

Mark Bathe
Curriculum Vitae

Education

2004 Ph.D., Mechanical Engineering, MIT
2001 M.Sc., Mechanical Engineering, MIT
1998 B.Sc., Mechanical Engineering, MIT

Postdoctoral Training

2006–08 Alexander von Humboldt Postdoctoral Fellow, University of Munich

Professional Experience

2016–present Associate Professor with Tenure, Department of Biological Engineering, MIT
2013–2016 Associate Professor without Tenure, Department of Biological Engineering, MIT
2009–2013 Assistant Professor, Department of Biological Engineering, MIT
2006–08 Alexander von Humboldt Postdoctoral Fellow, University of Munich

Affiliations

Broad Institute of MIT & Harvard
MIT Center for Environmental Health Sciences
MIT Center for Excitronics
MIT Center for Neurobiological Engineering
MIT Department of Mechanical Engineering

Awards

2015 Joy Cappel Young Investigator Award
2014 MIT Freshman Advising Award
2009–11 Samuel A. Goldblith Career Development Professorship
2006–08 Alexander von Humboldt Postdoctoral Research Fellow
2001–04 National Defense Science and Engineering Graduate Fellow
1998 Elected member of Sigma Xi and Pi Tau Sigma Academic Honor Societies

Professional Societies

American Chemical Society
Biophysical Society
Society for Neuroscience

Major Research Interests

Biophysics
Biomolecular Engineering
Computational Modeling of Biological Systems
Nucleic Acid Nanotechnology
Macromolecular Biochemistry & Biophysics

Publications

1. Boulais, E., Sawaya, N., Veneziano, R., Andreoni, A., Lin, S., Woodbury, N., Yan, H., Aspuru-Guzik, A., **Bathe, M.** Programmed coherent coupling in a DNA-based excitonic circuit. *In revision* (2017).
2. Cunningham, P., Bricker, W., Diaz, S., Medintz, I., **Bathe, M.**, Melinger, J.S. Optical determination of the electronic coupling and intercalation geometry of thiazole orange homodimer in DNA. *Journal of Chemical Physics*, in revision (2017).
3. Pan, K., Bricker, W., Ratanalert, S., **Bathe, M.** Structure and conformational dynamics of scaffolded DNA origami nanoparticles. *Nucleic Acids Research*, in press (2017).
4. Guo, S-M., Veneziano, R., Gordonov, S., Li, L., Park, D., Kulesa, A.B., Blainey, P.C., Cottrell, J.R., Boyden, E.S., **Bathe, M.** Multiplexed confocal and super-resolution fluorescence imaging of cytoskeletal and neuronal synapse proteins. *bioRxiv*, doi: 10.1101/111625 (2017).
5. Su, K.C., Barry, Z., Schweizer, N., Maiato, H., **Bathe, M.**, Cheeseman, I. A regulatory switch alters chromosome motions at the metaphase to anaphase transition. *Cell Reports*, 17: 728 (2016).
6. Veneziano, R., Ratanalert, S., Zhang, K., Zhang, F., Yan, H., Chiu, W., **Bathe, M.** Designer nanoscale DNA assemblies programmed from the top down. *Science*, 352: 1534 (2016).
7. Wang, P., Gaitanaros, S., Lee, S., **Bathe, M.**, Shih, W.M., Ke, Y. Programming Self-Assembly of DNA Origami Honeycomb Lattices and Plasmonic Metamaterials. *JACS*, 138: 7733 (2016).
8. Katz, Z.B., English, B.P., Lionnet, T., Yoon, Y.J., Monnier, N., Ovryn, B., **Bathe, M.**, Singer, R.H. Mapping translation 'hot-spots' in live cells by tracking single molecules of mRNA and ribosomes. *eLife*, e10415 (2016).
9. Dhakal, S., Adendorff, M., Liu, M., Yan, H., **Bathe, M.**, Walter, N. Rational design of DNA-actuated enzyme nanoreactors guided by single molecule analysis. *Nanoscale*, 8: 3125 (2016).
10. Hogstrom, L., Guo, S.M., Murugadoss, K., **Bathe, M.** Advancing multiscale structural mapping of the brain through fluorescence imaging and analysis across length-scales. *Journal of The Royal Society Interface*, 6: 20150081 (2016).
11. Gordonov, S., Hwang, M.K., Wells, A., Gertler, F.B., Lauffenburger, D., **Bathe, M.** Time-series modeling of live-cell shape dynamics for image-based phenotypic profiling. *Integrative Biology*, 8: 73 (2016).
12. Sedeh, R., Pan, K., Adendorff, M., Hallatschek, O., Bathe, K.J., **Bathe, M.** Computing nonequilibrium conformational dynamics of structured nucleic acid assemblies. *Journal of Chemical Theory & Computation*, 12: 261 (2016).
13. Monnier, N., Barry, Z., Park, H.Y., Su, K.C., Katz, Z., English, B., Dey, A., Pan, K., Cheeseman, I., Singer, R., **Bathe, M.** Inferring transient particle transport dynamics in live cells. *Nature Methods*, 12: 838 (2015)

