. *Journal of Experimental Biology*, 202(10):1195-1203. **Cover.**

## Preprints and Peer Reviewed Conference Proceedings

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C16. Han, S., Espinosa, G., Huang, J., MacIver, M.A., Dombeck, D.A., and B.C. Stadie. (2025) Of mice and machines: A comparison of learning between real world mice and RL agents. ICML 2025, Vancouver British Columbia Canada. arXiv:2505.12204

C15. Espinosa, G., Wink, G.E., Lai, A.T., Dombeck, D. A., and M. A. MacIver. Achieving mouse-level strategic evasion performance using real-time computational planning. arXiv <https://doi.org/10.48550/arXiv.2211.02700.4>

C14. Mugan, U., M. A. MacIver. How sensory ecology affects the utility of planning, 2018. Conference on Cognitive Computational Neuroscience, Philadelphia PA. Sept 2018.

C13. Mamakoukas, G., M. A. MacIver, and T. D. Murphey, Superlinear Convergence Using Controls Based on Second-Order Needle Variations, 2018. IEEE Conference on Decision and Control, Miami Beach FL.

C12. Ugurcan, M., M. A. MacIver, and M. Peshkin, Information-theoretic approach to sensor selection, 2017. The 8th International Symposium on Adaptive Motion of Animals and Machines, Sapporo Japan.

C11. Mamakoukas, G., M. A. MacIver, and T. D. Murphey, Feedback Synthesis for Controllable Underactuated Systems using Sequential Second Order Actions, Robotics: Science and Systems, 2017.

C10. Mamakoukas, G., M. A. MacIver, and Todd. D. Murphey. Sequential Action Control for Models of Underactuated Underwater Vehicles in a Planar Ideal Fluid. American Control Conference, Boston MA, 2016.

C09. Neveln, I. D., L. M. Miller, M. A. MacIver, and T. D. Murphey, Improving Object Tracking through Distributed Exploration of an Information Map, IEEE Int. Conf. on Intelligent Robots and Systems (IROS), 2014. Pages: 3441 - 3447, doi: 10.1109/IROS.2014.6943042.

C08. Silverman, Y., L. M. Miller, M. A. MacIver, and Murphey, T.D. (2013) Optimal Planning for Information Acquisition. Intelligent Robots and Systems (IROS), 2013 IEEE/RSJ International Conference, p5974-5980, Tokyo Japan. doi: 10.1109/IROS.2013.6697223

C07. Shahin Sefati, Izaak Neveln, Malcolm A. MacIver, Eric Fortune, Noah J. Cowan (2012). Counter-Propagating Waves Enhance Maneuverability and Stability: A Bio-Inspired Strategy for Robotic Ribbon-Fin Propulsion. Biomedical Robotics and Biomechanics (BioRob), 2012 4th IEEE RAS & EMBS International Conference on, pp. 1620-1625. DOI: 10.1109/BioRob.2012.6290909.

- C06. Yonatan Silverman, James Snyder, Yang Bai, and Malcolm A. MacIver (2012) Location and Orientation Estimation with an Electrosense Robot. *Intelligent Robots and Systems (IROS)*, 2012 IEEE/RSJ International Conference on, pp.4218-422e, 7-12 Oct. 2012. doi: 10.1109/IROS.2012.638617.
- C05. Bai, Y., Snyder, J. B., Silverman, Y., Peshkin, M. and MacIver, M.A. (2012). Sensing Capacitance of Underwater Objects in Bio-inspired Electrosense. *Intelligent Robots and Systems (IROS)*, 2012 IEEE/RSJ International Conference on, pp.1467-1472, 7-12 Oct. 2012. doi: 10.1109/IROS.2012.638617.
- C04. Snyder, J., Silverman, Y., Bai, Y. MacIver, M.A., (2012). Underwater object tracking using electrical impedance tomography. *Intelligent Robots and Systems (IROS)*, 2012 IEEE/RSJ International Conference on, vol., no., pp.520-525, 7-12 Oct. 2012 doi: 10.1109/IROS.2012.6386251.
- C03. Epstein, M., Colgate, J.E, MacIver, M.A. (2006) Generating Thrust with a Biologically-Inspired Robotic Ribbon Fin Source. 2006 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Beijing, China. pp: 2412 - 2417, DOI: 10.1109/IROS.2006.281681.
- C02. Epstein, M., Colgate, J.E, MacIver, M.A. (2005) A Biologically Inspired Robotic Ribbon Fin. *Proceedings of the 2005 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, workshop on Morphology, Control, and Passive Dynamics.
- C01. MacIver, M.A., Lin, J.L., Nelson, M.E. (1997) Estimation of signal characteristics during electrolocation from video analysis of prey capture behavior in weakly electric fish. *Computational Neuroscience: Trends in Research*, 1997. Plenum Press. pp. 729-734.

### Invited Book Chapters, Commentaries, etc

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- I05. MacIver, M. A. (2023) Evolution: Blinking through deep time. *Current Biology*, Dec 18; 33(24):R1292-R1293. doi: 10.1016/j.cub.2023.10.019.
- I04. MacIver, M. A. (2013) Engineering Health and Sustainability through Consciousness-Enhancing Technologies, *McCormick Magazine*, Spring 2013, Northwestern University, pp. 18-19.
- I03. MacIver, M. A. Fitting Science and Screen [Book Review]. *Science*, 6 May 2011: Vol. 332 no. 6030 p. 665. DOI: 10.1126/science.1205130.
- I02. MacIver, M.A. [Neuroethology: From Morphological Computation to Planning](#) (2009). *The Cambridge Handbook of Situated Cognition*, Robbins P. & Aydede, M. (eds). Cambridge University Press: Chapter 26, 480-504.
- I01. MacIver, M.A. (2001) How building physical models can reduce and guide the abstraction of nature. *Brain and Behavioral Sciences* 24(6):1066-1067.

### Video animation

2017. Our Short-Sighted Inner Fish. Written and Produced by Kristin Pichaske in collaboration with Malcolm A. MacIver. Animation by Kaleida Studios and Cartuna. Animators: Julie Gratz, Kevin Ryan, and Kinga Nagorka. Music and Sound: Noah Pardo. [Link to video](#). 98,000 views.

### Serious Game

2020. Survival. Programming by German Espinosa. Art by Alexander Lai. Written to illustrate simulation environments used in the Mugañ & MacIver 2020 [Nature Communications](#) study. [Link to browser based game](#). 13,000 plays.

### Art Collaborations

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2023 A dialogue between the scientist Malcolm MacIver and artist Dario Robleto explores how art and science both contemplate—and seek to overcome—the physical and temporal limits of human life. The discussion touches on the question of how art might provide a model for long-term thinking, especially in times of societal and ecological transformation. Presented in conjunction with the exhibition The Heart's Knowledge: Science and Empathy in the Art of Dario Robleto. [Video of event](#).

2019 **Emergent Horizons [course for artists and engineers]**, with Iñigo Manglano-Ovalle. We inhabit and think within a bubble of space and time, the shape and size of which are rarely an object of thought. The first multicellular animal's bubble, 700 million years ago, extended only to the body surface. With hundreds of millions of years our event horizon has been pushed out to what we do in the next few minutes and days. Now we need to not only vividly imagine but also care about more distant horizons. How can we bootstrap our imagination to do this in art and in science? This class will emphasize experiential art that is also informed by cognitive and perceptual science.

2016 **Risk [course for artists and engineers]**, with Michael Rakowitz. We can view several looming existential threats to humanity as examples where the increase in risk is too shallow to trigger our usual motivated responses, like the parable of the frog in the warming pot of water not ever realizing it was getting too hot to live. The smokestack can be considered an icon of this idea: without a long chimney, people would fight the pollution, but by making pollutants go high into the atmosphere, we put the risk below the threshold of action. Examples of this problem include the rise of CO<sub>2</sub>, the fall of biodiversity, and increasing inequality

At the heart of this class is the hope that students will develop an ethical program as individual artists and designers. Students will be asked to approach their research and project in ways that range from countering risk to increasing the gradient of risk so that we must act now. Indeed, sometimes we need better monsters.

2011 **scale**, Malcolm A. MacIver, Marlena Novak, and Jay Allan Yim. **translife**, International Triennial of New Media Art. **National Art Museum of China**, July 27—August 17, 2011, Beijing, China. **Documentation:** [Exhibit Statement and Video at OTHER INTERESTS](#). Estimated participation: 10,000. [New York Times review of the show](#).

2010 **scale**, Malcolm A. MacIver, Marlena Novak, and Jay Allan Yim. World premiere at the **STRP Festival of Art and Technology in Eindhoven**, The Netherlands, Nov 18-28 2010. The [STRP](#) Festival is one of the largest e-culture events in Europe which melds music, art & technology together. 30,000 people visited the festival during the premiere.

2003 **Body Electric**, Malcolm A. MacIver and Simon Penny. **Williamson Art Gallery** in the Art Center College of Design in Pasadena CA, April 15-June 29 2003. Part of the NEURO exhibition developed by the Caltech Center for Neuromorphic Systems Engineering and the Williamson Art Gallery. **Documentation:** [Exhibit Statement and Video at OTHER INTERESTS tab here](#).

