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EDUCATION and POSITIONS

4/15 – present	**Zhejiang University**	Hangzhou, China
	Director and Professor of Interdisciplinary Institute of Neuroscience and Technology (ZIINT), School of Medicine, Zhejiang University	
	Director of Zhejiang University 7T Brain Imaging Research Center	
	Professor of Biomedical Engineering	
	Professor of Neuroscience at Zhejiang University School of Medicine	
	Professor of Clinical Neuroscience at Zhejiang University Second Hospital	
9/15 – 8/20	Oregon Health Sciences University	Portland, OR
	Professor in Division of Neuroscience, Oregon National Primate Research Center (ONPRC)	
	Professor in Department of Behavioral Neuroscience, OHSU	
7/10 – 8/15	Vanderbilt University	Nashville, TN
	Professor in Department of Psychology	
	Professor in Dept of Radiology (secondary appointment).	
	Professor in Biomedical Engineering (secondary appointment).	
	Fellow of Vanderbilt Unversity Institute of Imaging Sciences	
2/12 – 7/12	Institute of Neuroscience, Chinese Academy of Sciences	Shanghai, China
	Visiting Scholar (sabbatical)	
9/03 – 6/10	Vanderbilt University	Nashville, TN
	Associate Professor (tenured) in Department of Psychology.	
	Associate Prof in Dept of Radiology (secondary appointment).	
	Associate Prof in Biomedical Engineering (secondary appointment).	
7/02 – 8/03	Yale University School of Medicine	New Haven, CT
	Associate Professor (tenure track) in Department of Neurobiology.	
9/96 – 6/02	Yale University School of Medicine	New Haven, CT
	Assistant Professor (tenure track) in Section of Neurobiology.	
3/96 - 8/96	University of Queensland	Brisbane, Australia
	Visiting Scholar at Vision Touch & Hearing Research Center.	
7/95 - 2/96	Baylor College of Medicine	Houston, TX
	Research Assistant Professor (non-tenure track) in Division of Neuroscience.	
12/92 - 6/95	Baylor College of Medicine	Houston, TX
	Post-doctoral fellow in Division of Neuroscience under Dr. Daniel Y. Ts'o.	
6/91 - 11/92	Rockefeller University	New York, NY
	Post-doctoral fellow in Dept. of Neurobiology under Dr. Daniel Y. Ts'o & Torsten Wiesel.	
9/86 – 5/91	M.I.T.	Cambridge, MA
	Ph.D. program in Dept. of Brain and Cognitive Sciences. (Thesis under Dr. Mriganka Sur)	
9/85 – 8/86	Yale University	New Haven, CT
	Doctoral program in Section in Neuroanatomy (lab moved to MIT).	
9/84 – 6/85	Harvard University	Boston, MA
	Doctoral program in Program in Neuroscience (transferred to Yale).	
9/79 – 6/84	Harvard University	Cambridge, MA
	B.A. *cum laude* 1984. Biochemistry major with special field of interest in neurobiology.	

RESEARCH HISTORY

My research interests are driven by the question of how the organization of the brain produces behavior. My academic travels began at Harvard where studies in mathematics quickly drove me to study the brain. At MIT, under Mriganka Sur, my doctoral work on the 'rewired ferret' preparation is now part of neuroscience textbook curricula on brain development. In 1991, I joined the group of Nobel Laureate Torsten Wiesel at Rockefeller University and helped to develop intrinsic signal optical imaging methods for mapping basic submillimeter (mesoscale) units of brain function in anesthetized monkeys. In 1996, I joined Yale as a junior faculty in Pasko Rakic's department where the Packard Foundation Engineering Fellowship gave me support to develop methods for watching, in real time through windows on the brain in behaving monkeys, arrays of basic submillimeter (mesoscale) cortical modules. This then launched a series of studies on comparisons of how the brain's modules process simple visual feature information (such as color, form, motion, and depth) vs categorical visual information, and led to hypotheses about the fundamental modular layout of the brain. These questions pushed me to develop, at Vanderbilt, MRI technologies to understand mesoscale organizations at whole brain scale, giving me glimpses of how mesoscale units were behaving in systematic and cooperative fashion across multiple brain areas. Lacking a method to study networks of mesoscale units systematically, I developed focal stimulation (electrical, optogenetic, and infrared neural stimulation) and ultrahigh field imaging methods. Needless to say, consistently, interdisciplinary interactions have been at the root of scientific discovery and technological breakthroughs. This fundamental theme marks every phase of my scientific, technological, and administrative evolution and is at the core of my views on scientific education.

CURRENT RESEARCH

My current primary research project is the establishment of a mesoscale functional connectome (study of all brain connections) in the Macaque monkey. This project aims to understand the brain architecture underlying primate intelligent behavior. My hypothesis is that there is a one-to-one mapping of mesoscale networks to behaviors. Understanding the organization of these networks unlocks how our brain systematically organizes our behavioral repertoire. This is a new view of brain organization, one which is not based on topographic organization of areas but on topographic organization of networks. I currently focus is on understanding networks underlying primate-specific visual foveolar behavior, which directs motor, cognitive, limbic networks such as those for fine manual manipulation and social communication. The method I developed for these studies is a novel brain network mapping technology INS-fMRI (2019 top 10 medical technologies in China) which generates mesoscale functional circuits in the brain *in vivo*, at high resolution, rapidly, and systematically. This has finally permitted me to pursue a fundamental and theoretical pursuit. My hypothesis about brain architecture is that it contains a great deal of regularity comprising repeating brainwide network motifs. Since such motifs are simply classes of topological relationships, they can be captured mathematically, forming a set of basis vectors for human behavior. This work addresses the heart of AI and will lead to a *Theory of Brain*.