14. Sun, G., Guo, S.M., Teh, C., Korzh, V., **Bathe, M.**, Wohland, T. Bayesian model selection applied to the analysis of FCS data of fluorescent proteins in vitro and in vivo. *Analytical Chemistry*, 87: 4326 (2015).
15. Zhou, Z., Munteanu, E.L., He, J., Ursell, T., **Bathe, M.**, Huang, K.C., Chang, F. The contractile ring coordinates curvature dependent septum assembly during fission yeast cytokinesis. *Molecular Biology of the Cell*, 26: 78 (2015).
16. Pan, K., Kim, D.N., Zhang, F., Adendorff, M., Yan, H., **Bathe, M.** Lattice-free prediction of three-dimensional structure of programmed DNA assemblies. *Nature Communications*, 5: 5578 (2014).
17. Klingner, C., Cherian, A.V., Diesinger, P.M., Aufschnaiter, R., Maghelli, N., Keil, T., Beck, G., Tolic-Norrelykke, I., **Bathe, M.**, and Wedlich-Soldner, R. An isotropic acto-myosin network promotes organization of the apical cell cortex in epithelial cells. *The Journal of Cell Biology*, 207: 107-121 (2014).
18. Sun, W., Boulais, E., Hakobyan, Y., Wang, W., Guan, A., **Bathe, M.**, Yin, P. Casting inorganic structures with DNA molds. *Science* 346: 717 (2014).
19. Mori, M., Somogyi, K., Kondo, H., Monnier, N., Falk, H., Machado, P., **Bathe, M.**, Nedelec, F., and Lenart, P. An Arp2/3 nucleated F-actin shell fragments nuclear membranes at nuclear envelope breakdown. *Current Biology*, 24: 1421-1428 (2014).
20. Oh, H.S., Bryant, K.F., Nieland, T., Mazumder, A., Bagul, M., **Bathe, M.**, Root, D.E. and Knipe, D.M. Targeted RNAi Screen Reveals NOVEL. Epigenetic Factors that Regulate Herpesviral Gene Expression in U2OS Osteosarcoma Cells. *mBio*, 5: e01086-13 (2014).
21. Guo, S.M., Bag, N., Mishra, A., Wohland, T., **Bathe, M.** Bayesian total internal reflection fluorescence correlation spectroscopy reveals hIAPP-induced plasma membrane domain organization in live cells. *Biophysical Journal*, 106: 190-200 (2014).
22. Pan, K., Boulais, E., Yang, L., **Bathe, M.** Structure-based model for light-harvesting properties of nucleic acid nanostructures. *Nucleic Acids Research*, doi: 10.1093/nar/gkt1269 (2013).
23. Mazumder, A., Pesudo, L.Q., McRee, S., **Bathe, M.**, Samson, L. Genome-wide single-cell-level screen for protein abundance and localization changes in response to DNA damage in *S. cerevisiae*. *Nucleic Acids Research*, 41: 9310-9324 (2013).
24. Subramanian, V., Mazumder, A., Surface, L.E., Butty, V., Fields, P.A., Alwan, A., Torrey, L., Thai, K.K., Levine, S., **Bathe, M.**, Boyer, L. H2A.Z acidic patch couples chromatin dynamics to regulation of developmental gene expression programs during lineage commitment. *PLoS Genetics*, 9: e1003725 (2013).
25. Johnson-Buck, A., Nangreave, J., Kim, D.N., **Bathe, M.**, Yan, H., Walter, N. Super-resolution fingerprinting detects chemical reactions and idiosyncrasies of single DNA pegboards. *Nanoletters*, 13: 728-733 (2013).