## Near-Term Funding Pipeline

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### **Risk-related decision-making in a social context**

Principal Investigators: Daniel Dombeck, Malcolm MacIver, Genia Kozorovitskiy

Agency: National Institute of Health

Period: Five years from start date.

Requested Funds: \$3.3M

*This proposal was ranked 3 out of 5 expected awards but due to the rule change to fund all years only the first 2 awards were made; we were told to resubmit for this coming 2026 cycle.*

### **The ecological induction of cognition: Technical innovations, fundamental behaviors, and neural correlates**

Principal Investigators: Malcolm MacIver, Daniel Dombeck, Genia Kozorovitskiy, Bradly Stadie

Agency: National Institute of Health

Period: Five years from start date.

Funds: \$6.9M

*This proposal was ranked 3 out of 5 expected awards but due to the rule change to fund all years only the first 2 awards were made; we were told to resubmit for this coming 2026 cycle.*

### **The role of hippocampal replay events in episodic projection in humans**

Principal Investigators: Rodrigo Braga, Malcolm MacIver, Daniel Dombeck

Agency: National Institute of Health

Period: Five years from start date. Submission in October 2026.

Funds \$4.0M

**The origins of terrestrial intelligence.**

Principal Investigators: Stephan Reber

Co-investigators: Mathias Osvath, Malcolm MacIver

Agency: Swedish Research Council.

Period: Five years from the start date.

Funds: TBD

**Active Funding**

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**Determining if and how animals imagine what their adversaries might do**

Principal Investigators: Daniel Dombeck, Malcolm MacIver

Agency: Air Force Office of Scientific Research, #14329793

Period: 4/1/2026-3/31/2029

Funds: \$0.8M

**CRCNS Research Proposal: Measuring and modeling the biological intelligence advantage**

Principal Investigator: Malcolm A. MacIver

Co-Investigators: Daniel Dombeck (neurophysiology), Bradly Stadie (artificial intelligence)

Agency: National Science Foundation, IIS-2509217.

Period: 9/1/2025-8/31/2028

Funds: \$1.0M

**Cognitive convergence: Vertebrate carnivore-like predatory planning behaviors in jumping spiders.**

Principal Investigator: Chen Li (Johns Hopkins)

Co-Investigators: Malcolm A. MacIver, Diaqin Li (Hubei University, China), Ximena Nelson (University of Canterbury, New Zealand).

Agency: Human Frontiers Scientific Program, RGP017/2024.

Period: 12/1/2024-12/1/2027

Funds: \$1.3M

**What's the Place for Planning?**

Principal Investigator: Malcolm A. MacIver

Co-Investigators: Daniel A. Dombeck, Northwestern, Matthew T. Kaufman, University of Chicago, Bradly C. Stadie, Northwestern.

National Institute for Theory and Mathematics in Biology

Period 01/01/2025-08/31/2026

Funds: \$0.3M

## Completed Funding

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### **The Biology and Technology of Online Planning.**

Principal Investigator: Malcolm MacIver

Co-Investigator: Daniel Dombeck

Agency: National Science Foundation, IIS 2123725

Period 9/1/2021-8/31/2025

Funds: \$1.1M

### **How Ecology Induces Cognition: Paleontology, Machine Learning, and Neuroscience**

Principal Investigator: Malcolm MacIver

Co-Investigator: Daniel Dombeck

Agency: National Science Foundation, ECCS 1835389

Period 9/1/2018-8/31/2022

Funds: \$1.0M

## **PREVIOUS TO CHANGE IN SCIENCE IN 2018**

### **Reticulospinal Execution of Innate Decision-Making**

Principal Investigator: David McLean

Co-Investigators: Malcolm MacIver, Neelesh Patankar

Agency: National Science Foundation, IOS-ORG 1456830

Period: 5/01/2015-4/30/2019

### **NRI: Electrosense imaging for underwater telepresence and manipulation**

Principal Investigator: Michael Peshkin

Co-Investigators: Malcolm MacIver, Joshua Smith, Konrad Kording, Alex Mahklin.

Agency: National Science Foundation, NSF IIS-1427419

Period: 9/1/2014-8/31/2019

### **Development of a climate change prediction market for behavioral change**

Principal Investigator: Malcolm MacIver

Co-Investigator: Moran Cerf

Agency: Northwestern Institute on Complex Systems

Period 03/01/2015-11/01/2018

### **A Bio-Inspired underwater robot for station keeping with omnidirectional disturbances**

Principal Investigator: Malcolm MacIver

Co-Investigators: Michael Peshkin, Todd Murphey.

Agency: Office of Naval Research, N00014-14-1-0594.

Period: 5/1/14-9/30/17

### **Cyber-Enabled Discovery in Neuromechanical Systems**

Principal Investigator: Malcolm A. MacIver

Co-Investigators: Noah Cowan and Eric Fortune (Johns Hopkins), George Lauder (Harvard)

Agency: National Science Foundation, NSF CMMI-0941674

Period: 9/1/2009-8/31/2015

**CAREER: Infomechanics - The interdependence of animal information acquisition and mechanics**

Principal Investigator: Malcolm MacIver

Agency: National Science Foundation, IOB-0846032

Period: 8/15/2009-6/30/2015

**IGERT: Integrative Training in Motor Control and Movement**

Principal Investigator: Melina Hale (University of Chicago)

Co-Investigator: Malcolm A. MacIver, and three others at University of Chicago

Agency: National Science Foundation

Period: 8/1/2009-7/31/2014

**The development of a bio-inspired magneto-electrosensory navigation system**

Principal Investigator: Malcolm MacIver

Co-Investigators: Kinea Design LLC, Michael Peshkin, Kevin Lynch

Agency: Office of Naval Research, STTR mechanism, Phase II, N00014-10-C0420

Period: 1/5/2010-12/1/2012

**Fully resolved simulation of self-propelling fish**

Principal Investigator: Neelesh A. Patankar

Co-Investigator: Malcolm A. MacIver

Agency: National Science Foundation, CBET-0828749

Period: 9/1/2008-8/31/2012

**scale**

Principal Investigator: Malcolm MacIver

Co-Investigators: Jay Allan Yim, School of Music at Northwestern University, and Marlina Novak, Weinberg College of Arts and Sciences at Northwestern University.

Agency: Northwestern Center for Interdisciplinary Research in the Arts

Period: 7/15/2009-7/14/2010

**The development of a bio-inspired magneto-electrosensory navigation system**

Principal Investigator: Malcolm MacIver

Co-Investigators: Kinea Design LLC, Michael Peshkin, Kevin Lynch

Agency: Office of Naval Research, STTR mechanism

Period: 6/29/2009-1/25/2010

**Transforming sensory signals into muscle activations in a behavior with dynamic**

**constraints**

Principal Investigator: Malcolm A. MacIver

Co-Investigator: Kevin Lynch (ME)

Agency: National Science Foundation IOB-0517683

Period: 8/1/2005-10/2008

**Select Online Talks**

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- 2025      The geological basis of intelligence. June 12, Multi-disciplinary Conference on Reinforcement Learning and Decision Making (RLDM) Dublin, Ireland. <https://www.youtube.com/watch?v=PM5F3hhTryk>
  - 2025      The geological basis of intelligence. May 27, The Johns Hopkins Natural Philosophy Symposium. <https://youtu.be/YgAwqBwCyxo>
  - 2023      Evolution and mechanisms of planning through the lens of predator-prey dynamics, robotics, and artificial intelligence. Northwestern Institute on Complex Systems Seminar Series, Nov 11, 2023. <https://www.youtube.com/watch?v=vINeoZ1Tm1E>
  - 2023      Does terrestriality advantage planning in vertebrates? University College London NeuroAI Series. Feb 15, 2023. <https://mediacentral.ucl.ac.uk/Player/3G8IdbD0>
  - 2023      Does terrestriality advantage the emergence of cognition? Penn State Extraterrestrial Intelligence Center. Feb 2, 2023. [https://psu.mediaspace.kaltura.com/media/PSETI+SeminarA+Does+terrestriality+advantage+the+emergence+of+cognitionF+-+Malcolm+MacIver/1\\_5qwk12uy](https://psu.mediaspace.kaltura.com/media/PSETI+SeminarA+Does+terrestriality+advantage+the+emergence+of+cognitionF+-+Malcolm+MacIver/1_5qwk12uy)
  - 2022      Keynote for the 2022 Conference on Cognitive Computational Neuroscience in San Francisco. <https://youtu.be/E98sfm6x9Eg?t=240>
  - 2022      “Generative Adversarial Collaboration” for the 2022 Conference on Cognitive Computational Neuroscience. Other Participants: Nathaniel Daw, German Espinosa (NU), Jessica Hamrick (DeepMind), Mark Ho (Princeton), David Redish (U Minnesota), Bradly Stadie (NU), Jane Wang (DeepMind). Part 1: <https://youtu.be/11A1fouQg7E>. Part 2: <https://youtu.be/Bej9lHXh6ic>.
  - 2021      Sensory and ecological bases of plan-based action selection. Allen Institute for AI, Embodied AI Lecture Series. April 21, 2021. <https://www.youtube.com/watch?v=VXgV2cjfB00>.
  - 2019      Terrestrial sensory ecology provides a selective benefit to planning. COSYNE workshop 'Beyond trial-based choice: decision-making in naturalistic and temporally extended environments' in Cascais Portugal. <https://youtu.be/Q3H-5Z3-6gM>.

