

Zhi-De Deng

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Research Specialties

- § Noninvasive brain stimulation: technology development, modeling, device safety, translational and clinical applications
- § Computational electromagnetics
- § Electrophysiological and neuroimaging biomarker development
- § Neural plasticity
- § Nonlinear dynamics of physiological systems
- § Translational neuromodeling

Education

- Expected 2024 **M.H.Sc., Clinical Research**, Duke University
- 2013 **Ph.D., Electrical Engineering**, Columbia University
 - § Dissertation: *Electromagnetic Field Modeling of Transcranial Electric & Magnetic Stimulation: Targeting, Individualization, and Safety of Convulsive & Subconvulsive Applications*
- 2011 **M.Phil., Electrical Engineering**, Columbia University
 - § Graduate minor in Neuroscience
- 2007 **M.Eng., Electrical Engineering and Computer Science**, MIT
 - § Thesis: *Stochastic Chaos and Thermodynamic Phase Transitions: Theory and Bayesian Estimation Algorithms*
- 2007 **S.B., Electrical Science and Engineering**, MIT
- 2006 **S.B., Physics**, MIT
 - § Minor in Economics

Professional Appointments & Employment

Academic

- 2019–present **Staff Scientist, Director of Computational Neurostimulation Research Program**, Noninvasive Neuromodulation Unit, Experimental Therapeutics & Pathophysiology Branch, Intramural Research Program, NIMH
- 2016–2024 **Adjunct Assistant Professor**, Department of Psychiatry & Behavioral Sciences, Duke University School of Medicine
- 2016–2019 **Research Fellow**, Noninvasive Neuromodulation Unit, Experimental Therapeutics & Pathophysiology Branch, Intramural Research Program, NIMH
 § Richard J. Wyatt Memorial Fellowship for Translational Research
- 2015–2024 **Faculty**, Duke Institute for Brain Sciences, Duke University
- 2014–2016 **Medical Instructor**, Department of Psychiatry & Behavioral Sciences, Duke University School of Medicine
 § Duke Translational Medicine Institute KL2 Fellow
- 2013–2014 **Postdoctoral Associate**, Department of Psychiatry & Behavioral Sciences, Duke University School of Medicine
- 2010–2013 **Visiting Graduate Research Assistant**, Department of Psychiatry & Behavioral Sciences, Duke University School of Medicine
- 2007–2010 **Graduate Research Assistant**, Department of Psychiatry, Columbia University College of Physicians and Surgeons/New York State Psychiatric Institute
 § Columbia Irving Institute for Clinical and Translational Research T32 Fellow
- 2006–2007 **Graduate Research Assistant**, Harvard–MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology
- 2005–2006 **Undergraduate Research Assistant**, Harvard–MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology

Nonprofit Organization

- 2017–present **Co-founder, Scientific Advisor**, Singula Institute

Internships

- 2004 **Executive Intern**, Department of Anesthesiology, New York–Presbyterian Hospital/Weill Cornell Medical College
- 2003 **Internship Coordinator**, The New York Times Company Foundation
- 2002 **News Technology Intern**, The New York Times Company

Publications (* denotes first, joint first, or senior author)

