BIOGRAPHICAL SKETCH

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NAME: Dora Angelaki

eRA COMMONS USER NAME (credential, e.g., agency login): angelaki

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
National Technical University of Athens, Greece	Diploma	1985	Electrical Engineering
University of Minnesota, Minneapolis, MN	M.S.	1989	Biomedical Engineering
University of Minnesota, Minneapolis, MN	Ph.D.	1991	Biomedical Engineering
University of Texas, Medical Branch, Galveston, TX	Postdoc	1992	Vestibular physiology
University of Zurich, Zurich, Switzerland	Postdoc	1993	Oculomotor system

A. Personal Statement

I am interested in understanding the circuits that implement neural computation and its links to AI. Our expertise covers a wide range of topics, including theory and modeling, psychophysics, and large-scale neural recordings in macaques and rodents. We have studied problems related to vision and self-motion perception in the real world—how vision interacts with signals from the inner ear and other sensorimotor cues to guide perception, action, and cognition in health and disease.

Over the years I have trained young scientists at all levels both within my own laboratory and as a part of the larger neuroscience community. I have previously served both as Graduate Program Director (Washington University) and as a Department Chair (Baylor College of Medicine). My mentoring philosophy is to match a trainee's interests with a project that will challenge them to solve an important scientific problem while building both computational and project-management skills of use no matter their next steps. At a lab level, I work actively to identify opportunities for synergies among trainees through collaboration while allowing trainees to maintain ownership of their particular project. Several of my previous trainees hold independent faculty positions in the US and abroad. Currently there are 3 graduate students and 6 postdoctoral fellows in our lab.

My research funding is primarily from the BRAIN Initiative, typically in close collaboration with theorists and data scientists. My current research interests focus on the online computations of naturalistic action/perception closed-loop tasks like navigation and foraging. Our experimental models include mouse, monkey and humans actively foraging in the real world or in virtual reality.

Pitkow X, Angelaki DE (2017) Inference in the brain: Statistics flowing in redundant population codes, **Neuron** 94(5):943-953. doi: 10.1016/j.neuron.2017.05.028. PMCID: PMC5543692.

Laurens J, Angelaki DE (2018) The Brain Compass: A Perspective on How Self-Motion Updates the Head Direction Cell Attractor. **Neuron** Jan 17;97(2):275-289. doi: 10.1016/j.neuron.2017.12.020. PMCID: PMC5777220.

B. Positions, Scientific Appointments, and Honors

Faculty Positions-Scientific Appointments

2018-	Professor, Center for Neural Science and Mechanical/Aerospace Engineering, New York University, NYC
2011-2018	Wilhelmina Robertson Professor, Department of Neuroscience, Baylor College of Medicine, Houston, TX (Department Chair: 2011-2016)
2011-2018	Professor, Department of Electrical Engineering and Psychology, Rice University, Houston, TX 2011-2016,
2003-2011	Alumni Endowed Professor of Neurobiology, Department of Anatomy and Neurobiology, Washington University Medical School, St. Louis, MO
1999-2002	Associate Professor, Department of Anatomy and Neurobiology, and Biomedical Engineering, Washington University, St. Louis, MO
1993-1999	Assistant and Associate Professor, Department of Surgery (Otolaryngology), Anatomy and Physiology, University of Mississippi Medical Center, Jackson, MS

Honors

2019	Swammerdam Lecture, Neurosciences Amsterdam-Rotterdam
2019	Trotter Lecture, Washington University, St Louis MO
2017	Helmholtz Lecture, Utrecht University, The Netherlands
2017	Rank Prize Lecture, European Conference on Visual Perception
2016	Plenary Lecture, Barany Society
2016	Walter Heiligenberg Lecture, Neuroethology Society
2016	Flexner Discovery Lecture, Vanderbilt University
2014	Elected Member of the National Academy of Sciences
2014	Elected Fellow of the American Academy of Arts and Sciences
2014	Elected to the International Neuropsychological Society
2013	Donders Lecture, Nijmegen University, The Netherland
2013	Keynote Lecture, Visual Sciences Society
2012	Pradel Award in Neuroscience, National Academy of Sciences
2011	Grass Lecture, Society for Neuroscience
2006	Halpike-Nylen medal, Barany Society
1996	Presidential Early Career Award for Scientists and Engineers
1992-1993	NIH Postdoctoral Fellowship (F32 DC-00092)
1990-1991	NASA Pre-doctoral Fellowship (NGT 50581)
1989-1991	University of Minnesota Fellowships (5 total over these years)