BRIEF SYNOPSIS OF 2015-2022

In 2014, I made a proposal to build an interdisciplinary brain research institute at Zhejiang University (ranked 42nd in the world, 3rd in China, tops in engineering and medicine). The university enthusiastically supported this proposal and seeded with a $25 million investment, an amount at the time was the largest yet in Chinese universities. Over the past several years, I have built a successful Institute of Neuroscience and Technology at Zhejiang University (www.ziint.zju.edu.cn). The funds were used to construct The Science Building (comprising a nonhuman primate facility for up to 200 macaques and marmosets, 2-photon and 3-photon facility, and 15 labs) and The Zhejiang University MRI Center of which I am director (comprising a Siemens 7T MRI, electronics lab for constructing custom multi-array RF coils, psychophysics lab with 64 ch eeg). As the first successful 7T MRI center in China, we run both animal and clinical research projects and devote significant time to MR technology development. I also hired 15 PIs with different neuroscience and engineering backgrounds and a dozen administrative staff. In our research laboratories, over 80 graduate students from both biological and engineering backgrounds work on interdisciplinary projects, something rather unique in China. While each lab is independent, flexibly assembled teams are formed for specific projects. Thus, the institute has been a true pioneer with respect to scientific, engineering, educational, clinical and administrative accomplishments.

PEER-REVIEWED PUBLICATIONS (over 140 published)

2023

Li P*, Ping A, **Roe AW****, Zhu JM**, Xu KD** (2023) Infrared neural stimulation in human cerebral cortex. Brain Stimulation, https://doi.org/10.1016/j.brs.2023.01.1678. [8.955]

Yao SP*, Shi S*, Zhou Q, Wang J, Du Xiao, Takahata T**, **Roe AW**** (2023) Functional topography of mesoscale pulvinar-visual cortex networks in the macaque monkey revealed with INS-fMRI. J Comp Neurol, *in press***.** DOI: 10.1002/cne.25456. [3.215]

Zhang Y, Hu JM**, Schriver KE**, **Roe AW**** (2023) Spatial frequency representation in V2 and V4 of macaque monkey. Elife, 12:e81794. doi: 10.7554/eLife.81794 [8.713]

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Zaraza D*, Chernov MM*, Yang Y, Rogers JA, **Roe AW**,** Friedman RM** (2022) Head mounted optical imaging and stimulation system for use in behaving primates. Cell Reports Methods. doi.org/10.1016/j.crmeth.2022.100351.

Xie J-J, Li X-Y, Dong Y, Chen C, Qu BY, Wang S, Xu H, **Roe AW**, Lai H-Y, Wu Z-Y (2022) Local and Global Abnormalities in Pre-symptomatic Huntington's Disease Revealed by 7T Resting-state Functional MRI. Neurosci Bull. doi: 10.1007/s12264-022-00943-5

Zhu L, Wang M, Liu Y, Zhang W, Zhang H, **Roe AW**,** Xi W** (2022) Imaging microvasculature network evolution and neurodegeneration with precise photothrombosis approach. Small Methods, doi: 10.1002/smtd.202200917.

Mir Y, Zalányi L, Pálfi E, Ashaber M, **Roe AW**, Friedman RM, Négyessy L (2022) Modular organization of signal transmission in primate somatosensory cortex. Frontiers in Neurosci, 16:915238.

Du X*, Jiang X*, Kuriki I, Zhou T, **Roe AW**,** Tanigawa H** (2022) Representation of Cone-Opponent Color Space in Macaque Early Visual Cortices. Frontiers in Neurosci, 16:891247.

Hu JM, **Roe AW** (2022) Functionally specific and sparse domain-based micro-networks in monkey V1 and V2. Curr Biol, 32(13):2797-2809.e3.

Xu G, Zhao Z, Xu KD, Zhu J, **Roe AW**, Xu B, Zhang XT, Li J, Xu DR (2022) Magnetic Resonance Temperature Imaging of Laser-Induced Thermotherapy Using Proton Resonance Frequency Shift: Evaluation of Different Sequences in Phantom and Porcine Brain at 7T. Japan J Radiol, 40(8):768-780.

Wang JB, Nasr S, **Roe AW**,** Polimeni JR** (2022) Critical factors in achieving submillimeter-resolution MRI imaging: removing sources of inadvertent spatial smoothing. Human Brain Mapping, 43(11):3311-3331.

Zhang H*, Fu P*, Liu Y*, Zheng Z, Zhu L, Wang M, Abdellah M, He M, Qian J, **Roe AW**,** Xi W** (2022) Large-depth three-photon fluorescence microscopy imaging of cortical microvasculature on nonhuman primates with bright AIE probe *In vivo*. Biomaterials. 289:121809. [IF 15.304] doi.org/10.1016/j.biomaterials.2022.121809.

Milham …**Roe AW**…et al (2022) The PRIMatE Data and Resource Exchange (PRIME-DRE) Global Collaboration Workshop and Consortium "Towards next generation primate neuroscience: a collaboration-based strategic plan for integrative neuroimaging." Neuron. Nov 2:S0896-6273(21)00783-2. doi: 10.1016/j.neuron.2021.10.015.

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Chernov M, Friedman RM, **Roe AW** (2021) A fiberoptic array for multi channel infrared neural stimulation of the brain. Neurophotonics, 8(2):025005. doi: 10.1117/1.NPh.8.2.025005. [PMID 33898637]

Klink PC, …, **Roe AW**, …Petkov CI (2021) Combined Brain Perturbation and Neuroimaging in Non-human Primates. Neuroimage, 235: 118017. doi: 10.1016/j.neuroimage.2021.118017. [PMID 33794355]

Shi S*, Xu AG*, Rui YY, Romanski LM, Gothard KM, **Roe AW**** (2021) Infrared neural stimulation with 7T fMRI: a rapid *in vivo* method for mapping cortical connections of primate amygdala. Neuroimage, 231, 117818. 2021 Feb 3;117818. doi: 10.1016/j.neuroimage.2021.117818. [PMID 33548458]

Zhang X*,**, Zhang J*, Gao Y*, Qian M*, Qu S, Quan Z, Yu M, Chen X, Wang Y**, Pan G, Adriany G, **Roe AW** (2021) A 16-channel Dense Array for in vivo Animal Cortical MRI/fMRI on 7T Human Scanners. IEEE Trans Biomed Eng. 68(5):1611-1618. doi:10.1109/TBME.2020.3027296. [PMID 32991277]

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Hu J*, Song XM, Wang Q, **Roe AW**** (2020) Curvature domains in V4 of Macaque Monkey. Elife. 9:e57261. doi: 10.7554/eLife.57261. [PMC7707819][PMID 33211004]

Friedman RM*, Chehade NG, **Roe AW**, Gharbawie OA** (2020) Optical imaging reveals functional domains in primate sensorimotor cortex. Neuroimage, 221:117188. doi: 10.1016/j.neuroimage.2020.117188. [PMID 32711067][PMC 7841645]