- 2018 Mechanically optimal movement in fish and its coupling to information harvesting. University of Auckland, Auckland Bioengineering Institute. Auckland New Zealand. <https://www.youtube.com/watch?v=gAHcUyP3IDE>.
- 2018 How sentience changed after fish invaded land 385 million years ago. UQAM / ISC 2018 Summer School in Animal Cognition - The other minds problem: animal sentience and cognition. University of Quebec, Montreal Canada. [https://youtu.be/HI7fXIP\\_mjo](https://youtu.be/HI7fXIP_mjo).
- 2014 Electric fish robotics. AAAS National Meeting, Symposium on “Intelligent Autonomous Robots: Biologically Inspired Engineering”, Chicago IL. <https://vimeo.com/87924126>.
- 2013 Can We Expand Our Consciousness With Neuroprosthetics? TEDx Caltech, January 2013. Pasadena CA. <https://youtu.be/gj2zx1kEjKM>.
- 2011 Energy, Information, and the Emergence of Choice. FQXi Conference, Copenhagen. <https://youtu.be/dRDfwsuBNb4>.

**Invited Talks at Professional Symposia (keynotes/plenary talks are in Honors and Awards above)**

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- 2026 The partial observability of terrestrial behaviors in the genesis of offline cognition. Workshop on the Evolutionary Consequences of Energetic Cost of Intelligence, Feb 16-20, 2026. Santa Fe Institute.
- 2025 The Geology of Cognition. Grounding Cognition in Mechanistic Insight. April 27-May 2, 2025. HHMI Janelia Research Campus, Ashburn VA USA.
- 2023 Evolution & mechanisms of planning through the lens of predator-prey dynamics. Natural behaviors, brains & computations. Oct 1-3, 2023. Grand Tetons National Park, WY USA.
- 2023 The evolution of planning circuits through the lens of predator-prey dynamics. Caltech Symposium on Neuroscience and the Principles of Evolution. Apr 28, 2023. Pasadena CA USA.
- 2023 How mammals use stealthy visual updates during evasion of a predatory robot. Jan 18, 2023. Active Sensing: From Animals to Robots. Weizmann Institute, Tel-Aviv, Israel.
- 2022 Workshop “Senses in Motion: Sensory Processing in Freely Moving Animals” Oct 17 2022, Sainsbury Wellcome Centre, London, UK.
- 2022 Drivers of learning across timescales: an evolutionary perspective. Aug 25, 2022. Keynote for Computational Cognitive Neuroscience, San Francisco USA.

- 2019 Terrestrial sensory ecology provides a selective benefit to planning. March 5 2019 COSYNE workshop 'Beyond trial-based choice: decision-making in naturalistic and temporally extended environments' in Cascais Portugal.
- 2018 How sensory ecology affects the utility of planning. Computational Cognitive Neuroscience, September 5, Philadelphia 2018 USA.
- 2018 Evolving from reactivity to deliberation: steps in getting more time to think. Santa Fe Institute Workshop on the Origins & Implications of Time in Physical & Adaptive Systems. Santa Fe, New Mexico.
- 2018 How sentience changed after fish invaded land 385 million years ago. UQAM / ISC 2018 Summer School in Animal Cognition - The other minds problem: animal sentience and cognition. University of Quebec, Montreal Canada.
- 2018 Animal habitat as an evolutionary driving force for the development of planning systems. J. B. Johnston Club for Evolutionary Neuroscience, San Diego, CA.
- 2016 Mechanically optimal movement in fish and its coupling to information harvesting. Fifth annual winter workshop in the neuromechanics and dynamics of locomotion, Tulane University, New Orleans LA.
- 2015 Electric Fish Robotics. 7<sup>th</sup> International Symposium on Adaptive Motion of Animals and Machines. MIT, Cambridge MA.
- 2014 Vision versus electrosense. 26<sup>th</sup> Annual Karger Workshop in Evolutionary Neuroscience. November 2014, Washington DC.
- 2014 Electric fish robotics. AAAS National Meeting, Symposium on “Intelligent Autonomous Robots: Biologically Inspired Engineering”, Chicago IL.
- 2013 Vision versus electrosense: Mechanics and sensing in prey capture behavior of larval zebrafish compared to electric knifefish. Janelia Farms Conference, “Dynamics of Prey Capture and Escape” March 2013, Ashburn, VA.
- 2013 Can We Expand Our Consciousness With Neuroprosthetics? TEDx Caltech, January 2013. Pasadena CA.
- 2013 Vision versus electrosense: Mechanics and sensing in prey capture behavior in larval zebrafish compared to electric knifefish. Symposium keynote for “When Predators Attack,” Society of Integrative and Comparative Biology, January 2013, San Francisco, CA.
- 2012 How Knifefish Swim: Spanning the Gap Between Eel-like and Trout-Like Swimming. Weakly electric fish meeting, International Congress of Neuroethology August 2012, College Park MA.
- 2012 Sensory and Motor Spaces and the Emergence of Multiple Futures. Computational Neuroscience Annual Meeting, July 2012, Atlanta GA. (keynote).
- 2012 Sensory and Motor Spaces and the Emergence of Multiple Futures. Summer

- School in Cognitive Sciences, “The Evolution and Function of Consciousness,” June 30-July 9, Montreal Canada.
- 2012 “From electric fish to robot fish and back” PINC Conference, Amsterdam,
- 2011 “Energy, Information, and the Emergence of Choice” FQXi Conference, Copenhagen.
- 2011 “Energy-Information Trade-Offs between Movement and Sensing,” Gordon Conference on Neuroethology.
- 2011 “Energy-Information Trade-Offs between Movement and Sensing.” International workshop on bio-inspired robots, Nantes France (keynote).
- 2011 “Energy-Information Trade-Offs between Movement and Sensing.” German Society for Neuroscience, Gottingen.
- 2010 “Infomechanics and the bone-brain continuum.” Swiss Federal Institute of Technology, Life Science Symposium on Engineering Life, Lausanne, Switzerland.
- 2009 “The development of a bio-inspired magneto-electrosensory navigation module.” Office of Naval Research Symposium on Bio-inspired Systems, Washington DC
- 2009 “Biomechanical constraints on sensory acquisition in weakly electric fish” Society for Integrative and Comparative Biology, Symposium on Sensory Biomechanics, Boston, MA
2008. “Acquiring information under mechanical constraints” Fourth International Symposium on Adaptive Motion of Animals and Machines, Case Western Reserve University, Cleveland, OH
- 2007 “Sensory and movement volumes in animals: Implications for control” Symposium on top-down influences in active sensing. International Congress of Neuroethology, Vancouver BC Canada
- 2007 “Infomechanical specializations for maximizing prey capture in the knifefish” Satellite meeting on electrosensory organisms, International Congress of Neuroethology, Vancouver BC Canada
- 2007 “Robotic electrolocation: Active underwater target localization with electric fields.” Solberg, J.S., Lynch, K.M., and MacIver, M.A. International Conference for Robotics and Automation, Symposium on Bio-inspired Perception, Rome, Italy. Presenter: Solberg.
- 2006 “From morphological computation to planning: insights from neuroethology,” Tenth International Conference on the Simulation and Synthesis of Living Systems (ALife X), Workshop on Morphologies, Motion and Cognition, Bloomington, IN, USA
- 2006 “Generating Thrust with a Biologically-Inspired Robotic Ribbon Fin.” Epstein,

- M., Colgate, J. E., MacIver, M.A. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Beijing, China. Presenter: MacIver.
- 2005 “Explorations in Computational Morphology,” The Canadian Electric Fish Meeting, Merrickville, ON, Canada
- 2005 “A Biologically Inspired Robotic Ribbon Fin.” Epstein, M., Colgate, J. E., MacIver, M. A. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Edmonton, AB, Canada. Presenter: MacIver.
- 2004 “Matching of sensing and motor volumes in active sensory systems.” MacIver, M. A., Nelson, M. E., Burdick, J. W. Society for Neuroscience Satellite Symposium on Advances in Computational Motor Control, San Diego, CA, USA. Presenter: MacIver
- 2004 “Matching of sensing and motor volumes and optimality of movements in active sensory systems,” Center for Neuromorphic Systems Engineering 10<sup>th</sup> Anniversary Celebration.
- 2003 “Neuromechanical design and active sensory systems,” 13<sup>th</sup> International Symposium on Unmanned Untethered Submersible Technology, Durham, NH, USA
- 2003 “Getting around on a small charge: mechanics, sensing, and biorobotics with the weakly electric fish,” Second International Symposium on Aqua Bio-Mechanisms, Honolulu, HI, USA
- 2002 “Sensing, mechanics, and control: a framework for the integrated understanding of a natural behavior,” The Hebrew University and Caltech 2<sup>nd</sup> Joint Symposium on Frontiers in Computational Neuroscience, Pacific Grove, CA, USA
- 2000 “A robotic implementation of electrosensory signal acquisition in electric fish,” NASA Workshop on Biomorphing Robotics, Pasadena, CA, USA