Refereed Journal Articles

- 86 M. Teferi, H. Gura, M. Patel, A. Casalvera, K.G. Lynch, W. Makhoul, **Z.-D. Deng**, D.J. Oathes, Y.I. Sheline, and N.L. Balderston, “Intermittent theta-burst stimulation to the right dorsolateral prefrontal cortex may increase potentiated startle in healthy individuals,” *Neuropsychopharmacology*, online ahead of print, May 2024.
PMID: 38740902 DOI: 10.1038/s41386-024-01871-w
- 85 L. Beynel, H. Gura, Z. Rezaee, E. C. Ekpo, **Z.-D. Deng**, J.O. Joseph, P. Taylor, B. Lubner, and S.H. Lisanby, “Lessons learned from an fMRI-guided rTMS study on performance in a numerical Stroop task,” *PLOS ONE*, vol.19, no.5, e0302660, May 2024.
PMCID: PMC11073721 DOI: 10.1371/journal.pone.0302660
- 84 S.K. Kar, A. Agrawal, A. Silva-dos-Santos, Y. Gupta, and **Z.-D. Deng**, “The efficacy of transcranial magnetic stimulation in the treatment of obsessive-compulsive disorder: An umbrella review of meta-analyses,” *CNS Spectrums*, vol.29, no.2, pp.109–118, Apr. 2024.
PMID: 38053347 DOI: 10.1017/S1092852923006387
- *83 B. Kadriu, **Z.-D. Deng**, C. Kraus, J.N. Johnston, A. Figtman, I.D. Henter, S. Kasper, and C.A. Zarate, Jr., “The impact of body mass index on clinical features of bipolar disorder: A STEP-BD study,” *Bipolar Disorder*, vol.26, no.2, pp.160–175, Mar. 2024.
PMCID: PMC10839568 DOI: 10.1111/bdi.13370
Media coverage: Psychiatric Times, Feb. 2024 [URL]
- *82 P.L. Robins, S.N. Makaroff, M. Dib, S.H. Lisanby, and **Z.-D. Deng**, “Electric field characteristics of transcranial rotating permanent magnetic stimulation,” *Bioengineering*, vol.11, no.3, 258, Mar. 2024.
PMCID: PMC10968657 DOI: 10.3390/bioengineering11030258
- *81 **Z.-D. Deng**, B. Lubner, S.M. McClintock, R.D. Weiner, M.M. Husain, and S.H. Lisanby, “Clinical outcomes of magnetic seizure therapy vs electroconvulsive therapy for major depressive episode: A randomized clinical trial,” *JAMA Psychiatry*, vol.81, no.3, pp.240–249, Mar. 2024.
PMCID: PMC10701670 DOI: 10.1001/jamapsychiatry.2023.4599
Commentary: [DOI]; Reply: [DOI]
Media coverage: NIMH Research Highlight, Dec. 2023 [URL]; Brain & Behavior Research Foundation, Jan. 2024 [URL]; MedPage Today, Feb. 2024 [URL]; Psychiatric News, Feb. 2024 [DOI]
- *80 C.C. Abbott, J. Miller, D. Farrar, M. Argyelan, M. Lloyd, T. Squillaci, B. Kimbrell, S. Ryan, T.R. Jones, J. Upston, D.K. Quinn, A.V. Peterchev, E. Erhardt, A. Datta, S.M. McClintock, and **Z.-D. Deng**, “Amplitude-determined seizure-threshold, electric field modeling, and electroconvulsive therapy antidepressant and cognitive outcomes,” *Neuropsychopharmacology*, vol.49, no.4, pp.640–648, Mar. 2024.
PMCID: PMC10876627 DOI: 10.1038/s41386-023-01780-4
Research highlight commentary: vol.49, no.4, pp.635–636 [DOI]
- 79 W.A. Wartman, K. Weise, M. Rachh, L. Morales, **Z.-D. Deng**, A.R. Nummenmaa, and S.N. Makaroff, “An adaptive h-refinement method for the boundary element fast multipole method for quasi-static electromagnetic modeling,” *Physics in Medicine and Biology*, vol.69, no.4, 055030, Feb. 2024.
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- 78 M. Argyelan, **Z.-D. Deng**, O.T. Ousdal, L. Oltedal, B. Angulo, M. Baradits, A.J. Spitzberg, U. Kessler, A. Sartorius, A. Dols, K.L. Narr, R. Espinoza, J.A. van Waarde, I. Tendolkar, P. van Eijndhoven, G.A. van Wingen, A. Takamiya, T. Kishimoto, M.B. Jørgensen, A. Jørgensen, O.B. Paulson, A. Yrondi, P. Péran, C. Soriano-Mas, N. Cardoner, M. Cano, L. van Diermen, D. Schrijvers, J.-B. Belge, L. Emsell, F. Bouckaert, M. Vandembulcke, M. Kiebs, R. Hurlemann, P.C.R. Mulders, R. Redlich, U. Dannowski, E. Kavakbasi, M.D. Kritzer, K.K. Ellard, J.A. Camprodon, G. Petrides, A.K. Malhotra, and C.C. Abbott, "Electroconvulsive therapy-induced volumetric brain changes converge on a common causal circuit in depression," *Molecular Psychiatry*, online ahead of print, Nov. 2023.
PMID: 37985787 DOI: 10.1038/s41380-023-02318-2
- 77 S.N. Makaroff, Z. Qi, M. Rachh, W.A. Wartman, K. Weise, G.M. Noetscher, M. Daneshzand, **Z.-D. Deng**, L. Greengard, and A.R. Nummenmaa, "A fast direct solver for surface-based whole-head modeling of transcranial magnetic stimulation," *Scientific Reports*, vol.13, no.8, 18657, Oct. 2023.
PMCID: PMC10618282 DOI: 10.1038/s41598-023-45602-5
- *76 **Z.-D. Deng**, P.L. Robins, M. Dannhauer, L.M. Haugen, J.D. Port, and P.E. Croarkin, "Optimizing TMS coil placement approaches for targeting the dorsolateral prefrontal cortex in depressed adolescents: An electric field modeling study," *Biomedicines*, vol.11, no.8, 2320, Aug. 2023.
PMCID: PMC10452519 DOI: 10.3390/biomedicines11082320
- 75 C. Kraus, A. Kautzky, V. Watzal, A. Gramser, B. Kadriu, **Z.-D. Deng**, L. Bartova, C.A. Zarate, Jr., R. Lanzenberger, D. Souery, S. Montgomery, J. Mendlewicz, J. Zohar, G. Fanelli, A. Serretti, and S. Kasper, "Body mass index and clinical outcomes in individuals with major depressive disorder: Finding from the GSRD European Multicenter Database," *Journal of Affective Disorder*, vol.335, pp.349-357, Aug. 2023.
PMCID: PMC10502963 DOI: 10.1016/j.jad.2023.05.042
- 74 M. Teferi, W. Makhoul, **Z.-D. Deng**, D.J. Oathes, Y.I. Sheline, and N.L. Balderston, "Continuous theta burst stimulation to the right dorsolateral prefrontal cortex may increase potentiated startle in healthy individuals," *Biological Psychiatry: Global Open Science*, vol.3, no.3, pp.470-479, July 2023.
PMCID: PMC10382694 DOI: 10.1016/j.bpsgos.2022.04.001
- 73 J. Miller, T.R. Jones, J. Upston, **Z.-D. Deng**, S.M. McClintock, E. Erhardt, D. Farrar, D.K. Quinn, and C.C. Abbott, "Electric field, ictal theta power, and clinical outcomes in electroconvulsive therapy," *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, vol.8, no.7, pp.760-767, July 2023.
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- 72 A. Guillen, C.C. Abbott, **Z.-D. Deng**, Y. Huang, P. Pascoal-Faria, D.Q. Truong, and A. Datta, "Impact of modeled field of view in electroconvulsive therapy current flow simulations," *Frontiers in Psychiatry*, vol.14, 1168672, May 2023.
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- 71 M. Alawi, P.F. Lee, **Z.-D. Deng**, Y.K. Goh, and P.E. Croarkin, "Modelling the differential effects of age on transcranial magnetic stimulation induced electric fields," *Journal of Neural Engineering*, vol.20, no.2, 026016, Mar. 2023.
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- 70 X. Chen, R. Ma, W. Zhang, G.Q. Zeng, Q. Wu, A. Yimiti, X. Xia, J. Cui, Q. Liu, X. Meng, J. Bu, Q. Chen, Y. Pan, N.X. Yu, S. Wang, **Z.-D. Deng**, A. T. Sack, M. Mc Laughlin, and X. Zhang, "Alpha oscillatory activity is causally linked to working memory retention," *PLOS Biology*, vol. 21, no. 2, e3001999, Feb. 2023.
 PMID: PMC9983870 DOI: 10.1371/journal.pbio.3001999
- 69 Z. Fu, C.C. Abbott, J. Miller, **Z.-D. Deng**, S.M. McClintock, M.S.E. Sendi, J. Sui, and V.D. Calhoun, "Cerebro-cerebellar functional neuroplasticity mediates the effect of electric field on electroconvulsive therapy outcomes," *Translational Psychiatry*, vol. 13, 43, Feb. 2023.
 PMID: PMC9902462 DOI: 10.1038/s41398-023-02312-w
- *68 S.N. Makaroff, H. Nguyen, Q. Meng, H. Lu, A. Nummenmaa, and **Z.-D. Deng**, "Modeling transcranial magnetic stimulation coils with magnetic cores," *Journal of Neural Engineering*, vol. 20, no. 1, 016028, Jan. 2023.
 PMID: PMC10481791 DOI: 10.1088/1741-2552/acae0d
- 67 S. Qi, V.D. Calhoun, D. Zhang, J. Miller, **Z.-D. Deng**, K.L. Narr, Y.I. Sheline, S.M. McClintock, R. Jiang, X. Yang, J. Upston, T.R. Jones, J. Sui, and C.C. Abbott, "Links between electroconvulsive therapy responsive and cognitive impairment multimodal brain networks in late-life major depressive disorder," *BMC Medicine*, vol. 22, 477, Dec. 2022.
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- 66 H. Li, **Z.-D. Deng**, D. Oathes, and Y. Fan, "Computation of transcranial magnetic stimulation electric fields using self-supervised deep learning," *NeuroImage*, vol. 264, 119705, Dec. 2022.
 PMID: PMC9854270 DOI: 10.1016/j.neuroimage.2022.119705
- 65 A. Richie-Halford, M. Cieslak, L. Ai, S. Caffarra, S. Covitz, A.R. Franco, I.I. Karipidis, J. Kruper, M. Milham, B. Avelar-Pereira, E. Roy, V.J. Sydnor, J. Yeatman, The Fibr Community Science Consortium [including **Z.-D. Deng**], T.D. Satterthwaite, and A. Rokem, "An analysis-ready and quality controlled resource for pediatric brain white-matter research," *Scientific Data*, vol. 9, 616, Oct. 2022.
 PMID: PMC9556519 DOI: 10.1038/s41597-022-01695-7
- 64 J. Miller, T. Jones, J. Upston, **Z.-D. Deng**, S.M. McClintock, S. Ryman, D. Quinn, and C.C. Abbott, "Ictal theta power as an electroconvulsive therapy safety biomarker: A pilot study," *The Journal of ECT*, vol. 38, no. 2, pp. 88–94, June 2022.
 PMID: PMC10680084 DOI: 10.1097/YCT.0000000000000812
- 63 H. Bagherzadeh, Q. Meng, **Z.-D. Deng**, H. Lu, E. Hong, Y. Yang, and F.-S. Choa, "Angle-tuned coils: Attractive building blocks for TMS with improved depth-spread performance," *Journal of Neural Engineering*, vol. 19, no. 2, 026059, May 2022.
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- 62 B. Luber, S.W. Davis, **Z.-D. Deng**, D. Murphy, A. Martella, A.V. Peterchev, and S.H. Lisanby, "Using diffusion tensor imaging to effectively target TMS to deep brain structures," *NeuroImage*, vol. 249, 118863, Apr. 2022.
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- *61 **Z.-D. Deng**, M. Argyelan, J. Miller, D. Quinn, M. Lloyd, T. R. Jones, J. Upston, E. Erhardt, S. M. McClintock, and C. C. Abbott, "Electroconvulsive therapy, electric field, neuroplasticity, and clinical outcomes," *Molecular Psychiatry*, vol.27, no.3, pp.1676-1682, Mar. 2022.
 PMID: PMC9095458 DOI: 10.1038/s41380-021-01380-y
 Commentary: vol.27, no.9, pp.3571-3572 [DOI]; Reply: online ahead of print [DOI]
- 60 N. L. Balderston, J. C. Beer, D. Seok, W. Makhoul, **Z.-D. Deng**, T. Girelli, M. Teferi, N. Smyk, M. Jaskir, D. J. Oathes, R. T. Shinohara, and Y. I. Sheline, "Proof of concept study to develop a novel connectivity-based electric-field modelling approach for individualized targeting of transcranial magnetic stimulation treatment," *Neuropsychopharmacology*, vol. 47, no. 2, pp. 588-598, Jan. 2022.
 PMID: PMC8674270 DOI: 10.1038/s41386-021-01110-6