Other Experience and Professional Memberships

2017-2024	Horizon 2020/Synergy, European Research Council (ERC), Brussels
2017-2022	Welcome Trust Interview Review Panel, London, England
2014-2020	Scholar Award Committee, McKnight Foundation
2014-2020	Executive Committee for Simons Collaboration on the Global Brain, Simons Foundation
2013-2018	Editorial Committee, Annual Review of Vision Science
2012-2014	Elife, Board of Reviewing Editors
2011-2017	Human Frontier Science Program (HFSP) Selection Committee, Strasbourg, FRANCE
2011- 2016	Editorial Board, Multisensory Research
2011-2017	Sloan Foundation, Selection Committee
2009, 2010	NIH Pioneer Award, Selection Committee
2009-2012	NIH Sensorimotor Integration Study Section, Panel Member
2008-2014	Reviewing Editor, Journal of Neuroscience
2008-2012	Editorial Committee, Annual Review of Neuroscience
2008-2012	Reviewing Editor, Frontiers in Neuroscience
2006-2011	Human Frontiers Science Program, Grant Review Committee (adhoc yearly since then)
2006-2009	Society for Neuroscience, Publications Committee
2006-2008	Editorial Board, Journal of Neuroscience
2003-2009	Society for Neuroscience Program Committee, Chair (2007-2008)
2002-2008	Reviewing Editor, J. Neurophysiology
2002-2014	Editorial Board, J. Neurophysiology

2002- 2016 Selected for “Faculty for 1000 Editorial”
1999-2005 NIH Vision B/Central Visual Processing Study Section Panel Member
1999-2016 Editorial Board, Experimental Brain Research

C. Contributions to Science

Eye movements for planning and memory in navigation: Our most recent interest is in exploring how eye movements, and active sensing more generally, contribute to planning and memory during navigation and foraging. Our initial experiments have explored hippocampal activity in freely-moving macaques, multi-area cortical communication during virtual navigation, as well as the normative aspects of eye movements in planning and memory during virtual navigation.

Highlighted Publications (equal author contribution):*

Zhu S, Lakshminarasimhan KJ, Arfaei N, Angelaki DE (2022) Eye movements reveal spatiotemporal dynamics of visually-informed planning in navigation. **Elife** May 3;11:e73097. doi: 10.7554/eLife.73097. PMCID: PMC9135400.

Mao D, Avila E, Caziot B, Laurens J, Dickman JD, Angelaki DE (2022) Spatial modulation of hippocampal activity in freely moving macaques. **Neuron** Nov 3;109(21):3521-3534.e6. doi: 10.1016/j.neuron.2021.09.032. Epub 2021 Oct 12. PMCID: PMC8571030.

Lakshminarasimhan KJ, Avilla E, Neyhart E, DeAngelis GC, Pitkow X and Angelaki DE (2020) Tracking the mind's eye: Primate gaze behavior during virtual visuomotor navigation reflects belief dynamics. **Neuron** May 20;106(4):662-674.e5. doi: 10.1016/j.neuron.2020.02.023. Epub 2020 Mar 13. PMCID: PMC7323886.

Lakshminarasimhan KJ, Partsalis M, DeAngelis GC, Pitkow X* and Angelaki DE* (2018) A dynamic Bayesian observer model reveals origins of bias in visual path integration. **Neuron** 99(1):194-206.e5. doi: 10.1016/j.neuron.2018.05.040. Epub 2018 Jun 21. PMCID: PMC6188888.

Multisensory integration: My laboratory made fundamental advances toward understanding how vestibular signals can aid the visual system in improving heading perception, computing depth/distance, and distinguishing object-motion from self-motion. Our work demonstrated that when visual motion cues are combined with vestibular signals, perceptual accuracy and precision are improved. Furthermore, we identified neural correlates underlying these functions in a broad extrastriate circuit in the parietal cortex, finding that both perception and multisensory neurons combine cues optimally, consistent with theoretical predictions. This work opened new vistas for multisensory perception/action and provides a paradigm shift for understanding the neural correlates of real-world vision.

Highlighted Publications (equal author contribution):*

Drugowitsch J, DeAngelis GC*, Angelaki DE* and Pouget A* (2015) Maximizing the reward rate in multisensory decision-making. **Elife** Jun 19;4:e06678. doi: 10.7554/eLife.06678. PMCID: PMC4487075.

Drugowitsch J, DeAngelis GC, Klier EM, Angelaki DE*, Pouget A* (2014) Optimal multisensory decision-making in a reaction-time task. **Elife** Jun 14;3:e03005. doi: 10.7554/eLife.03005. PMCID: PMC4102720.

Zaidel A, Ma WJ, Angelaki DE (2013) Supervised calibration relies on the multisensory percept. **Neuron** 80(6):1544-57. doi: 10.1016/j.neuron.2013.09.026. PMCID: PMC3872253.

Oshiro T, Angelaki DE, DeAngelis GC (2011) A normalization model of multisensory integration. **Nat Neurosci.** 14(6):775-82. doi: 10.1038/nn.2815. PMCID: PMC3102778. News and Views by Churchland AK. Nat Neurosci. 14(6):672-3. doi: 10.1038/nn.2850.