### Other Invited Academic Talks

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| 1. University of Washington, Computational Neuroscience Center                  | 2025 |
| 2. University of Oregon, Institute of Neuroscience                              | 2025 |
| 3. Dartmouth College, Dept. Psychological & Brain Sciences                      | 2024 |
| 4. U Mass Amherst, Organismic and Evolutionary Biology                          | 2024 |
| 5. Northwestern Department of Environmental Engineering Colloquium              | 2023 |
| 6. UCL Consciousness Club Series  | 2023 |
| 7. UCL NeuroAI Talk Series  | 2023 |
| 8. Max Planck for Neurobiology of Behavior, Bonn Germany                        | 2022 |
| 9. Natural Philosophy Group (inaugural talk), Johns Hopkins University          | 2022 |
| 10. Laboratory for Computational Sensing and Robotics, Johns Hopkins University | 2022 |
| 11. Generative Adversarial Collaboration, The Place of Planning                 | 2022 |

12. Roeder Lecture, Tufts	2021
13. Columbia University, Zuckerman Mind Brain Behavior Institute	2020
14. University of Auckland, Bioengineering Program	2018
15. University of Otago, Department of Zoology	2018
16. University of Cincinnati, Department of Psychology	2018
17. Washington and Lee University, Physics-Engineering Seminar Series	2015
18. University of Chicago, Chicago IL, Computational Neuroscience Seminar Series	2013
19. University of Wisconsin, Milwaukee, Dept. of Neurobiology	2013
20. Cornell University, Distinguished Speaker Series, BBS Seminar	2013
21. Grand Rounds, Northwestern Department of Psychiatry	2013
22. University of Washington, Seattle, Dept. of Computer Science & EE	2012
23. iRobot, Durham NC	2010
24. International Neuroethology Congress, Coupled Robot-Animal Systems	2010
25. Northwestern University Institute of Neuroscience Retreat, St. Charles IL	2009
26. Slivka Residence Hall Fireside Science Talk, Evanston IL	2009
27. Dept. of Engineering Sci., U. of Illinois Urbana-Champaign	2009
28. Division of Eng., & Dept. of Ecology and Evolutionary Biology, Brown University	2009
29. Dept. of Biomedical Engineering, University of California Irvine	2008
30. Program in Neuroscience and Cognitive Science, U. of Maryland, College Park, MD	2007
31. Dept. of Mechanical Engineering, Johns Hopkins, Baltimore MD	2007
32. Dept. of Philosophy, Univ. of Chicago, IL, USA	2006
33. Dept. of Physiology, Northwestern U. Feinberg School of Medicine, Chicago, IL	2006
34. IGERT Seminar Series, Machines & Organisms, Cornell University, Ithaca, NY	2006
35. Neuroscience Program, Michigan State University, East Lansing, MI	2005
36. Dept. of Electrical and Computer Engineering, Univ. of Illinois Chicago, IL	2005
37. Neuroscience Program, Univ. of Illinois Urbana-Champaign, IL	2005
38. Dept. of Biology, McGill University, Montreal, QC	2005
39. Dept. of Physical Therapy & Human Movement Sci., Northwestern Univ.	2005
40. Dept. of Aeronautics and Astronautics, Univ. of Washington, Seattle, WA	2005
41. Committee on Computational Neuroscience, Univ. of Chicago, IL	2005
42. Evolutionary Discussion Group, Northwester Univ., Evanston, IL	2004
43. Sensory Motor Performance Program, Rehabilitation Institute of Chicago, IL	2003
44. IGERT Program on Dynamics of Complex systems, Evanston, IL	2003
45. Northwestern University Institute of Neuroscience, St. Charles, IL,	2003
46. Sloan Theoretical Neurobiology Seminar Series, Caltech, Pasadena CA	2002
47. Caltech Bioengineering Seminar Series, Caltech, Pasadena CA	2001
48. Beckman Institute Visualization Seminar Series, Urbana, IL	1998

### Contributed Academic Talks and Selected Posters

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- 1) 2026 International Congress of Neuroethology (3 submissions; poster or talk)
- 2) 2022 International Congress of Neuroethology (poster)

- 3) 2020 Neuromatch v3 (two talks)
- 4) 2019 Bernstein Conference on Computational Neuroscience (poster & talk)
- 5) 2019 Cognitive Computational Neuroscience (poster)
- 6) 2019 Society for Neuroscience (2 posters)
- 7) 2018 J.B. Johnston Club for Evolutionary Neuroscience (talk)
- 8) 2018 Society for Neuroscience (talk)
- 9) 2018 International Congress of Neuroethology, Brisbane Australia (poster)
- 10) 2017 Adaptive Motion in Animals and Machines, Sapporo, Japan (poster)
- 11) 2016 J. B. Johnston Club for Evolutionary Neuroscience, San Diego, CA (talk)
- 12) 2016 Society for Vertebrate Paleontology, Salt Lake City, Utah (talk)
- 13) 2015 Adaptive Motion of Animals and Machines, MIT Cambridge MA (poster)
- 14) 2015 Society for Integrative and Comparative Biology, West Palm Beach FL (talk+poster),
- 15) 2013 Janelia Farms, Dynamics of Prey Capture and Escape (1 talk, 1 poster)
- 16) 2013 Society for Integrative and Comparative Biology, San Francisco (2 talks).
- 17) 2012 International Congress of Neuroethology, College Park, Maryland (2 posters).
- 18) 2012 International Conference on Intelligent Robots and Systems, Portugal (3 talks).
- 19) 2012 Fourth IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics, Rome Italy (talk)
- 20) 2012 First International Workshop on Robotic Electrosense (3 posters, 3 talks)
- 21) 2011 American Physical Society, 64<sup>th</sup> Annual Meeting (poster)
- 22) 2009 American Physical Society, 62<sup>nd</sup> Annual Meeting (talk, presenter: Curet; talk, presenter Shirgaonkar; talk, presenter: Patankar), Minneapolis, MN
- 23) 2009 Society for Neuroscience (poster), Chicago, IL
- 24) 2009 Society for Integrative and Comparative Biology (talk), Boston, MA
- 25) 2008 American Physical Society, 61<sup>st</sup> Annual Meeting (talk, presenter: MacIver) San Antonio, TX
- 26) 2008 American Physical Society, 61<sup>st</sup> Annual Meeting (talk, presenter: Curet) San Antonio, TX
- 27) 2008 American Physical Society, 61<sup>st</sup> Annual Meeting (talk, presenter: Shirgaonkar) San Antonio, TX
- 28) 2008 American Physical Society, 61<sup>st</sup> Annual Meeting (video submission to Gallery of Fluid Motion, San Antonio, TX
- 29) 2007 American Physical Society, 60<sup>th</sup> Annual Meeting (talk, presenter: MacIver), Salt Lake City, UT
- 30) 2007 American Physical Society, 60<sup>th</sup> Annual Meeting (talk, presenter: Shirgaonkar), Salt Lake City, UT
- 31) 2007 American Physical Society, 60<sup>th</sup> Annual Meeting (talk, presenter: Curet), Salt Lake City, UT
- 32) 2007 American Physical Society, 60<sup>th</sup> Annual Meeting (poster, presenter: Curet), Salt Lake City, UT
- 33) 2007 International Congress of Neuroethology, Vancouver BC (talk)
- 34) 2007 International Congress of Neuroethology, Vancouver BC (poster)

- 35) 2007 International Congress of Neuroethology, Vancouver BC (poster)
- 36) 2007 International Congress of Neuroethology, Vancouver BC (poster)
- 37) 2007 IEEE International Conference on Robotics and Automation, Rome, Italy (talk)
- 38) 2006 Biomedical Engineering Society, Chicago, IL
- 39) 2006 Society for Neuroscience, Atlanta, GA (poster)
- 40) 2006 American Physical Society, 59th Annual Meeting, with Neelesh Patankar and Oscar Curet, Tampa, FL (talk, presenter: Shirgaonkar)
- 41) 2006 American Physical Society, 59th Annual Meeting, with Oscar Curet and Neelesh Patankar, Tampa, FL (talk, presenter: MacIver)
- 42) 2005 Developmental Basis of Evolutionary Change, Chicago, IL (poster)
- 43) 2005 Developmental Basis of Evolutionary Change, Chicago, IL (poster)
- 44) 2005 Joint Dept of Neurology and Biomedical Engineering Poster Session (with T. Kuiken & A. Schultz), Chicago, IL (poster)
- 45) 2005 Southern California Joint Symposium on Computational Neuroscience (with J. Burdick), California Institute of Technology, Pasadena CA (talk)
- 46) 2005 Neural Engineering Workshop (with J. Snyder), Chicago IL
- 47) 2004 International Soc. Neuroethology, Nyborg, Denmark (with J. Burdick & M. Nelson) (poster)
- 48) 2002 Gordon Research on Sensory Coding and the Natural Environment (with M. Nelson), South Hadley, MA (poster)
- 49) 2001 International Soc. Neuroethology, Bonn, Germany (poster with M. Nelson)
- 50) 2000 Society for Neuroscience 30th Meeting, New Orleans LA (poster with M. Nelson)
- 51) 1999 Computation and Neural Systems Meeting (CNS), Pittsburgh, PA (poster with M. Nelson)
- 52) 1998 International Soc. Neuroethology, San Diego, CA (poster with M. Nelson)
- 53) 1997 Society for Neuroscience 27th Meeting, New Orleans, LA (poster with M. Nelson)
- 54) 1996 Computation and Neural Systems Meeting (CNS), Boston, MA (poster with M. Nelson)
- 55) 1995 Society for Neuroscience 25th Meeting, San Diego, CA (poster with M. Nelson)

## Public Engagement

### Select movie and TV Series Science Advising

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2025 Advisor, American Film Institute, *The End is At Hand*  
 2022 Advisor, American Film Institute, *When the Forests Burn*  
 2021 Advisor, American Film Institute, *Children of Change*  
 2015 Advisor, *Terminator Genisys*  
 2015 Advisor, *The Avengers: Age of Ultron*  
 2013 Advisor, *Superman, Man of Steel*  
 2010 *Tron Legacy*

2009-2010 Robotics & science script consultant for SyFy Channel's prequel to Battlestar Galactica, *Caprica*, Seasons 1 & 2. Collaborators: Jane Espenson and Michael Taylor.