- 59 S. H. Lisanby, S. M. McClintock, W. V. McCall, R. G. Knapp, C. M. Cullum, M. Mueller, **Z.-D. Deng**, A. A. Teklehaimanot, M. V. Rudorfer, E. Bernhardt, G. Alexopoulos, S. H. Bailine, M. C. Briggs, E. T. Geduldig, R. M. Greenberg, M. M. Husain, S. Kaliora, V. Latousakis, L. S. Liebman, G. Petrides, J. Prudic, P. B. Rosenquist, S. Sampson, K. G. Tobias, R. D. Weiner, R. C. Young, C. H. Kellner, Prolonging Remission in Depressed Elderly (PRIDE) Work Group, "Longitudinal neurocognitive effects of combined electroconvulsive therapy (ECT) and pharmacotherapy in geriatric major depressive disorder: Phase 2 of the PRIDE study," *American Journal of Geriatric Psychiatry*, vol. 30, no. 1, pp. 15-28, Jan. 2022.
 PMID: PMC8595359 DOI: 10.1016/j.jagp.2021.04.006
- 58 B. Kadriu, C. A. Farmer, P. Yuan, L. T. Park, **Z.-D. Deng**, R. Moaddel, I. D. Henter, B. Shovestul, E. D. Ballard, C. Kraus, P. W. Gold, R. Machado-Vieira, and C. A. Zarate, Jr., "The kynurenine pathway and bipolar disorder: Intersection of the monoaminergic and glutamatergic systems and immune response," *Molecular Psychiatry*, vol. 26, no. 8, pp. 4085-4095, Aug. 2021.
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- 57 A. Takamiya, F. Bouckaert, M. Laroy, J. Blommaert, A. Radwan, A. Khatoun, **Z.-D. Deng**, M. Mc Laughlin, W. Van Paesschen, F.-L. De Winter, J. Van den Stock, S. Sunaert, P. Sienaert, M. Vandenbulcke, and L. Emsell, "Biophysical mechanisms of electroconvulsive therapy-induced volume expansion in the medial temporal lobe: A longitudinal *in vivo* human imaging study," *Brain Stimulation*, vol. 14, no. 4, pp. 1038-1047, July-Aug. 2021.
 PMID: PMC8474653 DOI: 10.1016/j.brs.2021.06.011
- 56 E. A. Friðgeirsson, **Z.-D. Deng**, D. Denys, J. A. van Waarde, and G. A. van Wingen, "Electric field strength induced by electroconvulsive therapy may be associated with clinical outcome: A pilot study," *NeuroImage: Clinical*, vol. 30, 102581, Feb. 2021.
 PMID: PMC7895836 DOI: 10.1016/j.nicl.2021.102581
- 55 P. J. C. Suen, S. Doll, M. C. Battistuzzo, G. Busatto, L. B. Razza, F. Padberg, E. Mezger, L. Bulubas, D. Keeser, **Z.-D. Deng**, and A. R. Brunoni, "Association between tDCS computational modeling and clinical outcomes in depression: Data from the ELECT-TDCS trial," *European Archives of Psychiatry and Clinical Neuroscience*, vol. 271, no. 1, pp. 101-110, Feb. 2021.
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- 54 C. C. Abbott, D. Quinn, J. Miller, E. Ye, S. Iqbal, M. Lloyd, T.R. Jones, J. Upston, **Z.-D. Deng**, E. Erhardt, and S.M. McClintock, "Electroconvulsive therapy pulse amplitude and clinical outcomes," *American Journal of Geriatric Psychiatry*, vol.29, no.2, pp.166–178, Jan. 2021.
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- 53 M.L. Cox, **Z.-D. Deng**, H. Palmer, A. Watts, L. Beynel, J.R. Young, S.H. Lisanby, J. Migaly, and L.G. Appelbaum, "Utilizing transcranial direct current stimulation to enhance laparoscopic technical skills training: A randomized controlled trial," *Brain Stimulation*, vol.13, no.3, pp.863–872, May–June 2020.
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- 52 S. Aronson Fischell, T. J. Ross, **Z.-D. Deng**, B. J. Salmeron, and E. A. Stein, "Transcranial direct current stimulation applied to the dorsolateral and ventromedial prefrontal cortices in smokers modifies cognitive circuits implicated in the nicotine withdrawal syndrome," *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, vol.5, no.4, pp.448–460, Apr. 2020.
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- 51 S. H. Lisanby, S. M. McClintock, G. Alexopoulos, S. H. Bailine, E. Bernhardt, M. C. Briggs, C. M. Cullum, **Z.-D. Deng**, M. Dooley, E. T. Geduldig, R. M. Greenberg, M. M. Husain, S. Kaliora, R. G. Knapp, V. Latoussakis, L. S. Liebman, W. V. McCall, M. Mueller, G. Petrides, J. Prudic, P. B. Rosenquist, M. V. Rudorfer, S. Sampson, A. A. Teklehaimanot, K. G. Tobias, R. D. Weiner, R. C. Young, C. H. Kellner, on behalf of the CORE/PRIDE Work Group, "Neurocognitive effects of combined electroconvulsive therapy (ECT) and venlafaxine in geriatric depression: Phase 1 of the PRIDE study," *American Journal of Geriatric Psychiatry*, vol.28, no.3, pp.304–316, Mar. 2020.
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- 50 N. L. Balderston, E. M. Beydler, C. Roberts, **Z.-D. Deng**, T. Radman, T. Lago, B. Luber, S. H. Lisanby, M. Ernst, and C. Grillon, "Mechanistic link between right prefrontal cortical activity and anxious arousal revealed using transcranial magnetic stimulation in healthy subjects," *Neuropsychopharmacology*, vol.45, no.4, pp.694–702, Mar. 2020.
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- 49 L.-Z. Yang, W. Zhang, W. Wang, Z. Yang, H. Wang, **Z.-D. Deng**, C. Li, B. Qiu, D.-R. Zhang, R. Cohen Kadosh, H. Li, and X. Zhang, "Neural and psychological predictors of cognitive enhancement and impairment due to neurostimulation," *Advanced Science*, vol.7, no.4, 1902863, Feb. 2020.
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- 48 N. L. Balderston, E. M. Beydler, M. Goodwin, **Z.-D. Deng**, T. Radman, B. Luber, S. H. Lisanby, M. Ernst, and C. Grillon, "Low-frequency parietal repetitive transcranial magnetic stimulation reduces fear and anxiety," *Translational Psychiatry*, vol.10, no.1, 68, Feb. 2020.
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- 47 T. Dufor, S. Grehl, A. D. Tang, M. Doulazmi, M. Traoré, N. Debray, C. Dubacq, **Z.-D. Deng**, J. Mariani, A. M. Lohof, and R. M. Sherrard, "Neural circuit repair by low-intensity magnetic stimulation requires cellular magnetoreceptors and specific stimulation patterns," *Science Advances*, vol.5, no.10, eaav9847, Oct. 2019.
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- *45 L. Beynel, L.G. Appelbaum, B. Luber, C.A. Crowell, S.A. Hilbig, W. Lim, D. Nguyen, N.A. Chrapliwy, S.W. Davis, R. Cabeza, S.H. Lisanby, and **Z.-D. Deng**, “Effects of on-line repetitive transcranial magnetic stimulation (rTMS) on cognitive processing: a meta-analysis and recommendations for future studies,” *Neuroscience and Biobehavioral Reviews*, vol.107, pp.47–58, Dec. 2019.
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- 44 S.M. Goetz, S.M. Madhi Alavi, **Z.-D. Deng**, and A.V. Peterchev, “Statistical model of motor evoked potentials,” *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol.27, no.8, pp.1539–1545, Aug. 2019.
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- 43 T. Popa, L.S. Morris, R. Hunt, **Z.-D. Deng**, S. Horovitz, K. Mente, H. Shitara, K. Baek, M. Hallett, and V. Voon, “Modulation of resting connectivity between the mesial frontal cortex and basal ganglia,” *Frontiers in Neurology*, vol.10, 587, June 2019.
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- 42 M.J. Dubin, I.P. Ilieva, **Z.-D. Deng**, J. Thomas, A. Albright, K. Kravets, B.D. Brody, P.J. Christos, J.H. Kocsis, C. Liston, and F.M. Gunning, “A double-blind pilot dosing study of low field magnetic stimulation (LFMS) for treatment-resistant depression (TRD),” *Journal of Affective Disorders*, vol.249, pp.286–293, Apr. 2019.
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- 41 P.E. Croarkin, P.A. Nakonezny, **Z.-D. Deng**, M. Romanowicz, J.L. Vande Voort, D. Doruk Camsari, K.M. Schak, J.D. Port, and C.P. Lewis, “High frequency repetitive TMS for suicidal ideation in adolescents with depression,” *Journal of Affective Disorders*, vol.239, pp.282–290, Oct. 2018.
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- 40 B. Wang, M.R. Shen, **Z.-D. Deng**, J.E. Smith, J.J. Tharayil, C.J. Gurrey, L.J. Gomez, and A.V. Peterchev, “Redesigning existing transcranial magnetic stimulation coils to reduce energy: Application to low field magnetic stimulation,” *Journal of Neural Engineering*, vol.15, no.3, 036022, Apr. 2018.
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- 39 S. Grehl, D. Martina, C. Goyenvalle, **Z.-D. Deng**, J. Rodger, and R.M. Sherrard, “*In vitro* magnetic stimulation: A simple stimulation device to deliver defined low intensity electromagnetic fields,” *Frontiers in Neural Circuits*, vol.10, 85, Nov. 2016.
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- 0 C. Thomas, **Z.-D. Deng**, Y. Huang, C. C. Abbott, G. Venkatasubramanian, and A. Datta, “Exploring the potential impact of race on cortical current flow due to ECT: A computational analysis.”
- 0 N. I. Hasan, M. Dannhauer, D. Wang, **Z.-D. Deng**, and L. J. Gomez, “Real-time computation of brain E-field for enhanced transcranial magnetic stimulation neuronavigation and optimization,” *bioRxiv*, Oct. 2023.
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- 0 B. Luber, L. Beynel, **Z.-D. Deng**, L. G. Appelbaum, T. Jones, A. Harrison, D. L. K. Murphy, E. Lo, R. A. McKinley, and S. H. Lisanby, “Site- and frequency-specific enhancement of visual search performance with online individual alpha frequency (IAF) repetitive transcranial magnetic stimulation (rTMS) to the inferior frontal junction.”
- 0 N. Khadka, **Z.-D. Deng**, S. H. Lisanby, M. Bikson, and J. A. Camprodon, “Computational models of high-definition electroconvulsive therapy (ECT) for focal or multi-targeting.”
- 0 H. Nguyen, C. Q. Li, S. Hoffman, **Z.-D. Deng**, Y. Yang, and H. Lu, “Ultra-high frequency repetitive TMS at subthreshold intensity induces suprathreshold motor response via temporal summation.”
- 0 J. R. Young, J. T. Galla, C. S. Polick, **Z.-D. Deng**, M. Dannhauer, A. Kirby, M. Dennis, C. W. Papanikolas, M. K. Evans, S. D. Moore, E. A. Dedert, M. A. Addicott, L. G. Appelbaum, and J. C. Beckham, “Multimodal smoking cessation treatment combining transcranial magnetic stimulation, cognitive behavioral therapy, and nicotine replacement therapy in veterans with posttraumatic stress disorder: A feasibility randomized controlled trial protocol,” *medRxiv*, Sept. 2023.
PMCID: PMC10602046 DOI: 10.1101/2023.09.06.23294958
- 0 L. Morales, W. A. Wartman, J. Ferreira, A. Miles, M. Daneshzand, H. Lu, A. R. Nummenmaa, **Z.-D. Deng**, and S. N. Makaroff, “Software package for transcranial magnetic stimulation coil and coil array analysis and design,” *bioRxiv*, Aug. 2023.
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- *0 M. Dib, J. D. Lewine, C. C. Abbott, and **Z.-D. Deng**, “Electroconvulsive therapy modulates loudness dependence of auditory evoked potentials: A pilot MEG study,” *medRxiv*, Apr. 2024.
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Dissertation & Thesis