Tremblay…**Roe AW**… et al (2020) An open resource for non-human primate optogenetics. Neuron, 108(6):1075-1090. doi: 10.1016/j.neuron.2020.09.027 [PMID 33080229]

Roe AW**, Chen G, Xu AG, Hu JM (2020) A roadmap to a columnar visual cortical prosthetic. Curr Opin Physiol, 16:68–78. https://doi.org/10.1016/j.cophys.2020.06.009

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Hu J*, Qian M, Tanigawa H, Song XM, **Roe AW**** (2020) Focal electrical stimulation of cortical functional networks. Cerebral Cortex. bhaa136, https://doi.org/10.1093/cercor/bhaa136. [PMID 32483588]

Zhang Y*, Yao L, Yang F, Yang S, Edathodathil A, Xi W, **Roe AW****, Li P** (2020) INS-fOCT: a label-free, all-optical method for simultaneously manipulating and mapping brain function. Neurophotonics. 7(1), 015014, doi: 10.1117/1.NPh.7.1.015014. [PMC 7108754][PMID 32258220]

Friedman RM*, Morone K, Gharbawie OA, **Roe AW**** (2020) Mapping mesoscale cortical connectivity in monkey sensorimotor cortex with optical imaging and microstimulation. J Comp Neurol. 528(17):3095-3107. doi:10.1002/cne.24918. [PMC 7541397][PMID: 32255200] *Cover figure*.

Cai ZC, Zhu L, Wang MQ, **Roe AW****, Xi W**, Qian J** (2020) NIR-II fluorescence microscopic imaging in non-human primates. Theranostics. 10(9):4265-4276. doi:10.7150/thno.43533. [PMC: 7086344] [PMID: 32226552][IF 11.556]

Quan QY*, Gao Y, Qu SX, Wang XJ, Friedman RM, Chernov M, Kroenke C, **Roe AW**, Zhang XT** (2020) A 16-Channel Loop Array for in vivo Macaque Multi-modal Neuroimaging at 3T MRI. MRI. 68:167-172. [PMC 7784245] [PMID: 32081631]

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Mekbib DW*, Han JW, Zhang L, Fang S, Jiang HJ, Zhu JM, **Roe AW****, Xu DR** (2020) Virtual reality therapy for upper limb rehabilitation in patients with stroke: a meta-analysis of randomized clinical trials. Brain Injury. 34(4):456-465. [PMID: 32064964]

Gao Y*, Mareyam A, Sun Y, Witzel T, Arango N, Kuang I, White J, **Roe AW**, Wald L, Stockmann J**, Zhang XT** (2020) A 16-Channel AC/DC array coil for anesthetized monkey whole-brain imaging at 7T. Neuroimage. 207:116396. [PMC: 7309650] [PMID: 31778818]

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Roe AW (2019) Columnar connectome: towards a mathematics of brain function. Network Neuroscience 3(3):779-791. doi.org/10.1162/netn_a_00088 . [PMC: 6663318][PMID: 31410379]

Li M**, Song XM**, Xu T, Hu D*, **Roe AW***, Li C-Y* (2019) Subdomains within orientation columns of primary visual cortex Science Advances, 5(6):eaaw0807. doi: 10.1126/sciadv.aaw0807. [**co-first author, *co-corresponding] [PMC: 6551190][PMID: 31183405]

Xu AG*, Qian M*, Tian F, Xu B, Friedman RM, Wang J, Song X, Sun Y, Chernov MM, Cayce JM, Jansen ED, Mahadevan-Jansen A, Zhang XT**, Chen G**, **Roe AW**** (2019) Focal infrared neural stimulation with high-field functional MRI: a rapid way to map mesoscale brain connections. Science Advances, 5(4):eaau7046 DOI: 10.1126/sciadv.aau7046. [PMC: 6482007][PMID: 31032400]

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Chernov M*, Friedman RM, Chen G, **Roe AW**** (2018) Functionally specific optogenetic modulation in primate visual cortex. Proc Natl Acad Sci. 115(41):10505-10510. [PMC6187135] [PMID: 30257948]

Pálfi E, Zalányi L, Ashaber M, Palmer C, Kántor O, **Roe AW**, Friedman RM, Négyessy L (2018) Connectivity of neuronal populations within and between areas of primate somatosensory cortex. Brain Struct Funct. 223(6):2949-2971. [PMID: 29725759]

Yin H, Fu P, Lu HD, Tanigawa H, **Roe AW**, Chen G (2018) Reply to Doi et al.: Functional architecture matters in the formation of perception. Proc Natl Acad Sci. 115(30):E6969-E6971. [PMC: 6065029] [PMID: 29980648]

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Chen G*, Lu HD, Tanigawa H, **Roe AW**** (2017) Solving visual correspondence between the two eyes via domain-based population encoding in nonhuman primates. Proc Natl Acad Sci, 114(49):13024-13029. [PMC5724244] [PMID: 29180437]

Wang YL, Han X, Xi W, Li JY, **Roe AW**, Lu P, Qian J (2017) Bright AIE nanoparticles with F127 encapsulation for deep-tissue three-photon intravital brain angiography. Adv. Healthcare Mater. 6(21):1700685. [PMID 28795507] [doi: 10.1002/adhm.201700685]

Roe AW**, Winberry J, Friedman RM (2017) Study of single and multidigit activation in monkey SI using voltage sensitive dye imaging. Neurophotonics, 4(3):031219. [PMC5446783] [PMID: 28573156]

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Tanigawa H*, Chen G, **Roe AW**** (2016) Spatial distribution of attentional modulation at columnar resolution in macaque area V4. Frontiers in Neural Circuits, 10:1-13. [PMC5149540][PMID: 28018181]

Jennings C, Landman R, Zhou Y, Sharma J, Hyman J, Movshon JA, Qiu Q, Roberts A, **Roe AW**, Wang XQ, Zhou HH, Wang LP, Zhang F, Desimone R, Feng GP (2016) Modeling human brain disorders in transgenic primates: Opportunities and challenges. Nature Neuroscience, 19(9):1123-30. [PMID: 27571191]

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Roe AW, Garraghty PE, Sur M (1988) The terminal arbors of single on-center and off-center X and Y retinogeniculate axons within the ferret's lateral geniculate nucleus. J Comp Neurol, 288(2):208-242. [PMID: 2477415]

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REVIEW ARTICLES, BOOK CHAPTERS, AND BOOKS (17)

Zhang X, Zhang Y, Roe AW (2021) Ultra-high-field MRI studies of brain structure and function in humans and non-human primates: a collaborative approach to precision medicine. Curr Opin BME 20:100320. https://doi.org/10.1016/j.cobme.2021.100320

Ping A, Li P, Zhang J, Xu K, Schriver KE, Zhu J*, **Roe AW*** (2021) Targeted optical neural stimulation: a new era for personalized medicine. The Neuroscientist. 10:1-19. doi.org/10.1177/10738584211057047. *Review*.