26. Mazumder, A., Tummler, K., **Bathe, M.**, Samson, L. Single-cell analysis of RNR transcriptional and translational response to DNA damage. *Molecular & Cellular Biology*, 33: 635–642 (2013).
27. Krishnan, Y. and **Bathe, M.** Designer nucleic acids to probe and program the cell. *Trends in Cell Biology*, 22: 624–633 (2012).
28. Schmidt, J.C., Haribabu, A., Boeszoermenyi, A., Dashkevich, N.M., Wilson-Kubalek, E., Monnier, N., Markus, M., Oberer, M., Milligan, R., **Bathe, M.**, Wagner, G., Grishchuk, E. L., Cheeseman, I.M. The kinetochore-bound Ska1 complex tracks depolymerizing microtubules by binding to curved protofilaments. *Developmental Cell*, 23: 968–980 (2012).
29. Monnier, N., Guo, S.M., Mori, M., He, J., Lenart, P., **Bathe, M.** Bayesian approach to MSD-based analysis of particle motion in live cells. *Biophysical Journal*, 103: 616–626 (2012).
30. Guo, S.M., He, J., Monnier, N., Sun, G., Wohland, T., **Bathe, M.** Bayesian approach to the analysis of fluorescence correlation spectroscopy data II: Application to simulated and in vitro data. *Analytical Chemistry*, 84: 3880–3888 (2012).
31. He, J., Guo, S.M., **Bathe, M.** Bayesian approach to the analysis of fluorescence correlation spectroscopy data I: Theory. *Analytical Chemistry*, 84: 3871–3879 (2012).
32. D.N. Kim, Kilchherr, F., Dietz, H., **Bathe M.** Quantitative prediction of 3D solution shape and flexibility of nucleic acid nanostructures. *Nucleic Acids Research*, 40: 2862–2868 (2012).
33. M. Mori, Monnier, N., Daigle, N., **Bathe, M.**, Ellenberg, J., Lenart, P. Intracellular transport by an anchored homogeneously contracting F-actin meshwork. *Current Biology*, 21: 606–611 (2011).
34. Castro, C.E., Kilchherr, F., Kim, D.N., Lin Shiao, E., Wauer, T., Wortmann, P., **Bathe, M.**, Dietz, H. A primer to scaffolded DNA origami. *Nature Methods*, 8: 221–229 (2011).
35. Kim, D.N., Altschuler, J., Strong, C., McGill, G., **Bathe, M.** Conformational Dynamics Data Bank (CDDDB): a database for conformational dynamics of proteins and supramolecular protein assemblies. *Nucleic Acids Research*, 39: D451–455 (2011).
36. Kim, D.N., Nguyen, C.T., **Bathe, M.** Conformational dynamics of supramolecular protein assemblies. *Journal of Structural Biology*, 173: 261–270 (2011).
37. Strehle, D., Schnauss, J., Heussinger, C., Alvarado, J., **Bathe, M.**, Kaes, J., Gentry, B. Transiently crosslinked F-actin bundles. *European Biophysical Journal*, 40: 93–101 (2011).
38. Sedeh, R., Fedorov, A.A., Fedorov, E.V., Ono, S., Matsumura, F., Karplus, M., Almo, S.C., **Bathe, M.** Structure, evolutionary conservation, and conformational dynamics of human fascin-1, an F-actin-crosslinking protein. *Journal of Molecular Biology*, 400: 589–604 (2010).
39. **Bathe, M.**, Chang, F. Cytokinesis and the contractile ring in fission yeast: towards a systems-level understanding. *Trends in Microbiology*, 18: 38–45 (2010).
40. Sedeh, R., **Bathe, M.**, Bathe, K.J. The subspace iteration method in protein normal mode analysis. *Journal of Computational Chemistry*, 31: 66–74 (2010).

41. **Bathe, M.**, Heussinger, C., Claessens, M.M.A.E., Bausch, A.R., and Frey, E. Cytoskeletal bundle mechanics. *Biophysical Journal*, 94: 2955–2964 (2008).
42. **Bathe, M.** A Finite Element framework for computation of protein normal modes and mechanical response. *Proteins: Structure, Function, and Bioinformatics*, 70: 1595–1609 (2008).
43. Heussinger, C., **Bathe, M.**, and Frey, E. Statistical mechanics of wormlike bundles. *Physical Review Letters*: 99: Art. No. 048101 (2007).
44. Claessens, M.M.A.E., **Bathe, M.**, Frey, E., and Bausch, A.R. Actin-binding proteins sensitively mediate F-actin bundle stiffness. *Nature Materials*, 5: 748–753 (2006).
45. **Bathe, M.**, Rutledge, G.C., Grodzinsky, A.J., and Tidor, B. Osmotic pressure of aqueous chondroitin sulfate solution: A molecular modeling investigation. *Biophysical Journal*, 89: 2357–2371 (2005).
46. **Bathe, M.**, Rutledge, G.C., Grodzinsky, A.J., and Tidor, B. A coarse-grained molecular model for glycosaminoglycans: Application to chondroitin, chondroitin sulfate, and hyaluronic acid. *Biophysical Journal*, 88: 3870–3887 (2005).
47. **Bathe, M.**, Grodzinsky, A.J., Tidor, B., and Rutledge, G.C. Optimal linearized Poisson–Boltzmann theory applied to the simulation of flexible polyelectrolytes in solution. *Journal of Chemical Physics*, 121: 7557–7561 (2004).
48. Kaazempur-Mofrad, M.R., **Bathe, M.**, Karcher, H., Younis, H.F., Seong, H.C., Shim, E.B., Chan, R.C., Hinton, D.P., Isasi, A.G., Upadhyaya, A., Powers, M.J., Griffith, L.G., and Kamm, R.D. Role of simulation in understanding biological systems. *Computers & Structures*, 81: 715–726 (2003).
49. **Bathe, M.** and Rutledge, G.C. Inverse Monte Carlo procedure for conformation determination of macromolecules. *Journal of Computational Chemistry*, 24: 876–890 (2003).
50. **Bathe, M.**, Shirai, A., Doerschuk, C.M., and Kamm, R.D. Neutrophil transit times through pulmonary capillaries: The effects of capillary geometry and fMLP-stimulation. *Biophysical Journal*, 83: 1917–1933 (2002).
51. **Bathe, M.** and Kamm, R.D. A fluid-structure interaction finite element analysis of pulsatile blood flow through a compliant stenotic artery. *Journal of Biomechanical Engineering*, 121: 361–369 (1999).