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### ***Public Lectures/Interviews***

- 2025 BBC Horizon, "Secrets of the Brain," Episodes 1&2. Initial broadcast on Sept 15 2025 in the UK on BBC Two. [Link to video of Episode 1: My portion starts at 33:46.](#)
- 2018 New Zealand Science Festival, Dunedin New Zealand. [Robots: The New Generation.](#)
- 2016 reddit "Ask Me Anything" [PLOS Science Wednesday](#), on our PLOS paper on the convergent evolution of mechanically optimal swimming.
- 2015 Northwestern University, Lawrence B. Dumas Domain Dinner on New Technologies That Will Be Transformative. Talk title: *Engineering Empathy*
- 2015 Chicago Museum of Science and Industry, public talk on Electric Fish Robotics in association with their new exhibition on robotics, *Robot Revolution*.
- 2014 Chicago Council on Science and Technology talk and panel discussion on *The Future of Work*. [Video at this location](#) (<https://www.youtube.com/watch?v=PcQ68vTPXb4>)
- 2014 PBS TV affiliate WTTW panel discussion on the *Future of Work*, Chicago Tonight. [Video at this location](#) (<http://chicagotonight.wttw.com/node/17033>)
- 2014 *Big Data in Neuroscience*, talk for the Shirley Ryan Learning for Life Series.
- 2014 *Cheetahs, Fish, Fingers & Bacteria: The coming menagerie of mechanical cohabitants*. Panel discussion for the Adler Planetarium public event "Hops'n Bots", with Sangbae Kim (MIT), Antonio Bicci (University of Pisa), and Bradley Nelson (ETH Switzerland).
- 2014 *The Future of Artificial Intelligence*, interview with the creators of the CBS TV Series *Person of Interest* for Season 3 DVD Extra. [Video at this location](#), at two minutes forty seconds ([https://www.dropbox.com/s/2hlp6805vgbwee0/PERSON\\_OF\\_INTEREST\\_S3\\_DISC\\_6.m4v?dl=0](https://www.dropbox.com/s/2hlp6805vgbwee0/PERSON_OF_INTEREST_S3_DISC_6.m4v?dl=0))
- 2014 BBC World Service (Interview) on developing robotic fish.
- 2014 BBC Radio 5 (Interview) on the development of a robot fish.
- 2014 BBC *Amazon electric fish inspire underwater robotics*. [Story and video at this location](#) (<http://www.bbc.com/news/science-environment-26025563>).
- 2013 Interview by Jennifer Ouellette for the show *Virtually Speaking Science* on my biography, science advising to movie makers, and a variety of science topics.
- 2013 *Can We Expand Our Consciousness With Neuroprosthetics?* TEDx Caltech, January 2013. Pasadena CA. [Video at this location](#) (<https://www.youtube.com/watch?v=gj2zx1kEjKM&list=PLsRNoUx8w3rP8morYo0ZmBAwrEpJVr51X>)

- 2013 Discovery Science Channel, *Alien Encounters* Season 2, Episodes 1-2, Commentator, March 2013.
- 2012 *From electric fish to robot fish and back* PINC Conference, Amsterdam
- 2010-2012. Blogger on robotics, artificial intelligence, and neuroscience for Science Not Fiction, Discover Magazine. Links to posts above.
- 2011 “Death and the Powers” Public panel on the new robot opera by Tod Machover, with Tod Machover, March 2, 2011, Dean’s Seminar Series, McCormick School of Engineering, Northwestern University. Article and video: [http://www.mccormick.northwestern.edu/news/articles/archive/2009-2012/article\\_852.html](http://www.mccormick.northwestern.edu/news/articles/archive/2009-2012/article_852.html)
- 2011 *Science of Cyborgs* March 1, 2011, Directors Guild of America, Los Angeles CA. Talk on movie portrayals of robotics and androids, transhumanism, and the evolutionary basis of consciousness. Article and video of presentation
- 2011 Interview on NPR Chicago affiliate WBEZ *Clever Apes* radio program on the origin and history of consciousness.
- 2010 Interview on the National Academy of Engineering Innovation Podcast and Radio Series *Body Intelligence--Does all cleverness and intelligence come from our brains? That may seem logical, but may not be the case.*
- 2010 Science Café “The Evolution of Consciousness” March 17, 2010, Firehouse Grill Evanston IL.
- 2010 Interview on NPR Chicago affiliate WBEZ *Clever Apes* radio program on the electric fish art installation “scale”. [Story and audio here](#)
- 2009-2010 Blogger for the Science in Society Blog, Feinberg School of Medicine.
- 2009 Lecturer for the Illinois Science Council’s Science Café “Body Electric: Lightning, defibs, and Tasers” at Lucky Strike (AMC Theater Building), 322 E Illinois St., Chicago IL.
- 2003 NSF High School Teacher Program, worked with a Los Angeles inner city school district teacher to bring biofluids research to high schools
- 2003 NSF & Caltech sponsored art show, Williamson Gallery in Pasadena, interactive art installation on active sensing with Simon Penny. More details at <http://www.neuromech.northwestern.edu/uropatagium/#ArtSci>

*Select Blog Posts*

- B37. Information Wants to Be Free. What About Killer Information? Discover Magazine Online. Dec 27, 2011.
- B36. The Geek Rapture and Other Musings of William Gibson Discover Magazine Online. Oct 17, 2011.
- B35. Why Did Consciousness Evolve, and How Can We Modify It, Pt. III: Memory, Communication, and Perception [Discover Magazine Online. Aug 8, 2011.](#)
- B34. Why Did Consciousness Evolve, and How Can We Modify It, Pt. II: The Supremacy of Vision [Discover Magazine Online. Mar 23, 2011.](#)
- B33. Why Did Consciousness Evolve, and How Can We Modify It? [Discover Magazine Online. Mar 14, 2011.](#)
- B32. Transhumanism: A Secular Sandbox for Exploring the Afterlife? Discover Magazine Online. Feb 28, 2011.
- B30. A Robots That Evolve Like Animals Are Tough and Smart—Like Animals Discover Magazine Online. Feb 14, 2011.
- B29. A Does AI Need Guts to Get to the Singularity? Discover Magazine Online. Feb 2, 2011.
- B28. A New Robot for the Bestiary: How to Build a Robotic Ghost Fish Discover Magazine Online. Jan 26, 2011.
- B27. The Real-Life District 9—Class and Sci-Fi in South Africa Discover Magazine Online. Jan 12, 2011.
- B26. Would Death Be Easier If You Know You've Been Cloned? Discover Magazine Online. Dec 27, 2010.
- B25. Killing The Dr. Evils of Iran: Is it Open Season On Scientists? Discover Magazine Online. Nov 30, 2010.
- B24. How to Conduct the World's First Electric Fish Orchestra Discover Magazine Online. Nov 23, 2010.
- B23. Mutants, Androids, Cyborgs and Pop Culture Films Discover Magazine Online. Nov 2, 2010.
- B22. Electric Fish "Plug in" and Turn Their Zapping Into Music Discover Magazine Online. Oct 23, 2010.
- B21. Caprica Puzzle: If a Digital You Lives Forever, Are You Immortal? Discover Magazine Online. Oct 5, 2010.
- B20. I Have Seen the Furniture, and It Is Robotic, Discover Magazine Online. Sept 28, 2010.