Morone KA**, Neimat J, **Roe AW,** Friedman RM** (2017) Functional and clinical relevance of intrinsic signal optical imaging in human brain mapping. Neurophotonics, 4(3):031220. [PMC5466092] [PMID: 28630881]

Chernov M*, **Roe AW**** (2014) Infrared neural stimulation: a new stimulation tool for CNS applications. Neurophotonics, 1(1):011011. [PMID:26157967] [PMC4478761]

Devor A, **Roe AW**, Mahadevan-Jansen, Boas DA (2014) The BRAIN Initiative. Neurophotonics.1(1):011001. Editorial. [PMID: 26157962] [PMC4489344]

Roe AW**, Chelazzi L, Connor CE, Conway BR, Fujita I, Gallant J, Lu H, Vanduffel W (2012) Towards a unified theory of visual area V4. Neuron, 74(2):12-29. [PMID: 22500626][PMC2376798]

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Roe AW, Chen LM, Friedman RM (2007) Intrinsic signal imaging of somatosensory function in non-human primates. The Senses: A Comprehensive Reference, Vol 6: Somatosensation (Eds Allan Basbaum et al). Elsevier, Oxford, UK. (ISBN: 9780126394825) http://www1.elsevier.com/homepage/about/mrwd/snse/table_of_contents.htm

Roe AW, Friedman RM, Chen LM (2007) Multiple Representation in Primate SI: A View From A Window on the Brain. In Handbook of Neurochemistry and Molecular Neurobiology: Sensory Neurochemistry, Vol 26 (Johnson D, Lajtha A, eds). Springer, New York NY, pp. 1-16.

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Ts'o DY, **Roe AW** (1995) Functional compartments in visual cortex: segregation and interactions. In The Cognitive Neurosciences (Gazzaniga MS, ed.). M.I.T. Press, Cambridge, MA, pp. 325-337.

Ts'o DY, **Roe AW** (1994) The organization and connectivity of color processing in visual cortex. Symposium for Otto Creutzfeldt. Springer-Verlag (Nothdruft C., ed.).

Sur M, Pallas SL, **Roe AW** (1990) Cross-modal plasticity in cortical development: differentiation and specification of sensory neocortex. Trends in Neurosci 13:227-233. [PMID: 1694329]

NEWS

2019 China's top ten medical science and technology news release. March 2019.

O'meara S (2015) At the very heart of progress. Nature. 2015 Dec 17; 528(7582):S179-81. doi: 10.1038/528S179a. Includes interview with Anna Wang Roe regarding science progress at Zhejiang University in Hangzhou, China.

CONFERENCE & SYMPOSIUM ORGANIZER

CONFERENCE ORGANIZER

Roe AW (2020) Conference organizer. Gordon Research Conference on Neuroplasticity of Sensory Systems. June 7-12, 2020. Hong Kong [cancelled due to coronavirus]

Roe AW (2018) Conference organizer. Asia-Pacific Conference on Vision. July 13-16, 2018. Hangzhou, China.

Roe AW (2018) Conference organizer. Gordon Research Conference on Neuroplasticity of Sensory Systems. June 3-8, 2018. Hong Kong

SYMPOSIUM ORGANIZER

Roe AW (2022) Program organizer: Optogenetics and Optical Manipulation. SPIE Photonics West, San Francisco CA

Roe AW (2021) Topic Area Leader. "Circuit-Level Perturbations: Methods and Applications." Global Collaboration Workshop, Prime-DE. April 12-14. Online.

Roe AW (2021) Program oganizer. Neurophotonics. SPIE Photonics West. Online.

Roe AW (2020) Program organizer: Neurophotonics. SPIE Photonics West, San Francisco CA.

Roe AW (2020) Program organizer: Neurophotonics. SPIE Photonics West, San Francisco CA.

Roe AW (2019) Co-organizer. Neuroimaging Techniques: from a single cell to the whole brain. 2019 CNS Meeting, Suzhou, China.

Roe AW (2019) Co-organizer. 2019 Annual ONPRC Scientific Symposium. ONPRC, OHSU. Beaverton, OR.

Roe AW (2018) Panelist. The Marmoset Social. Soc Neurosci Meeting. San Diego CA.

Roe AW (2018) Symposium organizer. Asia Communications and Photonics Conference (ACP). Oct 26-29, 2018. Hangzhou, China.

Roe AW (2018) Symposium organizer. Multisensory processing. Asia-Pacific Conference on Vision. July 13-16, 2018. Hangzhou, China.

Roe AW (2018) Symposium organizer. Binocular depth perception. Asia-Pacific Conference on Vision. July 13-16, 2018. Hangzhou, China.

RECENT CONFERENCES
(2021-2023)

Fu P*, Liu Y*, Zhu L, Wang M, Zhang W, Zhang H, **Roe AW****, Xi W** (2023) Two-photon Imaging of GABAergic and Non-GABAergic Neuronal Activity Induced by Infrared Neural Stimulation in Awake Mouse Cortex. SPIE Photonics West 2023, San Francisco, CA.

Li P*, Ping A, **Roe AW****, Zhu JM**, Xu KD** (2023) Infrared neural stimulation in human cerebral cortex. SPIE Photonics West 2023, San Francisco, CA.

Qian M, Wang J. Liu Y, Hu J, Zhang X, **Roe AW** (2022) Foveolar mapping in awake macaque monkeys in 7T fMRI. Chinese Soc Neurosci Abstr, online.