Patents

D.N. Kim, K. Pan, **M Bathe**, April 2016. *Techniques for Controlling Spatial Structure of Nucleic Acid Structures Based on Lattice-free, Three Dimensional Junction Coordinates*. US Patent No. US20160103951 A1.

M. Bathe, D.N. Kim, H. Dietz. October 2013. *Method and Apparatus for Controlling Properties of Nucleic Acid Nanostructures*. US Patent No. US8554489 B2.

M. Bathe, S.M. Guo, N. Monnier, J. He. Granted June 2013. *Bayesian Inference of Particle Motion and Dynamics from Single-Particle Tracking and Fluorescence Correlation Spectroscopy*. US Patent No. 13/328,879.

R. Veneziano, S. Ratanalert, **M. Bathe**. April 2016. *Stable Nanoscale DNA Assemblies and Methods Thereof*. Provisional Patent filed.

M. Bathe, S. Ratanalert, R. Veneziano, T. Shepherd. April 2016. *Nucleic Acid Random Access Memory*. Provisional Patent filed.

T. Shepherd, S. Ratanalert, R. Veneziano, **M. Bathe**. April 2016. *Nucleic Acid Capture, Detection, and Footprinting using Structured DNA Assemblies*. Provisional Patent filed.

S-M., Guo, R. Veneziano, S. Gordonov, **M. Bathe**. February 2017. *Multiplexed Confocal and Super-Resolution Fluorescence Imaging Using Mini-PEG Gamma-PNA, LNA, and DNA Barcoded Affinity Reagents*. Provisional Patent filed.

Invited Talks and Seminars

1. "Programming and Probing Biomolecular Machines," The Future of Integrative Structural Biology Workshop, Clemson University, Clemson, SC, 2017.
2. "Multi-channel Fluorescence Imaging of Neuronal mRNAs and Proteins," Frontiers in Imaging Science Workshop, Janelia Research Campus, Ashburn, VA, 2017.
3. "Programming and Probing Biomolecular Machines," Department of Chemistry, Carnegie Mellon University, Pittsburgh, PA, 2017.
4. "Structured DNA Nanoparticles for Therapeutic Delivery," Non-invasive Delivery of Macromolecules Conference, San Diego, CA, 2017.
5. "Top-down Design, Synthesis, and Functional Application of Designer DNA Nanoparticles," Gordon Conference on RNA Nanotechnology, Ventura Beach, CA, 2017.
6. "Programming and Probing Biomolecular Machines," Frederick National Laboratory for Cancer Research, Frederick, MD, 2016.
7. "Programming Structured DNA-based Materials," SRC/IBM/ONR Workshop on Biological Pathways for Electronic Nanofabrication and Materials, San Jose, CA, 2016.
8. "Multiplexed fluorescence imaging of neuronal proteins and mRNAs," High Content Analysis and 3D Screening Conference, Boston, MA, 2016.
9. "Multiplexed fluorescence imaging of neuronal proteins and mRNAs, Cell Organization and Behavior at Multiple Scales Workshop," Allen Institute for Cell Science in Seattle, WA, 2016.
10. "Probing and programming biomolecular machines," Department of Biology, Boston College, Chestnut Hill, MA, 2016.