- B19. A Robot Science Fiction and the Modding of Our Future, Discover Magazine Online. Sept 22, 2010.
- B18. A Robot That Tries To Rock You Asleep, Discover Magazine Online. Sept 14, 2010.
- B17. Is AI More Common Than Biological Intelligence Across the Universe?, Discover Magazine Online. Aug 31, 2010.
- B16. The New AI: Turn Robots Into Infant Scientists, Discover Magazine Online. Aug 25, 2010.
- B15. Amplifying Our Brain Power Through Better Interactive Holographics, Discover Magazine Online. Aug 10, 2010.
- B14. Inception and the Neuroscience of Sleep, Discover Magazine Online. Aug 10, 2010.
- B13. Why Keep Your Body? Help Yourself to Big Muscles, Cyborg Limbs, and a Big Booty, Discover Magazine Online. Jul 27, 2010.
- B12. When Sci-Fi Plays Play With Your Identity, Discover Magazine Online. Jul 19, 2010.
- B11. Hairshirted Eye for the Irritable Guy: New Study Shows How the Feel of Things Affects Thought, Discover Magazine Online. Jul 7, 2010.
- B10. IBM Computer Fails the Turing Test But Just Might Pass the Jeopardy Test. Science Not Fiction Blog, Discover Magazine Online. June 28, 2010.
- B09. The Animal Superpower That Robots Would Love to Have: Great Efficiency. Science Not Fiction Blog, Discover Magazine Online. June 18, 2010.
- B08. Guest Post: Malcolm MacIver on War with the Cylons. Sean Carroll's Blog, April 26 2010.
- B07. Are we 'wired for war' with cylons? Science and Society Helix Blog, Feb 11, 2009.
- B06. "A scary thing happened" --- How to make child's play of disasters. Science and Society Helix Blog, June 5, 2009.
- B05. Homeopathy and the limits of science. Science and Society Helix Blog, April 5, 2009.
- B04. Is it time to shut down the national center for complementary and alternative medicine (NCCAM)? Science and Society Helix Blog, March 23, 2009.
- B03. The Science Entertainment Exchange, Pt II. Science and Society Helix Blog, Feb 25, 2009.
- B02. The Science Entertainment Exchange, Pt II. Science and Society Helix Blog, Feb 25, 2009.
- B01. The Science Entertainment Exchange, Pt II. Science and Society Helix Blog, Feb 25, 2009.

## Trainee Fellowships

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2022- Gabbie Wink, National Defense Science and Engineering Graduate Fellowship  
2021-2023 Alexander Lai, Neurobiology of Information Storage Training Program  
2013-2016 Kiran D. Bhattacharyya, NSF Graduate Fellowship  
2013-2015 Matt Green, NSF Postdoctoral Fellowship  
2006-2010 Oscar Curet, Diversifying Higher Education Faculty in Illinois Graduate Fellowship

## Mentoring

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### Postdoctoral Associates

#### Current:

Christopher F. Angeloni (co-mentored with Dan Dombeck)

#### Past:

German Espinosa, 2023-2024.

Matthew Hobson Green (Co-supervised with David McLean), 2015-2016. Current position: Data scientist at Nordstrom.

Srinivas Ramakrishnan (Co-supervised with N. Patankar), 2009. Current position: Senior Software Developer at ANSYS, Inc.

Anup Shirgaonkar (Co-supervised with N. Patankar), Current position: Quantitative Strategist in Investment Management, Quantitative Machines.

Claire Postlethwaite (Co-supervised with M. Silber), 2006-Jun 2008: Associate Professor, University of Auckland, New Zealand.

### Graduate Students

#### Current (PhD):

Alexander Lai, Biomedical Engineering

Gabrielle Wink, Mechanical Engineering

Finn Petrie, Mechanical Engineering

#### Past (PhD):

German Espinosa, Computer Science. Current position: Postdoctoral scholar, Malcolm MacIver and Dan Dombeck.

Ugurcan Mugan, Biomedical Engineering. Current position: Postdoctoral scholar, David Redish laboratory.

Kiran D. Bhattacharyya, Biomedical Engineering. Current position: Robotics engineer, Intuitive Surgical.

Chen Chen, Biomedical Engineering. Current position: Sensor technologies, Apple Computer.

Yang Bai, Mechanical Engineering (with Michael Peshkin). Current position: Engineering Manager, Meta AI division.

Izaak Neveln, Biomedical Engineering. Current position: Caterpillar Inc. Machine Learning in Logistics.

Brad Patterson, Northwestern University Interdepartmental Neuroscience Program. (with David McLean). Current position: In training to be a US Army intelligence officer.

James Snyder, Biomedical Engineering. Current position: Engineering consultant and technology developer for embedded systems.

Rahul Bale, Mechanical Engineering (with Neelesh Patankar). Current position: Postdoc, RIKEN, Japan.

Oscar Curet (with N. Patankar), Mechanical Engineering (2003-2009). Current position: Assistant Professor, Department of Ocean and Mechanical Engineering, Florida Atlantic University, Boca Raton.

Michael Epstein, Mechanical Engineering (with E. Colgate) (2003-2007). Current position: Consulting.

James Solberg, Mechanical Engineering (with K. Lynch) (2003-2007). Current position: Senior Controls Engineer, HDT Expeditionary Systems Inc., Evanston IL.

Northwestern University Interdepartmental Neuroscience Program PhD Student 3 Month Rotations: Mark Agrios (2021), Sam Minkowicz (2017), Chris Mullens (2010), Ricardo Ruiz-Torres (2009), Lydia Wood (2005), Brian London (2004)

### **Masters students**

#### **Current:**

Joe Brock (Neuroscience M.S. Program)

#### **Past:**

Logan Boswell (Robotics, Professional Masters, 2025)

Maximiliano Palay (Robotics, Professional Masters, 2024)

Dilan Wijesinghe (Robotics, Professional Masters, 2023)

Kailey Smith (Robotics, Professional Masters, 2022)

Senthil Palanisamy (Robotics, Professional Masters, 2021)

Levi Todes (Robotics, Professional Masters, 2019)

Michael Wiznitzer (Robotics, Professional Masters, 2018)

Luke Shi (Robotics, Professional Masters, 2018)

Abhishek N. Patil (Robotics, Professional Masters, 2016)

Sandra Fang, Mechanical Engineering (2014-2016), Current position: JPL.

Ritwik Ummalneni (Robotics, Professional Masters, 2016)

Sun Yue (Robotics, Professional Masters, 2015)

Yoni Silverman, Mechanical Engineering (2010-2013). Current position: Research engineer at a Chicago area nuclear power controls company.

Aimee Schultz, Mechanical Engineering (2004-2007). Current position: Self-employed academic science paper writer.

Thesis Committees (PhD/MS candidates)

Luke Strgar, Department of Mechanical Engineering, PhD

Quinn Beato, Department of Biomedical Engineering, PhD

Ruize Yang, Northwestern University Interdepartmental Neuroscience Program, PhD

Ryan Lu, Northwestern University Interdepartmental Neuroscience Program, PhD

Daniel Bennett, Northwestern University Interdepartmental Neuroscience Program, PhD

Analisa Taylor, Department of Mechanical Engineering, PhD

Zachary Laswick, Department of Biomedical Engineering, PhD

Feng Xuan, Department of Neurobiology, PhD

Amy Kristl, Department of Neurobiology, PhD

Sam Minkowicz, Department of Neurobiology, PhD

Hannah Emnett, Dept. of Mechanical Engineering, PhD

Brad Radvansky, Neurobiology, PhD

Tommy Berrueta, Mechanical Engineering, PhD

Georgios Mamkoukas, Mechanical Engineering, PhD

Ana Pervan, Mechanical Engineering, PhD

Meagan Bechel, Biomedical Engineering, PhD

Peter Winter, Chemical and Biological Engineering, PhD

Thomas Harmon, Northwestern Interdepartmental Neuroscience Program, PhD

David Meyer, Mechanical Engineering, PhD

James Aaron Ellis, Biomedical Engineering, MS

Mao Mao, Mechanical Engineering, PhD

Elliot Johnson, Mechanical Engineering, PhD

Matthew Geary, Biomedical Engineering PhD

Brian London, Northwestern Interdepartmental Neuroscience Program PhD

Dhwanil Damania, Biomedical Engineering MS

Vladimir Turzhitsky, Biomedical Engineering PhD

Hariharan Subramanian, Biomedical Engineering PhD

Lexyne McNealy, Department of Physical Medicine and Rehabilitation MS

Michael Siegel, Biomedical Engineering MS

Albert Chen, Biomedical Engineering, PhD

### Undergraduate Students

2025- Izzy Bider, BME

2024- Jiayi Yu, IBIS

2023- Joshua Chi, Neuroscience

2022-2025 Judith Marciano, Neuroscience

2023-2024 Sydney Schulz

2023-2024 Maya Pandya

2023-2024 Joe Wood

2023-2024 Aria Ruan

2022-2024 Lily Browdy, Neuroscience

2021-2023 Ben Zitzewitz, Mechanical Engineering

2021-2022 Ryan O'Patka, CS and Neurobiology

2021-2023 Anthony Ryan, Theater and CS

2022-2023 Max Mcune, Mechanical Engineering

2021-2023 Sam Griswold, Mechanical Engineering

2016-2017 Alfred Astor, Mechanical Engineering & Neurobiology

2015-2016 Jonathan Denose (Electrical Engineering, URM), Michael Smith (Computer Science, URM), Nicholas Ohl (Biomedical Engineering).