- *2 **Z.-D. Deng**, “Electromagnetic Field Modeling of Transcranial Electric and Magnetic Stimulation: Targeting, Individualization, and Safety of Convulsive and Subconvulsive Applications,” Ph.D. dissertation, Columbia University, Department of Electrical Engineering, New York, NY, 2013. Sponsor: K.L. Shepard. Available: Columbia University Academic Commons, DOI: 10.7916/D8F47WCS
- *1 **Z.-D. Deng**, “Stochastic Chaos and Thermodynamic Phase Transitions: Theory and Bayesian Estimation Algorithms,” M.Eng. thesis, Massachusetts Institute of Technology, Department of Electrical Engineering and Computer Science, Cambridge, MA, 2007. Sponsor: C.-S. Poon. Available: DSpace@MIT, HDL: 1721.1/41649

Selected Abstracts (10/156)

- *10 P.L. Robins, S.N. Makaroff, and **Z.-D. Deng**, “Electric field characteristics of rotating permanent magnet stimulation,” *Biomedical Engineering Society Annual Meeting*, 2023; also presented at *NIMH IRP Fellows’ Scientific Training Day*, 2023. **NIMH IRP Trainee Travel Award**
- *9 J. Kim, B.A. Pritchard, G.R. Dold, R.H. Schor, S.H. Lisanby, and **Z.-D. Deng**, “Multi-channel Individualized Stimulation Therapy (MIST) system for treatment of depression,” *Proceedings of the IEEE Engineering in Medicine and Biology Society*, 2023.
- *8 M. Dannhauer and **Z.-D. Deng**, “Optimizing the placements of multielectrode tES montages from EEG dipole modeling,” *Brain Stimulation*, vol.16, no.1, pp.136–137, 2023.
- *7 P.L. Robins, M. Dannhauer, L.M. Haugen, J.D. Port, P.E. Croarkin, and **Z.-D. Deng**, “Comparison of coil localization approaches and induced electric fields in depressed adolescents receiving repetitive transcranial magnetic stimulation,” *Brain & Human Body Modeling Conference*, 2022. **First Place in International Student Competition**
- *6 **Z.-D. Deng**, “Introduction to computational psychiatry,” *Journal of the American Academy of Child and Adolescent Psychiatry*, vol.60, no.10, pp.S308–S309, 2021.
- *5 **Z.-D. Deng**, “Toward individualized seizure therapy,” *Neuropsychopharmacology*, vol.44, p.S75, 2019.
- *4 **Z.-D. Deng**, E.M. Lo, L. Beynel, E. Fang, B. Luber, and A.D. Krystal, “Cortical excitability in patients with treatment resistant depression,” *Biological Psychiatry*, vol.81, no.10, p.S242, 2017.
- *3 **Z.-D. Deng**, S.M. McClintock, and S.H. Lisanby, “Connectivity analysis of resting EEG in depressed patients receiving electroconvulsive therapy and magnetic seizure therapy,” *Neuropsychopharmacology*, vol.40, no.S1, p.S486, 2015.
- *2 **Z.-D. Deng**, S.M. McClintock, and S.H. Lisanby, “EEG-based graph theoretical measures as biomarkers of clinical outcome in electroconvulsive and magnetic seizure therapy,” *The National Network of Depression Centers Annual Conference*, 2014. **Innovative Poster Award**
- *1 **Z.-D. Deng**, S.H. Lisanby, and A.V. Peterchev, “Improving the focality of electroconvulsive therapy: The roles of current amplitude, and electrode size and spacing,” *The Journal of ECT*, vol.26, no.2, p.151, 2010. **Best Abstract Award**

Intellectual Property

- 8 PRecision, Optimally Targeted, Electroconvulsive Therapy (PROTECT)
 Inventors: **Z.-D. Deng**, J. Kim, G. R. Dold, B. A. Pritchard, R. H. Schor, S. H. Lisanby
 § US Provisional Patent application; June 4, 2024
- 7 Systems and methods for multichannel individualized stimulation therapy
 Inventors: **Z.-D. Deng**, B. A. Pritchard, J. Kim, G. R. Dold, R. H. Schor, S. H. Lisanby
 Assignee: NIH
 § PCT/US24/23876; Apr.10, 2024
 § US Provisional Patent application No. 63/495,244; Apr.10, 2023
- 6 Systems and methods for E-field informed electroconvulsive therapy
 Inventors: C. C. Abbott, **Z.-D. Deng**, J. Upston, T. Jones, A. Datta
 Assignee: University of New Mexico
 § PCT/US24/10363; Jan.4, 2024
 § US Provisional Patent application No. 63/437,017; Jan. 4, 2023
- 5 Systems and methods for amplitude-determined seizure titrations and electric field modeling in electroconvulsive therapy
 Inventors: C. C. Abbott, A. Datta, J. Upston, T. Jones, **Z.-D. Deng**
 Assignee: University of New Mexico
 § US Provisional Patent application No. 63/516,371; July 28, 2023
- 4 Whole body non-contact electrical stimulation device with variable parameters
 Inventors: S. N. Makarov, G. M. Noetscher, V. S. Makarov, **Z.-D. Deng**
 Assignee: NEVA Electromagnetics, LLC
 § US No.10,551,449; Feb. 4, 2020
- 3 Systems and methods for detecting a physiological abnormality in a patient by using cardiac or other chaos in combination with a non-increasing parasympathetic modulation
 Inventors: C.-S. Poon, **Z.-D. Deng**
 Assignee: MIT
 § US No.9,737,258; Aug. 22, 2017
 § PCT WO/2014/120353; July 8, 2014
- 2 Transcranial magnetic stimulation coil with electronically switchable active and sham modes
 Inventors: A. V. Peterchev, **Z.-D. Deng**
 Assignee: Columbia University
 § US Provisional Patent application No. 61/525,922; Aug. 22, 2011
- 1 Methods, apparatus, and systems for magnetic stimulation
 Inventors: A. V. Peterchev, S. H. Lisanby, **Z.-D. Deng**
 Assignee: Columbia University
 § US No.9,295,853; Mar. 29, 2016
 § US No.8,801,589; Aug.12, 2014
 § PCT WO/2010/017249, US 2011/0184223 A1, US 2009/052768; Aug. 4, 2009

Research Support

Pending Research Support

- 2024.02 **Targeting the causal depression network with electroconvulsive therapy**
NIH/NIMH R33/R61 (PI: M. Argyelan)
Role: Intramural NIH collaborator
- 2023.11 **Optimizing accelerated iTBS intersession interval to target Connectivity in Depression (CONNECT-D)**
NIH/NIMH U01 (PIs: Y.I. Sheline, Z. J. Daskalakis, P.B. Fitzgerald)
Role: Intramural NIH collaborator
- 2023.06 **Improving the optimization of TMS coil placement with precise calculation of electric fields and robust computation of personalized functional networks**
NIH/NIMH R01 (PI: Y. Fan)
Role: Intramural NIH collaborator

Ongoing Research Support

- 2024–
2027 **ADEPT: Adaptive trial for the treatment of depression associated with concussion using repetitive transcranial magnetic stimulation protocols**
Congressional Directed Medical Research Programs (PI: D.L. Brody)
Role: Intramural NIH collaborator
This study aims to compare different types of TMS that may alleviate depressive symptoms in US military service members with a history of concussion.
- 2023.07–
2028.05 **Charge-based brain modeling engine with boundary element fast multipole method**
NIH/NIMH R01 MH130490 (PI: S.N. Makaroff)
Role: Intramural NIH collaborator
This project seeks to create a new brain modeling engine that employs boundary element and fast multipole methods to achieve superior spatial resolution and accuracy in electromagnetic modeling, outperforming traditional approaches based on the finite element method.
- 2024.04– **Cognitive and neural correlates of TMS motor intracortical inhibition in schizophrenia**
NIH/NIMH K01 (PI: S.M. Hare)
Role: Intramural NIH collaborator/advisor
This study investigates the clinical significance of a paired-pulse TMS marker of cortical excitability, the short-interval intracortical inhibition, which is consistently reduced in individuals with schizophrenia.
- 2022.09–
2027.06 **Novel electric-field modeling approach to quantify changes in resting state functional connectivity following theta burst stimulation**
NIH/NIMH U01 MH130447 (PI: N.L. Balderston)
Role: Intramural NIH collaborator
This study aims to develop a model using whole-brain estimates of the TMS-induced electric field to predict changes in resting state functional connectivity following neuromodulatory TMS, and validate this model in a large cohort of healthy volunteers receiving multiple doses of either intermittent or continuous theta burst stimulation.