11. "Programming Functional Nanoscale DNA-based Materials," American Chemical Society Annual Meeting, Philadelphia, PA, 2016.
12. "Programming Nanoscale Synthetic Excitonic Circuits with DNA," Conference on Excited State Processes, Santa Fe, New Mexico, 2016.
13. "Probing and Programming Biomolecular Machines," U.S. Naval Research Laboratory, 2016.
14. "Mapping Viral Genome Structure using Scaffolded DNA Origami," Ten Years of DNA Origami Symposium, Caltech, Pasadena, CA, 2016.
15. "Inferring Neuronal Synapse Structure and Function In Situ using High-resolution Fluorescence Imaging and Analysis," Modeling and Inference Workshop: From Single Molecules to Cells, Ohio State University, Columbus, OH, 2016.
16. "Probing and Programming Biomolecular Machines," Biozentrum at the University of Basel, Basel, Switzerland, 2015.
17. "Probing and Programming Biomolecular Machines," Department of Chemistry, University of Chicago, Chicago, IL, 2015.
18. "Probing and Programming Biomolecular Machines," Department of Chemistry, University of Michigan, Ann Arbor, MI, 2015.
19. "Probing and Programming Biomolecular Machines," Autodesk Research, Inc., San Francisco, CA, 2015.
20. "Probing and Programming Biomolecular Machines," Department of Biological Engineering, MIT, Cambridge, MA, 2015.
21. "Programming Functional Structured DNA Assemblies," DNA21, Harvard University, Cambridge, MA, 2015.
22. "Probing and Programming Biomolecular Machines," Washington University, St. Louis, MO, 2015.
23. "Probing and Programming Biomolecular Machines Using Synthetic Nucleic Acids," Department of Biomedical Engineering, University of Minnesota, 2015.
24. "Computational Design of Functional DNA Assemblies," 14th European Conference on Computational Biology in Strasbourg, France, 2014.
25. "Probing and Programming Biomolecular Machines Using Nucleic Acids," Department of Cell & Molecular Biology at Uppsala University in Sweden, 2014.
26. "Bayesian Approaches to Quantitative Fluorescence Imaging-Based Biology," Microscopy Graduate Workshop at Stowers Institute for Medical Research in Kansas City, Missouri, 2014.
27. "Programming Functional Nucleic Acid Nanostructures," 110th International Titisee Conference, Titisee, Germany.

28. "Probing and Programming Biomolecular Machines Using Nucleic Acids," Department of Physics, McGill University, 2014.
29. "Computational Design of Megadalton-Scale Nucleic Acid Nanoassemblies," SIAM Conference on the Life Sciences, Charlotte, North Carolina, 2014.
30. "Computational Design Principles for Nanoscale DNA-Based Materials," World Congress of Biomechanics, Boston, MA, 2014.
31. "Bayesian Analysis of Live-Cell Fluorescence Imaging Data for Quantitative Cell Biology," World Congress of Biomechanics, Boston, MA, 2014.
32. "Probing and Programming Macromolecular Machines," Curie Institute, Paris, France, 2014.
33. "Computational Design Principles for Functional Nucleic Acid Nanostructures," DNATEC14, Dresden, Germany, 2014.
34. "Computational Design Principles for Functional Nucleic Acid Nanostructures," Foundations of NanoScience Conference, Snowbird, UT, 2014.
35. "DNA-Based Light-Harvesting Antennas for Biomimetic Photosystems," GPU Technology Conference, San Jose, CA, 2014.
36. "Precision Nanotech: Computational Design Principles for Functional Nucleic Acid Nano-Assemblies," National Academy of Sciences Kavli Frontiers of Science & Engineering Symposium, Rio de Janeiro, 2014.
37. "Probing and Programming Macromolecular Machines," Department of Biochemistry & Molecular Biology at Wayne State University School of Medicine, 2014.
38. "Bayesian Model Selection for Quantitative Cell Biology based on Fluorescence Imaging," Quantitative Bioimaging Conference at the University of New Mexico, 2014.
39. "Inferring and Programming the Structure and Dynamics of Macromolecular Machines," Physical Mathematics Seminar Series, MIT, Cambridge, MA, 2013.
40. "Inferring and Programming the Structure and Dynamics of Macromolecular Machines," Department of Physics, University of Maryland, College Park, MD, 2013.
41. "Rational Design of Megadalton-Scale DNA-Based Light Harvesting Antennas," Interdisciplinary Symposium on Advanced Nano/Biosystems: Design, Fabrication, and Characterization, University of Illinois at Urbana-Champaign, Champaign, IL, 2013.
42. "Inferring and Programming the Structure and Dynamics of Macromolecular Machines," Department of Chemistry and Biochemistry, Arizona State University, Phoenix, AZ, 2013.
43. "Inferring and Programming the Structure and Dynamics of Macromolecular Machines," National Centre for Biological Sciences TIFR, Bangalore, India, 2013.