Wang J-B, Du X, Yao S-P, Li L-H, Ping A, **Roe AW** (2022) Submillimeter mesoscale representation in macaque visual dorsal pathway revealed by 7T fMRI. Chinese Soc Neurosci Abstr, online.

Zhang Y, Schriver KE, Hu J, **Roe AW** (2022) Spatial frequency representation in V2 and V4 of macaque monkey. Soc Neurosci Abstr, San Diego CA.

Wang J-B, Du X, Yao S-P, Li L-H, Ping A, **Roe AW** (2022) Submillimeter mesoscale representation in macaque visual dorsal pathway revealed by 7T fMRI. Soc Neurosci Abstr, San Diego CA.

Qian M, Wang J. Liu Y, Hu J, Zhang X, **Roe AW** (2022) Multiple foveolar representation in awake macaque monkey imaged in 7T fMRI. Soc Neurosci Abstr, San Diego CA.

Li L-H, Ping A, **Roe AW** (2022) Brain-wide connections of nucleus CE in primate using 7T fMRI and infrared neural stimulation. Soc Neurosci Abstr, San Diego CA.

Roe AW (2022) **Invited symposium speaker.** Infrared stimulation of the mesoscale primate neuro-connectome. Fed Eur Neurosci Soc. Paris, France. July 9-13, 2022.

Schriver KE, Zhang Y, Liu Y, **Roe AW** (2022) Illuminating the Mesoscale Connectome: A 100-fiber Infrared Neural Stimulation System. Fed Eur Neurosci Soc. Paris, France. July 9-13, 2022.

Roe AW (2022) **Invited symposium speaker.** Basis Elements of Intelligent Primate Systems. RIKEN BDR Symposium. Online. Mar 3, 2022.

Roe AW (2021) **Invited symposium speaker.** INS-fMRI: a novel method for studying the architecture of brain networks. SPIE Advanced Biophotonics Conference 2021. Busan, Korea. Hybrid. Online talk. Invited Keynote Speaker.

Roe AW (2021) **Keynote Speaker.** Identifying fundamental features of efficient processing architecture in human and nonhuman primate brains. Westlake International Symposium in Engineering 2021. Hangzhou, China.

Roe AW (2021) Understanding limbic networks in nonhuman primates via INS-fMRI. Invited symposium speaker. Human Brain Project Summit 2021. Brussels, Belgium. Online talk.

Roe AW (2021) Understanding limbic networks in nonhuman primates via INS-fMRI. Symposium speaker. Chinese Society Neuroscience 2021.

Roe AW (2921) **Invited symposium speaker.** Functional Columnar Basis of Human and Non-human Primate Intelligence. Global Artificial Intelligence Technology Conference 2021 (GAITC). Hangzhou, China.

Roe AW (2021) **Keynote Speaker**. INS-fMRI: a method for mapping mesoscale connectomes in nonhuman primates. Organization for Human Brain Mapping 2021. Online.

Wang J, Nasr S, **Roe AW**, Polimeni JR (2021) Evaluation of spatial blur induced by preprocessing and distortion in UHF fMRI data. International Soc Magnetic Reson & Medicine. Chosen for E-Poster, oral. Online.

Xu AG, Shi S, Rui Y, Zhang X, Romanski L, Gothard KM, **Roe AW** (2021) A rapid in vivo method for mapping cortical connections of primate amygdala with infrared neural stimulation and 7T fMRI. International Soc Magnetic Reson & Medicine. Chosen for oral presentation. Recipient of **Summa Cum Laude postdoctoral award**. Online.

Roe AW (2021) **Invited topic leader**. PRIME-DE conference (International Primate Data Exchange) (online).

FUNDING

Institute Funding

Zhejiang University 985 Grant (Roe) 2014 – 2019 RMB 158,000,000 ($25,000,000)

Zhejiang University Interdisciplinary Institute of Neuroscience and Technology, Hangzhou, China

The goal of this proposal is to establish a brain research institute comprising 15 faculty, ultrahigh field MRI platform, and nonhuman primate facility. The MRI platform will support both animal and clinical research. Students will be recruited from both medical science and engineering sciences.

Zhejiang University 985 Grant (Roe) 2019-2020 RMB 15,000,000

Zhejiang University Interdisciplinary Institute of Neuroscience and Technology, Hangzhou, China

The goal of this proposal is to further develop the Interdisciplinary Institute of Neuroscience and Technology at Zhejiang University as a world reknowned brain research institute. The institute will grow to about 20 labs and will build new multimodal technologies (combined with ultrahigh field MRI) for neuroscience, engineering, and clinical applications.

Ongoing Research Support

China Brain Initiative (脑信号获取与干预项目) 2021ZD0200401 (Wu, Roe,…) 01/01/21-12/30/25

Brain computer interactive computing fusion research platform

This is a grant aimed at understanding computational aspects of brain function. Investigators include neuroscientists, engineers, computer scientists, and clnicians.

Chinese NSF Instrumentation Grant No. 31627802 (Chen, Roe, Zheng) 01/01/17-12/31/21 RMB 4,920,000 ($735,000) (direct 3,960,000, Roe: 750,000, $113,000)
Development of a 2000 channel neural interface with feedback
The goal of this proposal is to develop a large channel (over 2000) neural interface that is modular and flexible in design. It can interface with any electrode or recoding system with high throughput and with sufficiently high speed to permit real-time feedback.

Zhejiang University President's Fund (Roe) 01/01/19 – 12/31/20 RMB 2,000,000
Fundamental Research Funds for the Central Universities (2019XZZX003-20)
Development of connectome mapping device in highfield MRI
The goal of this proposal is to develop a device capable of mapping hundreds of networks at high spatial resolution using laser-fMRI within the brain in nonhuman primates *in vivo*.

Chinese Ministry of Science and Technology "National Key R&D Program of China" (脑机融合的脑信息认知关键技术研究) Grant No. 2018YFA0701400 (Wang) 01/01/20 – 12/31/24 Roe RMB 3,350,000
Key Technology Development for Brain-Computer Integration
The goal of this proposal is to develop multimodal methodologies for ultrahigh field MRI and brain interface technology.

Chinese Zhejiang Province Department of Science and Technology #2020C03004 (浙江省科技厅)
(Pan, Roe) 01/01/20-09/30/22 Roe RMB 3,200,000
High-throughput Neurochip and Application in Visual Restoration（脑机融合神经芯片及视觉修复原理应用）
The goal of this proposal is to develop brain-computer interface chip for visual restoration.