Ongoing Research Support (continue)

- 2023.02–
present **Development of a novel, scalable, neurobiologically-guided transcranial magnetic stimulation protocol for the treatment of cannabis use disorder**
Centre for Addiction and Mental Health, Toronto, ON, Canada (PI: V.M. Tang)
Role: Consultant
This proof-of-concept clinical trial will evaluate the feasibility and tolerability of a 4-week course of rTMS to the prefrontal cortex and insula as a treatment for cannabis use disorder.
- 2022.08–
2027.05 **Deciphering mechanisms of ECT outcomes and adverse effects (DECODE)**
NIH/NIMH R01 (MH128686 PI: Y.I. Sheline; MH128690 PIs: K.L. Narr, R. Espinoza; MH128691 PI: S.M. McClintock; MH128692 PI: C.C. Abbott)
Role: Intramural NIH collaborator
This multi-site prospective study aims to study the mechanism of ECT-induced antidepressant benefits and cognitive adverse effects to determine optimal ECT dose.
- 2021.02–
2023.01 **Electroconvulsive therapy amplitude titration for improved clinical outcomes in late-life depression**
NIH/NIMH R61/R33 MH125126 (PI: C.C. Abbott)
Role: Intramural NIH collaborator
This study uses titrated amplitude ECT, individualized based on seizure threshold, to improve clinical response while minimizing cognitive impairment in geriatric depression.
- 2020.05–
2023.04 **Neuromodulation of social cognitive circuitry in people with schizophrenia spectrum disorders**
NIH/NIMH R61/R33 MH120188 (PIs: A.N. Voineskos, D.M. Blumberger)
Role: Intramural NIH collaborator
This study uses advanced brain imaging, and compare different brain stimulation techniques, to determine whether targeting the dorsomedial prefrontal cortex can engage social cognitive brain circuitry in people with schizophrenia spectrum disorders.
- 2019.04–
2026.02 **Efficacy of biomarker-guided rTMS for treatment resistant depression**
NIH/NIMH R01 MH118388 (PIs: C.M. Liston, F.M. Gunning, N.R. Williams)
Role: Intramural NIH collaborator
This confirmatory efficacy trial tests a novel, biotype-guided treatment selection strategy for rTMS in treatment-resistant depression.
- 2019.09–
2023.07 **Examining the mechanisms of anxiety regulation using a novel, sham-controlled, fMRI-guided rTMS protocol and a translational laboratory model of anxiety**
NIH/NIMH K01 MH121777 (PI: N.L. Balderston)
Role: Intramural NIH collaborator/advisor
This study uses rTMS to study the effect of right dlPFC activity on objective and subjective measures of induced anxiety, anxiety-related working memory deficits, and TMS-evoked BOLD responses during simultaneous TMS–fMRI.
- 2020.09–
2025.08 **Personalized circuit-based neuromodulation targets for depression**
NIH/NIMH K23 MH121657 (PI: S.H. Siddiqi)
Role: Intramural NIH collaborator/advisor
This study aims to better understand how distinct brain circuits can be mapped and selectively stimulated with TMS to treat different symptoms of major depression.

NIH Protocols

- 2021–present **A feasibility study of Transcranial Electric Stimulation Therapy (TEST) for treatment resistant depression (TRD)**
NIMH Protocol 21-M-0031 (PI: S. H. Lisanby)
Role: Associate investigator
- 2020–present **Role of GABAergic transmission in auditory processing in Autism Spectrum Disorder**
NIMH Protocol 20-M-0159 (PI: S. H. Lisanby)
Role: Associate investigator
- 2019–present **Safety and feasibility of individualized low amplitude seizure therapy**
NIMH Protocol 19-M-0073 (PI: S. H. Lisanby)
Role: Associate investigator
- 2019–present **Mechanism of action underlying ketamine’s antidepressant effects: an investigation of the AMPA throughput theory in patients with treatment-resistant major depression**
NIMH Protocol 19-M-0107 (PI: C. A. Zarate, Jr.)
Role: Associate investigator
- 2017–present **Concurrent fMRI-guided rTMS and cognitive therapy for the treatment of major depressive episodes**
NIMH Protocol 17-M-0147 (PI: S. H. Lisanby)
Role: Associate investigator
- 2017–present **Development of non-invasive brain stimulation techniques**
NIMH Protocol 18-M-0015 (PI: S. H. Lisanby)
Role: Associate investigator
- 2017–present **Development of functional and structural magnetic resonance imaging techniques for the study of mood and anxiety disorders**
NIMH Protocol 07-M-0021 (PI: A. C. Nugent)
Role: Associate investigator
- 2017–present **Identifying neurobiological mechanisms that underlie acute nicotine withdrawal and drive early relapse in smokers**
NIDA Protocol 12-DA-N474 (PI: A. Janes)
Role: Associate investigator
- 2016–present **Neuropharmacologic imaging and biomarker assessments of response to acute and repeated-dosed ketamine infusions in major depressive disorder**
NIMH Protocol 17-M-0060 (PI: C. A. Zarate, Jr.)
Role: Associate investigator
- 2016–present **Evaluation of patients with mood and anxiety disorders and healthy volunteers**
NIMH Protocol 01-M-0254 (PI: C. A. Zarate, Jr.)
Role: Associate investigator
- 2018–2019 **Modulation of the parieto–frontal communication**
NINDS Protocol 18-N-0054 (PI: M. Hallett)
Role: Associate investigator
- 2017–2019 **Effect of TMS to frontoparietal attention network on anxiety potentiated startle**
NIMH Protocol 17-M-0042 (PI: C. Grillon)
Role: Associate investigator

Completed Research Support

- 2016.09–
2020.07 **ECT pulse amplitude and medial temporal lobe engagement**
NIH/NINDS U01 MH111826 (PI: C. C. Abbott)
Role: Co-I
This study explores the impact of targeted hippocampal engagement with varying levels of electroconvulsive therapy current amplitude in elderly patients with clinical, neuropsychological and neuroimaging assessments.
- 2018.06–
2020.06 **Individualized low amplitude seizure therapy (iLAST)**
Brain & Behavior Research Foundation Young Investigator Award 26161
Role: PI
This study aims to develop a novel form of seizure therapy for depression that avoids the neurocognitive side effects of electroconvulsive therapy by using computational modeling to direct multi-electrode configurations that provide targeted and individualized dosing.
- 2016.06–
2017.12 **Fast-Fail Trials: Mood and Anxiety Spectrum Disorders (FAST-MAS)**
NIMH 271201200006I-3-27100003-1 (PI: A. D. Krystal)
Role: Data analyst
The goal of this project is to establish the kappa opiate receptor occupancy and mu opiate receptor effects after two weeks of daily dosing with the investigational agent LY2456302, which has been demonstrated to be a selective kappa opiate receptor antagonist.
- 2015.04–
2017.01 **Transcranial direct current stimulation as a treatment for acute fear**
NIH/NIMH R21 MH106772 (PI: A. D. Krystal)
Role: Co-I
This study investigates the utility of transcranial direct current stimulation to engage a target neural circuit, which could serve as the basis for developing better therapies for those suffering from acute fear related difficulties.
- 2014.07–
2016.06 **Individualized optimally-targeted seizure therapy**
NIH/NCATS KL2 TR001115 (Training Grant PI: R. M. Califf)
Role: PI
This award from the Duke Translational Medicine Institute prepares the fellow for a successful career as a multidisciplinary independent investigator in the field of brain stimulation. The goal of the project is to develop a novel individualized neurotargeted seizure therapy.
- 2015.03–
2016.06 **Safety and feasibility of low amplitude electroconvulsive therapy**
Duke University School of Medicine, Pilot fund
Role: PI
This study evaluates whether neurocognitive side effects of electroconvulsive therapy can be improved by reducing the current pulse amplitude.
- 2009.04–
2016.03 **Prolonging Remission In Depressed Elderly (PRIDE)**
NIH/NIMH U01 MH084241 (PI: S. H. Lisanby)
Role: Data analyst
This study evaluates the efficacy and neurocognitive effects of combined electroconvulsive and pharmaco-therapy in prolonging remission in elderly patients with major depression.
- 2015.04–
2016.06 **Low field magnetic stimulation coil design**
Tal Medical (PI: A. V. Peterchev)
Role: Co-I
This project develops a novel coil system for low field magnetic stimulation.