44. "Inferring and Programming the Structure and Dynamics of Macromolecular Machines," Janelia Farm Research Campus, Ashburn, VA, 2013.
45. "Inferring and Programming the Structure and Dynamics of Macromolecular Machines," Department of Physics, Technical University of Munich, Munich, Germany, 2013.
46. "Computer-aided Engineering of Functional Nucleic Acid Nanostructures," eSENCE International Workshop on Macromolecular Structure and Dynamics, Uppsala University, Uppsala, Sweden, 2013.
47. "Inferring and Programming the Structure and Dynamics of Macromolecular Machines," SciLifeLab, The Svedberg Seminar Series, Uppsala University, Uppsala, Sweden, 2013.
48. "Data-driven, Bayesian Approaches to Physical Biology," Department of Biochemistry and Molecular Biology, University of Chicago, Chicago, IL, 2013.
49. "Biophysical Modeling of Nucleic Acid Nanostructure Solution Shape and Stability," 57th Annual Biophysical Society Meeting, Philadelphia, PA, USA, 2013.
50. "Data-driven Physical Biology," Boston University, Integrative Systems Biology Seminar Series, Boston, MA, USA, 2012.
51. "Computer-Aided Engineering for DNA Nanotechnology," Materials Research Society, Boston, MA, USA, 2012.
52. "Rational Engineering of DNA-based Nanostructures for Solar Energy Harvesting and Conversion," NNIN/C Conference, Synergy Between Experiment and Computation in Energy – Looking to 2030, Harvard University, Cambridge, MA, USA, 2012.
53. "Computer-aided Design and Engineering for Nucleic Acid Nanotechnology," Ohio State University, Columbus, OH, USA, 2012.
54. "Inverting Physical Biology," Soft Matter Approaches to Biological Physics, KITP UCSB, Santa Barbara, CA, USA, 2011.
55. "CanDo: Computer-aided Engineering for DNA Origami," Foundations of Nanoscience, Snowbird, UT, USA, 2011.
56. "Bayesian Analysis of Fluorescence Correlation Spectroscopy Data," Biophysical Society, Baltimore, MD, USA, 2011.
57. "Structure, Evolutionary Conservation, and Conformational Dynamics of Human Fascin-1, an F-actin Crosslinking Protein," Biophysical Society, Baltimore, MD, USA, 2011.
58. EMBO Workshop on Modeling, Microscopy, and Biophysical Methods, EMBL Heidelberg, Heidelberg, Germany, 2010.
59. Department of Biochemistry-Biophysics, Brandeis University, Waltham, MA, USA, 2010.
60. The Cellular Cytoskeleton, Pingree Park, CO, USA, 2010.

61. Harvard Squishy Physics, Harvard University, Cambridge, MA, USA, 2010.
62. MIT Graduate Student Council Alumni Speaker Series, Cambridge, MA, USA, 2009.
63. MIT BMES Undergraduate Students Association, Cambridge, MA, USA, 2009.
64. Annual Meeting of the United States Association for Computational Mechanics, Columbus, OH, USA, 2009.
65. Annual Meeting of the Biophysical Society, Boston, MA, USA, 2009.
66. WAM Seminar Series, Harvard University, Cambridge, MA, USA, 2009.
67. Institute for Biomolecular Science, Gakushuin University, Tokyo, Japan, 2009.
68. 2009 MIT in Japan Conference, Tokyo, Japan, 2009.

Workshops

1. Steering Committee Member, SRC Roadmap Committee on Synthetic Biology.
2. Co-Organizer, SRC/IBM/ONR Workshop on Biological Pathways for Electronic Nanofabrication and Materials in San Jose, CA, 2016.
3. Participant, Army Research Office Workshop on Bioenabled Materials Synthesis & Assembly, Army Research Laboratory, Fort Detrick, MD, 2016.
4. Participant, IARPA/SRC Workshop on DNA-based Massive Information Storage, Arlington, VA, 2016.
5. Participant, DARPA, From One, Many: Engineered Multi-cellularity, Arlington, VA, 2015.
6. Participant, DoD Future Directions in Chemical and Biological Engineering, UT Austin, Austin, TX, USA, 2013.
7. Organizer, Collective Behavior in Biological Systems, MIT, Cambridge, MA, USA, 2013.
8. Instructor, Quantitative Biology Workshop, MIT, Cambridge, MA, USA, 2013.
9. Organizer, MacroMoleculeBuilder Workshop, MIT, Cambridge, MA, USA, 2012.
10. Instructor, Quantitative Biology Workshop, MIT, Cambridge, MA, USA, 2012.
11. Participant, National Academies Keck Workshop on Frontiers in Imaging Science, National Academy of Sciences & Engineering, Irvine, CA, USA, 2010.
12. Instructor, EMBO Workshop on Modeling, Microscopy, and Biophysical Methods, EMBL Heidelberg, Heidelberg, Germany, 2010.