China NSFC-US NIH Cooperative Biomedical Grant # 8191101288 (Roe, Gothard) Roe RMB 3,000,000, 01/01/20 – 12/30/24
Development of Amygdalo-Prefrontal Connections in Adolescent Macaques
The goal of this proposal is to study establishment of prefrontal control of socio-emotional behavior by examining the changes in functional connectivity between the amygdala prefrontal cortex in juvenile macaque monkeys.

China NSFC-Provincial NSF Cooperative Grant #U20A20221 (Roe, Yu) Roe RMB 2,590,000
01/01/21 – 12/30/24 China NSFC Grant
基于INS-fMRI技术绘制活体猴脑皮层介观网络连接组：功能和计算(Mapping of in vivo mesoscale connectomes in primate cortex using INS-fMRI: function and computation)
The goal of this proposal is to map the whole brain connectome at mesoscale in macaque monkeys, understand the functionality of these networks in behaving monkeys, and model the architectural basis of intelligent networks.

<u>Completed Research Support</u>

NIH/NEI 5 R01EY029753 (Friedman, PI; Neuringer co-PI, Roe consult) 02/01/19 - 01/31/23 $3,153,596
Neural development of Macaque monkey foveal vision
The goal of this proposal is to investigate the development of the brain circuits underlying central (foveal) vision, which is critical for high spatial acuity vision, color vision, and visual attention. This will provide important understanding about development of foveally guided behaviors, such as reading, visuomotor behavior, social behaviors, and for treating visual developmental disorders.

NIH/NEI 2 R21 EY031073 (Friedman, PI; Roe consultant) 07/21/20 – 6/30/22 $150,000
Development of multimodal wireless brain interfaces in nonhuman primates
The goal of this research is to develop wireless optical imaging, electrical recording, and optogenetic stimulation capabilities for awake monkey behavioral studies.

NIH/NINDS 5 R01 NS093998 (Roe, PI; Friedman, PI) 04/01/16 – 03/31/21 $3,123,991
Neural basis of tactile object perception in SI cortex
The goal of this research is to examine how tactile object features such as shape, texture, and weight are encoded in SI of the monkey.

01/15 – 12/19 **Chinese NSF Key Project No. 81430010 (Roe, PI)** *Functional organization and attentional modulation in visual area V4* (RMB 3,230,000 direct)

05/18 – 04/19 **ONPRC Pilot Grant Research Program (Roe, PI)** *Studying Neural Basis of Attention in Non-headfixed Monkeys* ($72,500, direct).

01/15 - 12/17 **Chinese 863 Hi-Tech Research and Development Program No. 2015AA020515 (Roe, Ding, Wang, PIs)** *Development of a multifunctional microscope for multiscale imaging* [RMB 5,000,000 ($825,000)]

1/14 – 12/18 **Zhejiang University 985 Grant (Roe, PI)** *Establishment of the Zhejiang University Interdisciplinary Institute of Neuroscience and Technology, Hangzhou, China* ([RMB 158,000,000 ($25,000,000)]

8/12 – 6/15 **NIH/NIMH 1R21MH095009-01A1(Roe, PI)** *Functional mapping of cortical networks in primates with laser stimulation* ($275,000, direct). Role: PI.

9/12-8/14 **1R21 EY022853-01 (Stoner, Roe)** *Optogenetic modulation of neuronal and behavioral responses in the primate.* Role: co-PI.

7/10-8/14 **NIH/NINDS 5R01NS044375-10 (Roe)** *Optical imaging of tactile information in SI cortex* ($1,798,357, direct). Role: PI.

7/02-8/14 **NIH/NINDS 5R01NS044375-10 (Roe)** *Optical imaging of tactile information in SI cortex* ($1,798,357, direct). Role: PI.

10/12-9/14 **NIH/NIMH 1R21 EY022853-01(Stoner/Roe)** *Optogenetic neuronal and behavioral modulation in primates with minimal invasiveness (*$75,000 direct), role: co-PI.

7/09 – 6/12 **NIH/NEI RO1 EY11744-10 (Roe)**, *Inter-areal Cooperativity During Perception of Visual Contours and Surfaces* ($842.808 direct), role: PI.

9/12-8/13 **NIH/NINDS R01 NS044375-08S1 (Roe)** *Optical imaging of tactile information in SI cortex.* Supplemental funds awarded to cover additional fMRI and per diem costs. ($25,000)

9/11 – 8/12 **NIH/NINDS 3RO1 NS044375-09S1**, *Optical imaging of tactile information in SI cortex* ($40,280), role: PI. Supplemental funds awarded to cover additional fMRI and per diem costs.

9/08-8/09 **NIH/NINDS R56 NS044375**, *Optical imaging of SI cortex in the awake primate* ($329,000), role: PI.

9/06-8/09 **NIH/NIDA R21 DA023002**, *Fast optical imaging of cortical signals in the behaving primate* ($275,000), role: PI.

9/06-8/10 **NIH/NINDS R03 NS059061**, *Perceptual circuits in somatosensory cortices* ($30,000), role: PI.

4/06-3/09 **NIH/NINDS R21 NS052821**, *Optical imaging of SI cortex in the awake primate* ($275,000), role: PI.

9/03 – 8/08 **NIH/NINDS RO1 NS044375**, *Optical imaging of tactile information in SI cortex* ($2,043,750 total; $1,250,000 direct), role: PI.

3/02 – 2/07 **NIH/NEI RO1 EY11744**, *Inter-areal Cooperativity During Perception of Visual Contours and Surfaces* ($1,274,996; $819,823 direct), role: PI.

1997-2001 **NIH RO1 EY11744** , *Inter-areal Processing of Visual Contours* ($947,894 total; $585,941 direct) role: PI.

Other

6/12 – 5/15 **Vanderbilt University Discovery Grant (Maier, Roe)** *Microanatomy of cortical resting state functional connectivity*. ($50,000) Role: co-PI.

8/12 – 7/1 **Vanderbilt Brain Institute Grant (Johnson, Roe),** *Development of BRET sensors and imaging methods* ($25,000)

2008 - 2009 **Vanderbilt University VIO Grant**, *International Grant Exploring potential for conducting nonhuman primate brain research in China* ($4000), role: PI.