Completed Research Support (continue)

- 2015.11–
2016.06 **Concurrent cognitive behavioral therapy and transcranial magnetic stimulation in obsessive-compulsive disorder**
American Psychiatric Association Research Scholarship (Grantee: Y. Hu)
Role: Acting PI
The purpose of this pilot study is to evaluate the feasibility of repetitive transcranial magnetic stimulation of the supplementary motor area concurrently with elements of exposure and response prevention in patients with obsessive-compulsive disorder.
- 2014.01–
2015.12 **Evoked potentials as markers of ketamine-induced cortical plasticity in patients with major depressive disorder**
Janssen Research & Development, LLC (PI: A.D. Krystal)
Role: Co-I
This open-label trial evaluates the utility of somatosensory, motor, and transcranial magnetic stimulation-based evoked potentials as markers of cortical plasticity in response to a single intravenous infusion of ketamine in patients with depression.
- 2005.07–
2011.07 **Magnetic seizure therapy for the treatment of depression**
Stanley Medical Research Institute (PI: S.H. Lisanby)
Role: Postdoctoral fellow
This two-center, randomized, double-blind controlled trial compares the antidepressant efficacy and side effects of magnetic seizure therapy and electroconvulsive therapy.
- 2010.07–
2015.01 **Translational research evaluating neurocognitive memory processes**
NIH/NIMH K23 MH087739 (PI: S.M. McClintock)
Role: Postdoctoral fellow
This study informs the cognitive component processes underlying memory impairment after electroconvulsive therapy.
- 2010.07–
2015.12 **Rational dosing for electric and magnetic seizure therapy**
NIH/NIMH R01 MH091083 (PI: S.H. Lisanby)
Role: Graduate research assistant, contributed to grant writing
This study lays a foundation for optimizing stimulus parameters of electric and magnetic seizure therapy through computational modeling and preclinical studies of seizure induction.
- 2010.09–
2011.06 **Field shaping and coil design for transcranial magnetic stimulation**
NIH/NCRR TL1 RR024158 (Training Grant PI: H.N. Ginsberg)
Role: Predoctoral fellow
This award from the Columbia University Irving Institute for Clinical and Translational Research supports clinical research training for predoctoral students in the basic sciences. The goal of the project is to develop novel coil design for deep transcranial magnetic stimulation.
- 2007.08–
2009.07 **Development of a novel TMS device with controllable pulse shape**
NIH/NIBIB R21 EB006855 (PI: A.V. Peterchev)
Role: Graduate research assistant
This project develops an efficient transcranial magnetic stimulation device that produces nearly rectangular pulses with adjustable amplitude, width, and directionality.
- 2005.11–
2009.06 **Nonlinear analysis of heart rate variability**
NIH/NHLBI R01 HL079503 (PI: C.-S. Poon)
Role: Graduate research assistant
This project develops advanced nonlinear estimation and adaptive control algorithms for the modeling and analysis of the cardiovascular system.

Scholarships, Fellowships, & Honors

- 2023–2024 **Scholar, Advanced Research Institute in Geriatric Mental Health**, Dartmouth College, supported by grant from NIH (R25MH068502)
- 2019 **NIMH Director’s Award**, for scientific innovation at the interface of computation and psychiatry, NIMH Intramural Research Program
- 2018 **Richard J. Wyatt Memorial Fellowship Award for Translational Research**, NIMH Intramural Research Program
- 2018 **New Investigator Award**, American Society of Clinical Psychopharmacology
- 2018 **Travel Fellowship Award**, Society of Biological Psychiatry
- 2018 **Research Colloquium for Junior Investigators**, American Psychiatric Association
- 2018 **Alies Muskin Career Development Leadership Program**, Anxiety & Depression Association of America
- 2017 **NARSAD Young Investigator Award**, Brain & Behavior Research Foundation
- 2017 **Career Development Institute for Psychiatry**, Stanford University
- 2017 **New Investigator Award**, International Society for CNS Clinical Trials and Methodology
- 2016 **Certificate for Highly Cited Research**, Brain Stimulation, Elsevier
- 2015 **Young Investigator Memorial Travel Award**, American College of Neuropsychopharmacology
- 2015 **Scholar, Summer Research Institute in Geriatric Mental Health**, Weill Cornell Medical College, supported by grant from NIH (R25MH019946)
- 2015 **Chair’s Choice Award**, Society of Biological Psychiatry
- 2014 **Innovative Poster Award, Young Investigator Award Finalist**, National Network of Depression Centers
- 2010 **Best Abstract Award**, International Society for Neurostimulation
- 2010 **Presidential Teaching Award Finalist**, Columbia University
- 2006 **Student Paper Competition Finalist**, IEEE Engineering in Medicine and Biology Society
- 2002 **New York Times College Scholarship**, New York Times Company Foundation

Talks & Colloquia

Grand Rounds

- 2023 Advanced Research Institute Grand Rounds in Mental Health and Aging Research
Neurostimulation revolution: Advancing treatment optimization and technology innovation
- 2020 Westmead Hospital, Sydney, Australia
Advances in neuromodulation: Electroconvulsive therapy
- 2018 Clinical TMS Society Grand Rounds Webinar
Transcranial magnetic stimulation: Physics, devices, and modeling
- 2017 University of New Mexico School of Medicine, Psychiatry & Behavioral Sciences
Toward individualized electroconvulsive therapy for treatment of depression
- 2015 Central Regional Hospital, Butner, NC
Individualized seizure therapy
- 2015 Duke University School of Medicine, Department of Psychiatry & Behavioral Sciences
Toward next generation seizure therapy

Invited Talks, Seminars, Worskops, & Panels

- 2024 International Society for Magnetic Resonance in Medicine Annual Meeting
Panel: *From basics to applications: MRI of neuromodulation using TMS and FUS*
- 2023 University of Texas Southwestern, Center for Depression Research and Clinical Care
Advancements in computational neurostimulation for depression treatment optimization and technology development
- 2023 Brain and Human Body Modeling Conference, The Martinos Center for Biomedical Imaging, Massachusetts General Hospital
Chair: *New modeling methods and targets: Spinal cord stimulation and novel stimulation*
Chair: *Development and assessment of modeling methods*
Contributed talk: *Effects of low intensity magnetic stimulation*
Judge: Student competition
- 2023 International Conference of the IEEE Engineering in Medicine and Biology Society
Panel: *Computational analysis of non-invasive neuromodulation constructs: Brain and spine*
Contributed talk: *Modeling of transcranial magnetic stimulation and electroconvulsive therapy in the treatment of depression*
- 2023 University of Pittsburgh, Department of Psychiatry
Computational neurostimulation: Approach to treatment optimization and technology development
- 2023 ADAA Anxiety and Depression Conference
Panel: *Parsing through syndromic heterogeneity in youths with mental illness to identify neurocircuit mechanisms and develop novel treatments*
Contributed talk: *Modeling and dose optimization for transcranial magnetic stimulation and electroconvulsive therapy for treatment of depression*
- 2023 International Brain Stimulation Conference
Symposium chair: *Insights and challenges in preclinical models of TMS: Multimodal investigations across animal species*
Fast-track oral symposium chair: *Advanced computational modeling and optimization methods for noninvasive brain stimulation*

Invited Talks, Seminars, Worskops, & Panels (continue)

- 2022 International Network of tES-fMRI (INTF) Webinar Series
Electric field modeling and optimization approaches for individualized targeting
- 2022 International Society for Magnetic Resonance in Medicine, workshop on MRI of Neuromodulation: Target Engagement, Neural Mechanism & Biomarker Development
Modeling of TMS 📺
- 2022 Bergen Workshop of the Global ECT-MRI Collaboration
ECT device development 📺
- 2022 International Congress of Clinical Neurophysiology
Chair: *Towards optimized TMS targeting approaches*
- 2022 Brain and Human Body Modeling Conference, The Martinos Center for Biomedical Imaging, Massachusetts General Hospital
Chair: *Modeling of transcranial electrical stimulation and deep brain stimulation*
Contributed talk: *ECT, electric field, neuroplasticity, and clinical outcomes*
- 2022 European Conference of Brain Stimulation in Psychiatry
Panel: *Beyond clinical syndromes: Understanding mechanisms of neuromodulation from a dimensional perspective*
Contributed talk: *Depressive symptom dimensions and response trajectories in ECT and MST*
- 2022 Medical University of South Carolina, National Center of Neuromodulation for Rehabilitation
Model-driven design for brain stimulation therapies 📺
- 2022 Society of Biological Psychiatry Annual Meeting
Panel: *Dimensional approaches to device neuromodulation*
Contributed talk: *Depressive symptom dimensions and response trajectories in ECT and MST*
- 2022 NIMH Intramural Research Program Investigators' Seminar Series
Seizure therapies: The next generation
- 2022 Global ECT-MRI Collaboration (GEMRIC) Young Researchers Collective
ECT, electric field, neuroplasticity, and clinical outcomes
- 2021 Butler Hospital, Brown University
Computational model driven design for brain stimulation
- 2021 American Academy of Child and Adolescent Psychiatry Annual Meeting
Panel: *Recent work with contemporary computational methods and artificial intelligence to advance the practice of child and adolescent psychiatry*
Contributed talk: *Introduction to computational psychiatry*
- 2021 European College of Neuropsychopharmacology Congress
Panel: *Neurobiology of rapid mood changes*
Contributed talk: *Precision neurostimulation: Electroconvulsive therapy*
- 2021 University of Pennsylvania, Center for Neuromodulation in Depression and Stress
Electromagnetic brain stimulation from low to high intensity
- 2021 Society for Brain Mapping & Therapeutics Annual Congress
Advances in electroconvulsive therapy for treatment of depression