Academic Service at the Departmental and Campus Levels

Chair, Department of Biological Engineering Graduate Academic Program (2017–present)
Department of Biological Engineering Graduate Admissions Committee (2016–present)
NEET: New Engineering Education Transformation Committee (2016–present)
Department of Biological Engineering Undergraduate Program Committee (2016–present)
Institute for Medical Engineering & Science Faculty Search Committee (2015–2016)
Community Giving at MIT Committee (2015–present)
Department of Biological Engineering Teaching Assistantship Awards Committee (2015–present)
Computational & Systems Biology Graduate Committee (2009–present)
Computational & Systems Biology Graduate Admissions Committee (2009–present)
Department of Biological Engineering Graduate Program Committee (2008–2013)
Department of Biological Engineering Graduate Admissions Committee (2009–2013)
Department of Biological Engineering Retreat Organizing Committee (2014)
Department of Biological Engineering Seminar Series Organizing Committee (2014–present)
Department of Biological Engineering Undergraduate Program Committee (2013–present)
Department of Mechanical Engineering Graduate Admissions Committee (2011–2012)
MISTI Global Seed Funds Evaluation Committee (2011–2012)

Archival Journal Referee

Accounts of Chemical Research
ACS Nano
Analytical Chemistry
Angewandte Chemie
Biophysical Journal
Biopolymers
Cell
Chemical Reviews
E-life
European Physical Journal
Integrative Biology
Journal of the American Chemical Society
Journal of Biological Chemistry
Journal of Cell Biology
Journal of Cell Science
Journal of Chemical Information and Modeling
Journal of Chemical Physics
Journal of Computational Chemistry
Journal of Computational and Theoretical Nanoscience
Journal of Visualized Experiments
Nano Letters
Nanoscale
Nature Communications
Nature Methods
Nature Nanotechnology
Nucleic Acids Research
Physical Biology
Physical Review E

PLoS Computational Biology
 PLoS ONE
 PNAS
 Science
 Scientific Reports

Teaching

Term	Course Number	Course Title	Role	Course Type
Spring 2017	20.315/20.415	Physical Biology	Lecturer	Lecture
Fall 2016	20.430	Fields, Forces, & Flows in Biological Systems	Lecturer	Lecture
Spring 2016	20.310	Molecular, Cell, and Tissue Biomechanics	Lecturer	Lecture
Fall 2015	20.430	Fields, Forces, & Flows in Biological Systems	Lecturer	Lecture
Fall 2015	20.416	Topics in Biophysics & Physical Biology	Lecturer	Lecture
Spring 2015	20.415	Physical Biology	Lecturer	Lecture
Fall 2014	20.430	Fields, Forces, & Flows in Biological Systems	Lecturer	Lecture
Fall 2014	20.416	Topics in Biophysics & Physical Biology	Lecturer	Lecture
Spring 2014	20.415	Physical Biology	Lecturer	Lecture
Fall 2013	20.416	Topics in Biophysics & Physical Biology	Lecturer	Lecture
Spring 2013	20.416	Topics in Biophysics & Physical Biology	Lecturer	Lecture
Spring 2013	20.415	Physical Biology	Lecturer	Lecture
Fall 2013	20.430	Fields, Forces, & Flows in Biological Systems	Lecturer	Lecture
Fall 2012	CSB.100	Topics in Computational & Systems Biology	Lecturer	Lecture
Fall 2012	20.416	Current Research in Biophysics	Lecturer	Lecture
Fall 2012	20.430	Fields, Forces, & Flows in Biological Systems	Lecturer	Lecture
Spring 2012	20.415	Physical Biology	Lecturer	Lecture
Fall 2011	20.110	Thermodynamics of Biomolecular Systems	Lecturer	Lecture
Fall 2011	20.416	Current Research in Biophysics	Lecturer	Lecture
Fall 2010	20.430	Fields, Forces, & Flows in Biological Systems	Lecturer	Lecture
Spring 2010	20.415	Physical Biology	Lecturer	Lecture
Fall 2009	20.110	Thermodynamics of Biomolecular Systems	Lecturer	Lecture

Spring 2009	20.410	Molecular, Cell, and Tissue Biomechanics	Lecturer	Lecture
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Current & Past Graduate Students