2013-2015 Scott Schaper, Mechanical Engineering

2014 Adam Birnbaum

2012-2014 Alexandra Faye Salomon, HHMI Mentoring Fellows Program

2011-2013 Aliza Abraham, Integrated Science Program

2010-2011 Ethan Coffel, Computer Engineering and Integrated Science Program

2010 Leland Gossett, Biomedical Engineering (**Scale** project)

2010 Chris Semple, Biomedical Engineering (**Scale** project)

2010-2011 Kyle Liske, Mechanical Engineering (**Scale** project)

2009-2010 Uzair Admani, Biomedical Engineering  
 2009-2010 Omar Hassan, Biomedical Engineering  
 2009 Aravinda Gunda, SINE Intern, George Washington University  
 2008-2009 Jad Carson, Biomedical Engineering  
 2008-2009 Benjamin Proznitz, Dept. of Eng Sci and Applied Math  
 2007-2008, Jangir Selimkhanov, Dept. of Eng Sci and Applied Math  
 2007-2008, Alec Zopf, Dept. of Biomedical Engineering  
 2006-2007 Irene Chiang, Dept. Biochemistry, Molecular, and Cell Biology  
 2006-2007 Alfred Shoukry, Biomedical Engineering  
 2006-2007 Vicky Huang, Biomedical Engineering  
 2005-2006 Clif Lin, College of Arts and Science, Northwestern (with T. Kuiken)  
 2004-2007 Tiffany Keung, Biomedical Engineering, Northwestern 2003-2004  
 2004-2005 Marie Kyle, Mechanical Engineering, Northwestern (with E. Colgate)  
 2004-2005 Elana Green, Mechanical Engineering, Northwestern (with E. Colgate)  
 2004-2006 Colin Tan, Biomedical Engineering, Northwestern  
 2004-2005 Karin Stensvad, Mech Engineering, Washington University (with E. Colgate)  
 2004-2005 Beth Lapour, Mechanical Engineering, Northwestern (with E. Colgate)  
 2004-2005 Ani Chatterjee, Biomedical Engineering, Northwestern

## Teaching

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### Teaching-Northwestern University. Courses Developed:

Scientific and embedded programming with python (ME224).	2018-2025
Computational neuromechanics and neuroethology (BME 461)	2004-2020.
Neuromechatronics (BME 464)	2004-2012
Emergent Horizons (DSGN 495/ART 390, with Iñigo Manglano-Ovalle from Dept of Art Theory and Practice, Cross listed between School of Engineering and Dept of Art Theory and Practice)	2017
Risk (DSGN 495/ART 390, with Michael Rakowitz from Dept of Art Theory and Practice, Cross listed between School of Engineering and Dept of Art Theory and Practice)	2016
Water (DSGN 495/ART 390, with Michael Rakowitz from Dept of Art Theory and Practice, Cross listed between School of Engineering and Dept of Art Theory and Practice)	2015
Artists & Engineers Collaborate (DSGN 495, with Jeanne Dunning from Dept of Art Theory and Practice, Cross listed between School of Engineering and Dept of Art Theory and Practice)	2014

### Teaching-Northwestern University

Advanced systems physiology: Neuroscience (BME306)	2018-present
Great Experiments (team taught, Neuroscience Program 411-3)	2010-present

Decision-Making in the Wild (BME468)	2025-present
Scientific and embedded programming with python (ME224)	2018-2025
Analysis of Biological Systems (BME 306)	2015-2019
Design Thinking and Communication (DTC)	2013-2018
Professional Essentials (ME 513)	2008-2024
“Experimental Engineering” (ME 224)	2007-2017
Introduction to Biomechanics (BME 271)	2009-2013
IDEA 298 Faculty Advisor for Submersible Team	2007
“Honors Eng. Analysis 3”	2004-2006

### Other Teaching

University of Otago, Dunedin NZ, The evolution of planning, Zool 314, Zool 412, Jul 11 & Jul 13 2018.

Zygon Center for Religion and Science, Chicago IL, Situated Brain and Mind Seminar: “Situated Nervous Systems and Cognition” Feb 18, 2013.

Northwestern University, National High School Institute Cherubs, Theatre Arts Program, guest instructor for “Theatre for Nerds” elective, July 7-8, 2009.

Gulbenkian Research Institute, Portugal, “Normative Theories of Brain Function” Feb 2008

University of Chicago, guest lecturer, Dept. of Philosophy/HIPS, William Wimsatt

and John Haugeland, “Boundaries, Modules and Levels” Feb 2006

Guest lecturer, “Animal Behavior” Northwestern University 2004

### Teaching Prior to Northwestern University

University of Illinois, “Neurophysiology Laboratory” (PHYSL 416)	1/97-5/97
University of Illinois, “Topics in Neuroethology” (PHYSL 490)	8/96-12/96
University of Illinois, “Introduction to Neurobiology” (BIO 303)	8/94-12/94
Indiana University, “Introduction to Philosophy” (P100)	1/94-5/94
Indiana University, “Introduction to Ethics” (P140)	9/92-12/92
University of Toronto, “How Computers are Used” (CSC104)	1/91-5/91
University of Toronto, “How Computers are Used” (CSC104)	9/91-12/91
University of Toronto, “Computer Programming” (CSC108)	9/90-12/90
University of Toronto, “Science and Pseudo Science” (PHL272)	1/89-7/89
Confederation College, Thunder Bay ON. Digital Electronics, Programming	1/86-4/86

### Service

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### Memberships

International Society of Neuroethology

The J.B. Johnston Club for Evolutionary Neuroscience

Society for Neuroscience  
Institute of Electrical and Electronics Engineers  
American Physical Society

### Scientific Review Panels

NSF Ad-Hoc for Animal Sensation and Movement, and Neural Cluster Program Panels, 2007-present; NSF Neural Cluster Program Panel Meeting, 2008; NSF Animal Sensation and Movement Program Panel Meeting, 2006; MIT Sea Grant College Program, 2006; NIH Sensorimotor Integration Study Section, 2004.

### Conference Organization

Organizer: 10<sup>th</sup> International Symposium on Adaptive Motion of Animals and Machines, 2018 Chicago IL.  
First International Workshop on Robotic Electrolocation, August 3 2012, College Park Maryland.  
International Society for Neuroethology Symposium “Coupled Robot-Animal Systems,” Spain 2010

### Reviewer for the Following *Journals* and Conferences

*Advanced Robotics*  
*Animal Biology*  
*Autonomous Robots*  
*Bioinspiration and Biomimetics*  
*Biological Cybernetics*  
*Behavioral and Brain Sciences*  
*Brain, Behavior, and Evolution*  
*Cell Reports*  
*Complexity*  
Cognitive Computational Neuroscience Conference  
*Current Biology*  
*eLife*  
*Frontiers in Behavioral Neuroscience*  
IEEE Conference on Robotics and Automation  
*IEEE Journal of Oceanic Engineering*  
*IEEE Proceedings*  
*IEEE Transactions on Robotics*  
*IEEE Sensors Journal*  
*Integrative and Comparative Biology*  
*International Journal of Robotics Research*  
International Conference on Artificial Neural Networks  
International Congress of Neuroethology  
*iScience*  
*Journal of Biomechanics*

*Journal of Comparative Physiology*  
*Journal of Experimental Biology*  
*Journal of Neuroscience*  
*Journal of the Royal Society Interface*  
*Journal of Visualized Experiments*  
*Nature Communications*  
*Neurocomputing*  
*Neuron*  
*Physical Biology*  
*PLoS Computational Biology*  
*PLoS Biology*  
*Proceedings of the National Academy of Sciences*  
*Proceedings of the Royal Society B*  
 Robotics Science and Systems  
*Science*  
*Science Robotics*

### Current/Past Advisory Boards

2015-2017 Advisory Board, European Union (H2020 Project no. 640967), a group of 14 scientists from Italy, Austria, Belgium, Croatia, Germany, and France building a swarm of autonomous underwater robots.

2007-2013 FILOSE Advisory Board Member (of three). FILOSE (Robotic FIsh LOcomotion and SEnsing) is a FP7-ICT-2007-3 STREP research project financed by the European Union 7th Framework Program, headed by the Tallinn University of Technology in Estonia, with partners Riga Technical University of Latvia, the Italian Institute of Technology in Genova, and the Universities of Verona and Bath UK. Web site: [http://www.biorobotics.ttu.ee/tikiwiki\\_filose/tiki-index.php](http://www.biorobotics.ttu.ee/tikiwiki_filose/tiki-index.php).

### University Service

2026-	McCormick Engineering Strategic Plan Steering Committee for Embodied AI
2024-	Theme Leader for Prediction and Anticipation, National Institute for Theory and Mathematics in Biology
2022-	BME Graduate Program Committee
2018-2025	Promotion and Tenure Committee, McCormick School of Engineering
2019-2024	Office for Research Limited Submissions Advisory Committee
2021-2024	Academic Standing Committee, School of Engineering, Northwestern
2019-2021	Research Integrity Committee, Northwestern University
2016-2020	Dept. of Biomedical Engineering, Director of Graduate admissions
2015-2019	BME Undergraduate Program Committee, Faculty Community Committee
2009-2020	Tech and Ford Safety Committee, Safety Officer for Department of Biomedical

	Engineering and Department of Mechanical Engineering
2015	Interviewee for Program Review of the Department of Neurobiology
2014-2015	Northwestern Neuroscience Proposed Major Steering Committee
2011-2013	Faculty Senate representative, Department of Biomedical Engineering Faculty Senate Committee Chair, Secure Faculty Survey
2009-2013	Committee on Animal Resources
2011	Northwestern Interdepartmental Neuroscience Program Review Committee
2009-2010	Freshman Advising
2008-2009	BME Admissions Committee NUIN Student Interviews Organized and ran the ME Dept. Professional Skills graduate seminar series Freshman Advising
2007-2008	ME Control and Manufacturing Search Committee Organized and ran the ME Dept. Professional Skills graduate seminar series Interdisciplinary Committee on Evolutionary Processes NUIN Student Interviews
2006-2007	ME Target of Opportunity Ad-hoc Hiring Committee Department of Neurobiology and Physiology Hiring Committee ME Undergraduate Laboratory Course Renewal Committee NUIN Admissions Committee Interdisciplinary Committee on Evolutionary Processes
2005-2006	Dept. of Neurobiology and Physiology & Department of Physics and Astronomy Hiring Interdepartmental Hiring Committee Dynamics and Complex Systems IGERT, managed seminar series on the Mechanics of Locomotion
2004-2005	BME Departmental Website Faculty Liaison BME Graduate Student Admissions Committee BME Web Site Faculty Liason BME/Department of Physical Medicine and Rehabilitation Neural Engineering Hiring Committee BME/RIC Neural Engineering Hiring Committee ME/BME Neural Engineering Hiring Committee NUIN Retreat Planning Committee
2002-2003	Research Data Integration and Assessment System Development Committee Summer Minority Undergraduate Research Program mentor, Caltech