Invited Talks, Seminars, Worskops, & Panels (continue)

- 2021 American Society of Clinical Psychopharmacology Annual Meeting
Early Career Workshop: *How to give a virtual talk*
- 2021 International College of Neuropsychopharmacology Virtual World Congress
Panel: *Next generation seizure therapy and neuromodulation*
- 2020 European Conference of Brain Stimulation in Psychiatry
Panel: *What can we learn from ECT: Insights from the GEMRIC consortium*
Contributed talk: *Using electric field modeling to inform ECT dosing and device development*
- 2020 NIH Basic Training Course on Transcranial Magnetic Stimulation
TMS physics, devices, modeling 📺
- 2020 University of Minnesota Non-Invasive Brain Stimulation Workshop
Use of individual electric field models in clinical research 📺
- 2020 American Society of Clinical Psychopharmacology Annual Meeting
Panel: *New developments in neurostimulation #coronacancelled*
- 2020 VA Boston Healthcare System, Boston University School of Medicine, Harvard Medical School Neuropsychiatry Translational Research Fellowship Seminar
Precision neurostimulation: History, physics, computational modeling, engineering, and more
- 2020 NYC Neuromodulation Online
Discussant: *Noninvasive vagus nerve stimulation applied to stress management, opioid withdrawal, and neurocognitive disorders*
- 2020 Medical University of Vienna, Neuroimaging Lab
Precision seizure therapy
- 2019 American College of Neuropsychopharmacology
Panel: *Precision neurostimulation for treatment of psychiatric disorders*
Contributed talk: *Rational design of precision seizure therapy*
- 2019 International Symposium on Advancing Stimulation Precision Medicine of Brain Disorders, Copenhagen University Hospital Hvidovre, Danish Research Centre for Magnetic Resonance
Rational design of precision seizure therapy
- 2019 International College of Neuropsychopharmacology Meeting
Workshop: *Neurobiological and clinical characterization, and treatment development for treatment resistant depression*
Contributed talk: *Individualized electroconvulsive therapy: Reinventing ECT*
- 2019 American Society of Clinical Psychopharmacology Annual Meeting
Co-chair: *Treatment-resistant mood disorders across the lifespan: Novel therapeutics*
- 2019 Mount Sinai Icahn School of Medicine, Depression and Anxiety Center
Rational design of individualized noninvasive brain stimulation
- 2019 International Brain Stimulation Conference
Panel: *Individualized brain stimulation: Addressing heterogeneity across modalities*
Contributed talk: *Individualized electroconvulsive therapy for treatment of depression*

Invited Talks, Seminars, Worskops, & Panels (continue)

- 2018 NIMH Intramural Research Program Investigators' Seminar Series
Computational neurostimulation: Engineering better noninvasive brain stimulation therapies
- 2018 UCLA Brain Mapping Center
Computational neurostimulation: Engineering better brain stimulation therapies
Semel Institute for Neuroscience and Human Behavior, Neuromodulation Division
Modeling and design for magnetic stimulation
- 2018 USC Mark and Mary Stevens Neuroimaging and Informatics Institute
Computational neurostimulation
- 2018 2nd Bergen Workshop of the Global ECT-MRI Collaboration
Electric field modeling for electroconvulsive therapy
- 2018 Joint NYC Neuromodulation Conference & NANS Summer Series
Preconference workshop director: *Computational modeling in neuromodulation: Tools for engineers, clinicians, and researchers*
Contributed talk: *Optimizing stimulation arrays and high-density EEG for brain targeting*
- 2018 Neuropsychiatric Drug Development Summit
Targeted intermittent device delivered interventions will ultimately prove superior to maintenance treatment with drugs for brain disorders
- 2018 International Conference of the IEEE Engineering in Medicine and Biology Society
Chair: *Computational human models for brain stimulation*
Contributed talk: *Electric field induced by transcranial magnetic stimulation: Applications in depression and anxiety disorder*
- 2018 APA Annual Conference Presidential Symposium
Presidential symposium: *ECT in the era of new brain stimulation treatments: Road map of future enhancements*
Contributed talk: *Individualized neurotargeted seizure therapy: Reinventing ECT*
- 2018 ADAA Anxiety and Depression Conference
Panel: *Personalized medicine for treatment resistant depressed patients: Novel strategies to optimize treatment with antidepressant medications, ketamine, and ECT*
Contributed talk: *Individualized neurotargeted seizure therapy: Reinventing ECT*
- 2017 NIMH Non-Invasive Brain Stimulation Electric Field Modeling Workshop
Use of individual electric field models in clinical research 📺
- 2017 NYC Neuromodulation Conference
Low field magnetic stimulation
- 2016 NIDA, Neuroimaging Research Branch
Advances in transcranial magnetic stimulation technology
- 2016 NIMH Workshop on Transcranial Electrical Stimulation: Mechanisms, Technology, and Therapeutic Applications
Effect of anatomical variability on electric field characteristics of tES
- 2016 Mayo Clinic College of Medicine, Department of Molecular Pharmacology, Neurobiology of Alcoholism and Drug Addiction Lab
Transcranial magnetic stimulation technology development
Department of Neurosurgery Research, Neural Engineering Lab
Optimizing transcranial magnetic stimulation

Invited Talks, Seminars, Worskops, & Panels (continue)

- 2016 NIMH, Experimental Therapeutics & Pathophysiology Branch
Engineering better electromagnetic brain stimulation therapies
- 2015 International Society for ECT and Neurostimulation Annual Meeting
Workshop: *Spatial targeting with transcranial magnetic stimulation*
- 2015 Duke University School of Medicine, Department of Psychiatry & Behavioral Sciences
Chair's round: *Fundamentals of transcranial electric and magnetic stimulation dosing*
- 2015 Weill Cornell Medical College, Department of Biomedical Engineering
Transcranial magnetic stimulation: Pulse source, coil design, & concurrent neuroimaging
- 2014 Duke University, Department of Biomedical Engineering
Modeling and coil design considerations for transcranial magnetic stimulation

Teaching & Mentoring

Appointments

- 2022–present **Educational Counselor**, MIT
- 2018–2019 **Research Mentor**, Fischell Department of Bioengineering, University of Maryland, College Park, A. James Clark School of Engineering
Capstone Design Project: Detection of brain-to-brain synchrony for improved psychotherapy
- 2017, 2019 **Lecturer**, NINDS
Clinical Neuroscience Program Lecture Series
- 2017 **Lecturer**, NIMH
fMRI Course
- 2016 **Instructor**, Department of Neuroscience, Duke University
Research Independent Study
- 2014–2016 **Faculty**, Department of Psychiatry and Behavioral Sciences, Duke University School of Medicine
Visiting Fellowship in Transcranial Magnetic Stimulation & Electroconvulsive Therapy Fellowship (Continuing Medical Education)
- 2015–2016 **Research Mentor**, Matching Undergraduates to Science and Engineering Research Program, Duke University
- 2015–2016 **Faculty**, Biosciences Collaborative for Research Engagement, Duke University
- 2010 Spring **Teaching Assistant, Columbia Video Network Course Assistant**, Department of Electrical Engineering, Columbia University Fu Foundation School of Engineering and Applied Science
Analog Systems in VLSI (graduate level)
- 2009 Fall **Teaching Assistant**, Department of Electrical Engineering, Columbia University Fu Foundation School of Engineering and Applied Science
The Digital Information Age
- 2009 Fall **Recitation Instructor**, Department of Biostatistics, Columbia University Mailman School of Public Health
Biostatistics (graduate level)

2003–2007 **Teaching Assistant**, Department of Mathematics, MIT
Multivariable Calculus (Fall '03–'06), *Differential Equations* (Spring '04–'07)