5/05 – 6/07 **Vanderbilt Discovery Grant**, *Optical imaging of short-term working memory in prefrontal cortex of the Macaque monkey* ($50,000), role: PI.

1998-2003 **David and Lucile Packard Foundation Fellowship**, *High Spatial Resolution Imaging of Perception and Cognition* ($625,000 total; $562,500 direct) role: PI.

1997-1999 **Alfred P. Sloan Research Fellowship**, *Modular organization of mammalian sensory neocortex*, ($60,000) role: PI.

1996-1999 **Whitehall Foundation Research Fellowship**, *Higher Order Visual Contour Processing in Area V2 of the Primate* ($150,000) role: PI.

INVENTIONS

Patent Serial No. 61/489,522: Method and apparatus of pulsed infrared light for the inhibition of central nervous system neurons

Chinese Patent No 专利号 ZL 201810935858.5: High spatial resolution infrared laser stimulation-fMRI whole brain mapping (红外神经刺激诱导 全脑功能磁共振 高分辨率成像方法) Approved May 2020. 王菁, 陈岗，徐国华。

AWARDS and HONORS

2021	China Brain Computer Intelligence National Lab Member
2019	Elected Fellow of SPIE
2018	Zhejiang Optical Society Council Member
2018, 2020	Gordon Research Conference Organizer
2017	International Neuropsychological Symposium Member
2017	Elected Senior Member of SPIE
2016	ISMRM Plenary Speaker
2015	AAAS Fellow
2013	1000 Faculty Award, China
2008	Vanderbilt University International Grant "Exploring potential for conducting nonhuman primate brain research in China"
2007	Vanderbilt University College of Arts & Sciences Travel Award
2005-2007	Vanderbilt Discovery Grant: "Optical Imaging of Short-term Working Memory in Prefrontal Cortex of the Macaque Monkey" $30,000
2004	Vanderbilt University College of Arts & Sciences Travel Award
1998-2003	David and Lucile Packard Foundation Fellowship
1997-1999	Alfred P. Sloan Research Fellowship.
1996-1999	Whitehall Foundation Research Fellowship
1991-1994	NIH NRSA Post-doctoral Fellowship, Rockefeller Univ and Baylor College of Medicine.
1993	Winter Conference on Brain Research Fellowship Award, Whistler, Canada.
1992	Center for Visual Science Symposium Travel Fellowship, Rochester, NY.
1989-1991	Whittaker Health Sciences Fellowship, M.I.T.
1986-1989	NIGMS Graduate Traineeship, M.I.T.
1987	Gordon Research Conference Scholarship.
1985-1986	NIGMS Graduate Traineeship, Yale University.
1984-1986	NIGMS Graduate Traineeship, Harvard University.

SERVICE

<u>ACADEMIC SERVICE</u>

2021	Advisor, “浙江省精神心理疾病临床研究中心”和“浙江大学脑机调控转化研究中心精神疾病分中心” "Zhejiang Clinical Research Center for mental and psychological diseases" and "mental disease sub center of brain computer regulation and transformation research center of Zhejiang University"
2015 – present	Member, Dual Brain Faculty Search Committee

Grant Reviews

2019	US Brain Initiative grant reviewer
2018	Israel Science Foundation grant reviewer
2018	UK Medical Research Council grant reviewer
2017	Chinese 1000 Talents Faculty Applications reviewer

2011 – 2017	NIH study section, Sensorimotor Integration, member
2009	NIH study section, ad hoc
2006	NIH special review committee
2005	NIH special review committee
2002	NSF Cognitive Neuroscience Study Section, ad hoc
2000-2005	NIH IFCN-8 (COG) Study Section, member

Site Visit Reviews

2021	Shanghai NYU 5 year program review
June 2007	NIH/NIMH Board of Scientific Counselors review committee (ad hoc).
Oct 2006	NIH/NICHHD Site visit member.

Editorships, manuscript & abstract reviews

2019 -	Associate Editor, eLife
2017 -	Advisory Editorial Board, TINS
2016 -	Assoc Editor, Network Neuroscience
2014 - 2015	Special Issue Editor, Visual Neuroscience
2013 – present	Assoc Editor, Neurophotonics
2013 – 2020	Editor, Neuroimage
2012 – present	OHBM abstract review committee
2010 – present	Assoc Editor, Frontiers in Integrative Neuroscience
2007 - present	Editor, Frontiers in Systems Neuroscience
2003 - 2014	Assoc Editor, Neuroscience Letters
2006	Optical Soc America abstract review committee
2003 – 2011	Vision Sciences Society abstract review committee
9/96 – present	Ad hoc reviewer for Nature, Science, Neuron, Nature Neuroscience, Current Biology, J Neuroscience, J Neurophysiology, Nature NS, Neuroimage, Neurophotonics, Vision Research, PNAS, Frontiers of Neuroscience, J Neurosci Methods, Cerebral Cortex, American J Physiology, European J Neuroscience, BMC Journals, PLOS Biology, Attention Perception & Psychophysics, J Cereb Blood Flow & Metabolism, Neuroscience Letters, Neuroreport, Biomed Optics Express

Faculty Reviews

Universities and institutes in US, Europe, and Aisa.

Other

2020	ISMRM Overseas Chinese Awards Committee
2019-	Univ Marburger – Zhejiang Univ Partnership Ambassador
2019-2022	OHBM Awards Committee
2019	FENS Summer School Lecturer, Bologna, Italy
2018, 2020	Gordon Research Conference Organizer (Hong Kong, China)
2018 -	NIH Marmoset Advisory Committee, ONPRC representative
2019-2021	SFN Swartz Prize Selection Committee
2018 – present	Head of Neuroengineering Consortium, Zhejiang University.
2012 - present	Advisory committee to McGovern Institute at Beijing University, Beijing China.
2011 – present	SFN Peter Gruber International Research Award Selection Committee
2008 - present	Advisory committee to Systems Neuroscience Program at Tsinghua University, Beijing China.
1999-2001	German-American Frontiers of Science Symposia (Organizer and Participant)
2003 - present	Ad hoc reviewer on funding applications and promotion reviews for investigators from Europe, Asia, Australia.