### Select Media Coverage

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2025 BBC Horizon, “Secrets of the Brain,” Episodes 1&2. Initial broadcast on Sept 15 2025 in the UK on BBC Two. [Link to video of Episode 1. My portion at 33:46.](#)

2019 Sean Carroll's Mindscape Podcast, Episode 39: [Malcolm MacIver on Sensing, Consciousness, and Imagination](#).

2018 Radio New Zealand, Our Changing World. Robots - Nao and the Bristlebots. Interview with Mike Paulin by Allison Ballance on our New Zealand Science Festival engagement in Dunedin New Zealand on July 12, 2018. <https://www.radionz.co.nz/national/programmes/ourchangingworld/audio/2018653987/robots-nao-and-the-bristlebots>

2018 New Zealand Herald. Robot butlers: Don't expect them any time soon. Interview with Jamie Morton. [https://www.nzherald.co.nz/nz/news/article.cfm?c\\_id=1&objectid=12086561](https://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=12086561)

2018 When Stunning Won't Kill, Fish Use Electricity to Communicate. <https://www.insidescience.org/news/when-stunning-wont-kill-fish-use-electricity-communicate>

2017 SciTechNow, PBS TV. Interview by Hari Sreenivasan on PNAS study about why fish came on to land 385 million years ago, initial broadcast July 24 2017. <http://www.scitechnow.org/videos/data-reveals-long-ago-fish-made-leap-onto-land/>

2017 Fish Changed in a Surprising Way Before Invading Land. Ed Yong, The Atlantic Online, March 8 2017. <https://www.theatlantic.com/science/archive/2017/03/in-the-invasion-of-land-big-eyes-came-before-strong-legs/518883/>

2017 Why Did Life Move to Land? For the View. Jennifer Ouellette, Quanta Magazine, March 7, 2017. <https://www.quantamagazine.org/why-did-life-move-to-land-for-the-view-20170307/>

2015 ASME Mechanical Engineering Magazine. Ghost Knifefish in the Machine. [https://www.dropbox.com/s/qq7ndhk13hbfsyd/Ferb15a\\_electrosense\\_ASME.pdf?dl=0](https://www.dropbox.com/s/qq7ndhk13hbfsyd/Ferb15a_electrosense_ASME.pdf?dl=0)

2015 New York Times Science Take (Video + Article) The Right Ratio to Engineer a Swim. <http://www.nytimes.com/2015/05/11/science/the-right-ratio-to-engineer-a-swim.html>.

2015 Washington Post. How 22 diverse ocean creatures ended up using the same swim stroke. <http://www.washingtonpost.com/news/speaking-of-science/wp/2015/04/28/how-22-diverse-ocean-creatures-ended-up-using-the-same-swim-stroke/>

2015 Los Angeles Times. Would animals swim differently on an alien planet? <http://www.latimes.com/science/sciencenow/la-sci-sn-swimming-animals-convergent-evolution-ocean-bioinspired-alien-20150428-story.html>

2015 PLOS Biology Perspective Convergence on an Optimal Way to Swim, DOI: 10.1371/journal.pbio.1002124. <http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1002124>

2015 Journal of Experimental Biology Perspective, Life converges on solutions to swim optimally. <http://jeb.biologists.org/content/218/17/2663.2.full>

2015 CBS. Movements of fish, bats inspire next-gen robots. <http://www.cbsnews.com/news/movements-of-fish-bats-could-inspire-better-robots/>

2014 Entertaining Science—Scientific advisers for films and television help to bring credibility to the screen — and take some tangible and intangible benefits back to the lab. *Nature*, 3 July 2014, vol 511, p. 113-114. <http://www.nature.com/naturejobs/science/articles/10.1038/nj7507-113a>

2014 How Does a Chicken Tell Time? The New Yorker <http://www.newyorker.com/tech/elements/how-does-a-chicken-tell-time>

2014 Electric Eels Use Their Zaps to Remotely Control Prey. *Popular Mechanics*. <http://www.popularmechanics.com/science/animals/a13205/this-is-what-an-electric-eel-shocks-does-17493859/>

2014 Entertaining Science—Scientific advisers for films and television help to bring credibility to the screen — and take some tangible and intangible benefits back to the lab. *Nature*, 3 July 2014, vol 511, p. 113-114.. <http://dx.doi.org/10.1038/nj7507-113a>

2014 BBC TV: Robot builders inspired by animal kingdom. <http://www.bbc.com/news/science-environment-26222542>

2013 PBS Chicago affiliate WTTW Scientific Chicago with Neil Shubin on development of our electric fish robot. <http://chicagotonight.wttw.com/2013/11/26/scientific-chicago-neil-shubin>

2012 Popular Mechanics, “Meet the Scientists who Make Science Believable” Jan 17, 2012. <http://www.popularmechanics.com/culture/movies/a11747/scientific-advisors-to-the-stars/>

2011 New York Times, “A Beijing Exhibition on Art for the 'Post-Human Era', August 11, 2011. <http://www.nytimes.com/2011/08/12/arts/12iht-translife12.html>.

2011 Profile by the National Academy of Science’s **Science Entertainment Exchange**, June 2, 2011. <http://bit.ly/j3lcPX>.

2011 Written By, April/May 2011. The science and fiction toybox, by Louise Farr. Magazine article on work with science fiction movie and TV makers by the trade magazine of the writer’s guild of America.

2011 Video press release on new fish robot and results published in J. Royal Society Interface (2010), <http://bit.ly/ZKM8h>.

2010 Fast Company. Robotic ghost knifefish swims in every direction, causes brainiacs to high-five. <http://www.fastcompany.com/1718785/robotic-ghost-knifefish-swims-every-direction-causes-brainiacs-high-five-video>

2010 MSNBC. Electric fish could be model for underwater robots. [http://www.nbcnews.com/id/40787244/ns/technology\\_and\\_science-innovation/t/electric-fish-could-be-model-underwater-robots/-\\_Vgb9prR6ejk](http://www.nbcnews.com/id/40787244/ns/technology_and_science-innovation/t/electric-fish-could-be-model-underwater-robots/-_Vgb9prR6ejk)

2010 Wired Magazine. Black Ghost Knifefish Robot Unmasks Movement Secrets. <http://www.wired.com/2010/12/robot-fish-ribbon-fin/>

2010 National Association of Engineering, Engineering Innovation Podcast and Radio Series. Body Intelligence. Broadcast on WTOP in Washington DC on March 21, 2010. Does all cleverness and intelligence come from our brains? That may seem logical, but may not be the case.

2010 Interview on Tron and Caprica involvement: Engineering Professor and Caprica Science Consultant Malcolm MacIver. ScriptPhD

2010 C is for Caprica. Story on involvement with Caprica show. National Academy of Science Science Entertainment Exchange.

2010 Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana Champaign Alumni Profile <http://is.gd/a8iCT>.

2010 Northwestern University News: Robotics Expert Lends a Hand in 'Caprica' <http://is.gd/a8jTI>.

2009 ProPublica: “Stimulus for Cotton Candy, Tango and a Fish Orchestra? Wacky, or Actually Worthy?” <http://is.gd/4O7Vs>

2009 A Shark’s Sixth Sense (interview on electroreception in sharks for Shark Week). Chicago Tribune, August 6 2009, <http://tinyurl.com/nfsq9u>, and Feinberg Science and Society featured article <http://tinyurl.com/lahfv5>.

2007 Robotic submersibles take on fish-like sensing abilities. **engadget** technology blog <http://tinyurl.com/37pvm4>.

2007 Electric fields could give subs ‘fish-like’ sense. New Scientist Tech 2007 <http://tinyurl.com/m27oxo>.

2003 Avant science; Artists and scientists both think creatively, so why not match them in projects showcasing new research? In Pasadena, the results have been adventurous. By Suzanne Muchnic *The Los Angeles Times*. Los Angeles, CA, USA, Feb 16 2003. page E.41, <http://tinyurl.com/13uwbe>.

2003 What Is It Like To Be a Fish? By Margaret Wertheim, *LA Weekly*, Los Angeles, CA, USA. April 11, 2003, <http://tinyurl.com/ku8azp>.

2003 Neuro Art Show: *LA Weekly* Pick of the Week, May 9, 2003, <http://tinyurl.com/mkgaoj>.

2003 ‘Neuro’: Engineering Art and Science. By Lance Carlson, *Art Week*, July/August 2003, p. 24-25, <http://tinyurl.com/l9ee8d>.