2004 Fall **Grader**, Department of Electrical Engineering and Computer Science, MIT
Signals and Systems

Thesis Committee

2019 D.Q. Truong, “Translational Modeling of Non-Invasive Electrical Stimulation,” Ph.D. dissertation, City College of the City University of New York, Department of Biomedical Engineering, New York, NY, 2019. Sponsor: M. Bikson. Available: CUNY Academic Works, [URL: https://academicworks.cuny.edu/cc_etds_theses/774](https://academicworks.cuny.edu/cc_etds_theses/774)

2017 G. Asturias, “Effect of Repetitive Transcranial Magnetic Stimulation on the Structural and Functional Connectome in Patients with Major Depressive Disorder,” Undergraduate Honors Thesis, Duke University, Department of Psychology and Neuroscience, Durham, NC, 2017. Sponsor: Z.-D. Deng. Available: DukeSpace, [HDL: 10161/14299](https://dukespace.duke.edu/handle/10161/14299)

Mentees

Research Fellow/Postdoc

2022–2024 M. Dannhauer, Max Planck Institute for Human Cognitive and Brain Sciences

Graduate Student

2012 M. Kshirsagar, Biomedical Engineering, Duke University

NIH Postbaccalaureate IRTAs

2021–2024 P.L. Robins, Physics, Lawrence University

2018–2020 S.M. Awasthi, Biomedical Engineering, Johns Hopkins University

2018–2019 M.M. Noh, Bioengineering, MIT

2017–2019 J. Thomas, Physiology and Biophysics, University of Virginia

2016–2019 M. Velez Afanador, Microbiology, University of Puerto Rico

Undergraduate Students

2014–2017 G. Asturias, Neuroscience & Psychology, Duke University (Distinction)

Z. Feng, Biomedical Engineering and Biology, Duke University

M. Glidewell, Biomedical Engineering, Duke University

S. Lee, Biomedical Engineering, Duke University

J.R. Lilien, Electrical & Computer Engineering, Duke University (Walter J. Seeley Award)

W. Lim, Biomedical Engineering, Duke University

F.M. Mercer, Women’s Studies, Duke University

E. Salgado, Neuroscience & Psychology, Duke University (Distinction)

R. Shah, Neuroscience & Psychology, Duke University

E. Shinder, Biology, Duke University (Distinction)

E.P. Vienneau, Biomedical Engineering, Duke University (Howard G. Clark Award)

D.T. Weaver, Biology, Duke University

Summer Interns

2018 M. Dib, Biomedical Engineering, University of Maryland, College Park

2017 E. Chung, Psychology, University of Maryland, College Park

2017 A.L. Halberstadt, Biology and Psychology, Carnegie Mellon University

2015 C.M. Prevost, Biomedical Engineering, Clemson University

2013 J.V. McCall, Biomedical Engineering, North Carolina State University

Professional Affiliations & Services

Professional Society Membership

- 2004–present **Institute of Electrical and Electronics Engineers**, Senior Member
Engineering in Medicine and Biology Society
- 2019–present **American Society of Clinical Psychopharmacology**, Member
 - 2023–2027 Early Career Committee
 - 2023–2025 Technology Committee
 - 2023 Program Review Sub-Committee
 - 2020–2023 Technology Task Force
- 2021–present **Biomedical Engineering Society**, Member
- 2023–present **American College of Neuropsychopharmacology**, Associate Member
- 2024–present **Sigma Xi, The Scientific Research Honor Society**, Full Member
 - 2017–2018 **Anxiety and Depression Association of America**, Member
 - 2017–2019 **International Society for CNS Clinical Trials and Methodology**, Member
 - 2014–2018 **Organization for Human Brain Mapping**, Member
 - 2008–2012 **Society for Industrial and Applied Mathematics**, Student Member
 - 2005–2012 **Society for Neuroscience**, Student Member
 - 2004–2009 **American Physical Society**, Student Member

Editorial & Grant Review Services

Peer Review Journals

- 2022–present Frontiers in Psychiatry
 - Associate Editor: Neuroimaging
 - Co-Editor on Research Topic: How Does Brain Stimulation Work? Neuroversion and Other Putative Mechanisms of Action
 - Associate Editor: Neurostimulation
- Frontiers in Pharmacology
 - Guest Associate Editor: Neuropharmacology
 - Research Topic: Neurobiology of Rapid Mood Changes
- 2022–present Frontiers in Psychology
 - Review Editor: Addictive Behaviors
 - Review Editor: Consciousness Research
- 2024 Physics in Medicine and Biology
 - Guest Editor on Special Issue: Electromagnetic Modeling for Brain Stimulation

Conference Organizing Committee

- 2022–2023 Brain and Human Body Modeling Conference, The Martinos Center for Biomedical Imaging, Massachusetts General Hospital

Grant Review Panels

- 2022–2023 NIH BluePrint MedTech Program, reviewer
 - 2021 NIH Early Career Reviewer Program
 - Biophysics of Neural Systems Study Section, *ad hoc* reviewer
- 2018, 2021 Duke Institute for Brain Sciences, Research Incubator Awards

Conference Proceedings/Abstract Review

- 2008–present International Conference of the IEEE Engineering in Medicine and Biology Society
 IEEE/EMBS International Conference on Neural Engineering
 IEEE/EMBS International Conference on Biomedical and Health Informatics
 Biomedical Engineering Society Annual Meeting
 American Society of Clinical Psychopharmacology Annual Meeting
- ad hoc reviewer* AIP Advances
 American Journal of Psychiatry
 Asian Journal of Psychiatry
 Australasian Physical and Engineering Sciences in Medicine
 Biological Psychiatry
 BioMedical Engineering OnLine
 Brain Sciences
 Brain Stimulation
 Cerebral Cortex
 Clinical EEG and Neuroscience
 Clinical Neurophysiology
 CNS Spectrums
 Computational and Mathematical Methods in Medicine
 Computer Methods and Programs in Biomedicine
 Cortex
 European Psychiatry
 Frontiers in Cell and Developmental Biology
 Frontiers in Medicine: Intensive Care Medicine and Anesthesiology
 Frontiers in Neurology: Applied Neuroimaging
 Frontiers in Neuroscience: Brain Imaging Methods
 IEEE Transactions on Biomedical Engineering
 IEEE Transactions on Neural Systems & Rehabilitation Engineering
 IEEE Transactions on Magnetics
 Imaging Neuroscience
 Journal of ECT
 Journal of Neural Engineering
 Journal of Neuroscience Methods
 JoVE
 Medical & Biological Engineering & Computing
 Medical Hypotheses
 Nature Mental Health
 NeuroImage; NeuroImage Clinical
 Neuromodulation: Technology at the Neural Interface
 Neuroscience Letters
 PLOS One
 Scientific Reports
 Translational Psychiatry

Community Involvement & Outreach

- 2023-present NIH Research Workforce Diversity and Equity Outreach Special Interest Group
- 2022 Judge, NIMH Training Day Three-Minute Talks competition
- 2020 Mental Health Association of Maryland
Presentation: *Fundamentals of transcranial brain stimulation*
- 2020 Jewish Social Service Agency
Presentation: *Basics of brain stimulation devices: What are they and how do they work*
- 2020 Exhibitor, USA Science & Engineering Festival #coronacancelled
- 2019 University of Pennsylvania, Wharton Undergraduate Health Care Club
Presentation: *Research in mental health treatment*
- 2019 Judge, MIT Hacking Medicine: DC Grand Hack
- 2019 NIH High School Scientific Training and Enrichment Program
Presentation: *Bioelectricity and brain stimulation*
- 2019 NIH Take Your Child to Work Day
Presentation: *How to fool your brain*
- 2019 UCLA, CruX Neurotech Organization
Presentation: *Neuromodulation in psychiatry*
- 2018 University of Pennsylvania, Wharton Undergraduate Health Care Club
Presentation: *Technology and the future of mental health treatment*
- 2017-present NIH Noninvasive Brain Stimulation Special Interest Group
- 2017-2019 Judge/Lead Judge, NIH Postbac Poster Day
- 2016 Innovation Leader, Psychiatry Innovation Lab, American Psychiatric Association
- 2016 Duke Psychiatry, Mood Disorders Support and Education Group
Presentation: *Brain stimulation treatments for severe mood disorders*
- 2016 Duke Translational Medicine Institute, Undergraduate Research Society
Presentation: *Engineering meets psychiatry*
- 2015 Duke Psychiatry, Mood Disorders Support and Education Group
Presentation: *New frontiers in treatments for mood disorders*

Continuing Education & Professional Development

- 2023 Mid-Level Leadership Program, NIH
- 2021-2022 Diversity and Inclusion Certificate Program, NIH
- 2019 Non-invasive Transcranial Brain Stimulation Course, Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital Hvidovre
- 2015-2016 Health Disparities Research Curriculum, Duke Translational Medicine Institute CTSA
- 2015 Tackling the Challenges of Big Data, MIT Professional Education Program
- 2009 Transcranial magnetic stimulation administration certified, Columbia University Medical Center/New York State Psychiatric Institute
- renewed 2023 Basic Life Support, American Heart Association