<u>UNIVERSITY SERVICE</u>

Zhejiang University NeuroTechnology Consortium Director

Zhejiang University Institutional Animal Care and Use Committee (IACUC)
Zhejiang Dual Brain Faculty Search Committee
Zhejiang University Faculty Promotion Review Committee

TEACHING

Cold Spring Harbor Summer School (June 2023, Cold Spring Harbor NY)
Modern methods to visualize complex visual activity

FENS Summer School (June 2-8, 2019, Bologna, Italy)
Brain reading and writing: new perspectives of neurotechology

Zhejiang University, Hangzhou China

Fall 2015-2022	Course director and lecturer. Systems Neuroscience.
Spring 2022	Graduate Functional Neuroanatomy
Fall 2021, 2022	Medical School Neuroanatomy

Courses at Yale, Vanderbilt, Tsinghua:
Visual Neuroscience
Neuroanatomy
Neuroimaging
Systems Neuroscience
Cerebral Cortex
Cortical Networks for Behavior

MENTORSHIP

Past trainees who are faculty

Full Prof:	Limin Chen (Vanderbilt University)
	Haidong Lu (Beijing Normal University)
	Zheng Wang (Peking University)
Group Leader	Chou Hung (US Army)
Assoc Prof:	Robert Friedman (OHSU)
Asst Prof:	Omar Gharbawie (Univ Pittsburgh)
	Jiaming Hu (Zhejiang Univ)
	Yang Gao (Hangzhou Univ of Electronics)
	Gang Chen (Zhejiang University)
	Hisashi Tanigawa (Zhejiang University)
	Ling Wang (Univ Electronic Science & Technology of China)
Staff Scientist	Mykyta Chernov (OHSU)

INVITED TALKS (selected, past 5 years)

Typically 5-10 invited talks per year. A few selected talks listed below. Universities include: OHSU, RIKEN, Unv Barcelona, Zhejiang Univ, Westlake Univ, Max Planck Frankfurt, Univ Leuven, Tsinghua Univ, Peking Univ, Beijing Normal Univ, Fudan Univ, Shanghai Jiaotong Univ, City Univ Hong Kong, Univ Colorado, CINET Japan, Medical College of Georgia, Beijing Chinese Academy of Sciences, USC, Salk, Medical Coll Georgia, Rutgers, Johns Hopkins, Univ Utah, Univ Minnesota, Vanderbilt U, Wuhan National Laboratory of Optoelectronics, Taiwan University, Yang Ming University of Taipei, Univ Indiana, Univ Houston, Shanghai Inst of Neuroscience,…

2/23 Invited seminar speaker. ONPRC, OHSU, Portland, OR.
1/23 Invited seminar speaker. Univ California at Berkeley, Berkeley, CA.
1/23 Invited seminar speaker. Columbia Univ, New York, NY.
1/23 Invited seminar speaker. New York Univ, New York, NY.
1/23 Invited seminar speaker. Nathan Kline Institute, Orangeburg, NY.
12/22 Invited symposium speaker. SIAT (ShenZhen Institute of Advanced Technology), China (online). 第二届国际脑科学前沿与产业大会·会议日程（2022 年 12 月 28-29 日）
9/22 Invited seminar speaker. Fudan Univ, Shanghai, China.
6/22 Invited seminar speaker, IDIBAPS, Barcelona, Spain.
6/22 Invited Plenary Talk, Zhejiang Univ, Hangzhou, China.
3/22 Invited symposium speaker. RIKEN BDR Symposium, Riken, Japan. Online.
12/21 Invited topic leader. PRIME-DE conference (International Primate Data Exchange) (online).
11/21 Invited Keynote Speaker. SPIE Advanced Biophotonics Conference 2021. Busan, Korea. Online talk.
11/21 Invited Keynote Speaker. 9th International Conference on Parkinson's & Motor Disorders, West Lake, Hangzhou, China 2021
10/21 Invited Keynote Speaker. Westlake International Symposium in Engineering 2021. Hangzhou, China.
10/21 Invited Symposium Speaker. Human Brain Project Summit 2021. Brussels, Belgium. Online talk.
6/21 Invited Keynote speaker. Organization for Human Brain Mapping. Online.
6/21 Invited speaker for Siemens symposium. Organization for Human Brain Mapping. Online.
6/21 Invited symposium speaker for GAITC (Global AI Technology Conference 2021). In person.
5/21 Invited speaker. "Developing Ultrahigh Field MRI in China" International Society Magnetic Resonance & Medicine (ISMRM). Online.
1/21 Invited speaker. Institute of Neuroscience, Chinese Academy of Science, Shanghai, China.
1/21 Invited speaker. "Brain Connectomes: The Future of Personalized Medicine." ARCS, Portland OR.
6/20 Invited speaker. Chinese Computational & Cognitive Neuroscience 2020, Beijing, China. [online conference]
12/19 Invited speaker. ISTBI Symposium on Probing the Brain with Cutting-Edge MRI. Fudan University, Shanghai, China.
6/19 Invited speaker. Ernst Strungmann Institute for Neuroscience and Max Planck Society. Frankfurt, Germany.
6/19 Invited speaker. Gottingen University, German Primate Center. Gottingen, Germany.
12/18 Invited speaker. ISTBI Symposium on Functional and Molecular Imaging, Fudan University, Shanghai, China.
9/18 Invited speaker. 6th Biennial Conference on Resting State and Brain Connectivity. Montreal, Quebec City, Canada.
6/18 Invited speaker. City Univ of Hong Kong. Hong Kong, China.
6/17 Symposium speaker. Cold Spring Harbor Symposium. Suzhou, China.
6/17 Keynote speaker. Oregon National Primate Research Center Annual Retreat. Portland OR
4/17 Plenary speaker. ISMRM, Honolulu Hawaii.
3/17 Speaker. Conference on Primate Cognition. Shenzhen, China.

SOCIETY MEMBERSHIPS

Society for Neuroscience
Association for Advancement of Science
American Physiological Society
American Psychological Society
International Society Magnetic Resonance & Medicine
International Neuropsychological Symposium
Society of Women Engineers
SPIE (Society Photonics, Imaging, & Engineering)
Organization for Human Brain Mapping
Chinese Society for Neuroscience
Vision Sciences Society
Zhejiang Optical Society
Shanghai Nonhuman Primate Consortium Member
Chinese Vision Sciences Society