Cerebellar and thalamo-cortical computation for spatial orientation: The vestibulo-cerebellum transforms raw vestibular signals into central estimates of head motion: tilt (i.e., orientation relative to gravity) and inertial acceleration. We have modeled and characterized how tilt and translation are encoded in Purkinje cells and interneurons of the vestibulo-cerebellum. Our laboratory focuses on computational aspects of this problem, including a proposed theoretical framework, as well as mathematical methods used to model how cerebellar neurons encode tilt and translation. We also pursued the experimental and statistical framework needed to identify which variables are encoded by individual cerebellar neurons and probe the underlying multisensory integration operations, taking

advantage of a prescribed computation that links cells, circuits, and function.

Highlighted Publications (equal author contribution):*

Angelaki DE, Ng J, Abrego AM, Cham HX, E Asprodini, Dickman JD, Laurens J (2020) A gravity-based three-dimensional compass in the mouse brain. **Nature Communications** Apr 15;11(1):1855. doi: 10.1038/s41467-020-15566-5.

Laurens J, Meng H, Angelaki DE (2013) Neural representation of orientation relative to gravity in the macaque cerebellum. **Neuron** 80(6):1508-18. doi:10.1016/j.neuron.2013.09.029. PMCID: PMC3872004. PMCID: PMC7160108.

Yakusheva T, Shaikh AG, Green AM, Blazquez PM, Dickman JD, Angelaki DE (2007) Purkinje cells in the posterior cerebellar vermis encode motion in an inertial reference frame. **Neuron** 54(6):973-85. doi:10.1016/j.neuron.2007.06.003. PMID: 17582336.

Angelaki DE, Shaikh AG, Green AM, Dickman JD (2004) Neurons compute internal models of the physical laws of motion. **Nature** 29;430(6999):560-4. PMID: 15282606.

Neural basis of three-dimensional (3D) vision: A fundamental function of the visual system is to construct a 3D representation of the scene from 2D retinal input. This egocentrically encoded representation must then become independent of our own orientation in the world. How and where this process happens in the brain was not well understood. We made major contributions to solving this problem by first identifying the neural basis of motion parallax and its relationship to binocular disparity in visual area MT, and then identifying the neural basis of visual slant and tilt in the caudal intraparietal area and area V3a of macaque monkeys. The four papers listed below correspond to our most recent contributions in this area.

Highlighted Publications (equal author contribution):*

Kim HR, Angelaki DE, DeAngelis GC (2015) A novel role for visual perspective cues in the neural computation of depth. **Nat Neurosci.** 18(1):129-37. doi: 10.1038/nn.3889. PMCID: PMC4281299.

Sunkara A, DeAngelis GC and Angelaki DE (2015) Role of visual and non-visual cues in constructing a rotation-invariant representation of heading in parietal cortex. **Elife** Feb 18;4. doi: 10.7554/eLife.04693. PMCID: PMC4337725.

Rosenberg A, Angelaki DE (2014) Reliability-dependent contributions of visual orientation cues in parietal cortex. **PNAS** 111(50):18043-8. doi: 10.1073/pnas.1421131111. PMCID: PMC4273418.

Rosenberg A and Angelaki DE (2014) Gravity influences the visual representation of object tilt in parietal cortex. **J Neurosci.** 34(43):14170-80. doi: 10.1523/JNEUROSCI.2030-14.2014. PMCID: PMC4205545.

Neural variability and contributions to sensory perception and decision-making: Individual sensory neurons in the brain often predict animals' choices in simple perceptual decision-making tasks. Many of these cells have neural thresholds, which quantify sensitivity to stimulus variations, which are of the same order of magnitude as psychophysical thresholds. Through multi-electrode recordings in multiple brain areas and computational modeling that considers inter-neuronal correlations and decision top-down signals, we found that noise correlations are widespread in subcortical vestibular networks. We used modeling to understand what this tells us about the underlying computations in cortical and subcortical areas.

Highlighted Publications (equal author contribution):*

Pitkow X, Liu S, Angelaki DE, DeAngelis GC, Pouget A (2015) How can single sensory neurons predict behavior? **Neuron** 87(2):411-23. doi: 10.1016/j.neuron.2015.06.033. PMCID: PMC4683594.

Liu S, Gu Y, DeAngelis GC and Angelaki DE (2013) Choice-related activity and correlated noise in subcortical vestibular neurons. **Nat Neurosci.** 16(1):89-97. doi: 10.1038/nn.3267. PMCID: PMC3612962.

Gu Y, Yang Y, Liu S, Fetsch CR, Fok S, Sunkara A, DeAngelis GC*, Angelaki DE* (2011) Perceptual learning reduces interneuronal correlations in macaque visual cortex. **Neuron** 71(4):750-61. doi: 10.1016/j.neuron.2011.06.015. PMCID: PMC3163063.

Lakshminarasimhan KJ, Pouget A, DeAngelis GC, Angelaki DE* and Pitkow X* (2018) Inferring decoding strategies for multiple correlated neural populations. **PLOS Comp Biology** Sep 24;14(9):e1006371. doi: 10.1371/journal.pcbi.1006371. eCollection. PMCID: PMC6188888.