Name	Prior University	Training Period	Project Area	Current Position
Joseph Berleant	California Institute of Technology	Spring 2017–present	DNA nanotechnology	Graduate Student
Molly Parsons	Iowa State University	Spring 2017–present	DNA nanotechnology	Graduate Student
Rebecca Du	California Institute of Technology	Spring 2017–present	DNA nanotechnology	Graduate Student
Matthew Adendorff	Rhodes University	Fall 2011–Winter 2015	Computing free energy landscapes of DNA immobile four-way junctions	Co-founder and CIO, GMA Innovations
Zachary Barry	Georgia Institute of Technology	Fall 2012–present	Bayesian analysis of peptidoglycan synthesis	Graduate Student
Philip Bransford	University of Minnesota	January 2009–Spring 2011	Dynamics and evolution of cadherins and actin-bundling proteins	Scientist I, Vertex Pharmaceuticals, Inc.
Simon Gordonov	Rutgers University (undergrad); University of Cambridge (M.Phil.)	Fall 2012–present	Modeling morphological complexity and signaling localization in cell migration	Current Graduate Student
Syuan-Ming Guo	National Taiwan University	Fall 2009–Spring 2016	Bayesian inference and super-resolution imaging of membrane dynamics	Postdoctoral Associate, MIT
Nilah Monnier	Harvard University	Summer 2009–Spring 2012	Bayesian inference approaches for particle trajectory analysis in cell biology	Postdoctoral Fellow, Stanford University
Sakul Ratanalert	Cornell University	August 2013–present	Structural DNA nanotechnology	Graduate Student
Reza Sedeh	Tehran University	June 2009–June 2012	Contributions to the analysis of proteins	Research Staff, Philips Research North America

Current Postdoctoral Research Associates

Name	Doctoral University	Training Period	Project Area	Current Position
Remi Veneziano	Institute Charles Gerhardt	04/21/14–present	Membrane-associated biomolecular structure and dynamics	Postdoctoral Associate
Hyungmin Jun	Korea Advanced Institute of Science and Technology	02/01/15–present	Structural DNA nanotechnology	Postdoctoral Associate
Tyson Shepherd	University of Iowa	09/08/15–present	RNA nanostructures	Postdoctoral Associate
William Bricker	Washington University	09/18/15–present	Computational modeling and simulation	Postdoctoral Associate
Syuan-Ming Guo	National Taiwan University	02/05/16–present	Bayesian inference and super-resolution imaging of membrane dynamics	Postdoctoral Associate
Martin Tomov	Colleges of Nanoscale Science and Engineering, SUNY Polytechnic Institute / University at Albany-SUNY	7/1/2016–present	Multiplexed fluorescence imaging of stem cell-derived neurons	Postdoctoral Associate
James Banal	University of Melbourne	05/23/16–present	Programmable excitonic systems on DNA nanostructures	Postdoctoral Associate
Matthew Stone	University of Michigan	01/19/17–present	Multiplexed fluorescence imaging of cancer tumor samples	Postdoctoral Associate

Former Postdoctoral Research Associates

Name	Doctoral University	Training Period	Project Area	Current Position
Keyao Pan	Rice University	10/03/11–10/02/16	DNA nanostructure solution shape prediction	Research Scientist, Boston Biomedical, Inc.
Jessica Wu	University of California, Irvine,	03/28/16–09/19/16	Phenotypic Profiling of	Research Scientist, Abvie,

	Irvine, CA		Synaptic Proteins and mRNAs in Neurological Diseases	Inc.
Stavros Gaitanaros	University of Texas at Austin	05/19/14–07/15/15	DNA nanostructure solution shape and mechanics	Assistant Professor, Johns Hopkins University
Etienne Boulais	École Polytechnique de Montréal	03/01/13–05/31/15	Excitonic properties of DNA-dye assemblies	Research Scientist, MDA, Inc.
Changsun Eun	University of California San Diego (Postdoc) - University of North Carolina at Chapel Hill (Ph.D.)	05/25/14–12/23/14	DNA scaffolded multi-enzyme cascades	Research Scientist, LG Chemicals, Inc.
Pramod Pisharady	National University of Singapore	10/14/13–10/13/14	Bayesian reconstruction of structural MRI data	Postdoctoral Associate, University of Minnesota
Yera Hakobyan	Cornell University	09/09/13–09/08/14	Structure-based mechanical modeling of DNA origami	Postdoctoral Researcher, University of Minnesota
Lun Yang	Carnegie Mellon University	9/01/12–02/15/13	Modeling nanoscale excitonic networks	Senior PDE Software Quality Engineer, MathWorks, Inc.
Do-Nyun Kim	MIT	06/10/11–01/15/13	Predicting 3D structure of DNA origami	Associate Professor, Seoul National University
Philipp Diesinger	Institute of Theoretical Physics, University of Heidelberg	02/15/10–12/31/11	Quantitative analysis of cytoskeletal dynamics	Business Enterprise Consultant, SAP
Aprotim Mazumder	NCBS – TIFR Bangalore, India	07/01/09–06/30/14	Single-cell DNA Damage Response	Assistant Professor, TCIS, TIFR Hyderabad
Jun He	Brown University	06/15/09–06/14/11	Bayesian approach to imaging-based spectroscopy	Senior Data Scientist, Opera Solutions, Inc.

Doctoral Thesis Committee Reader

2009 BoBae Lee (DMSE), Thesis Committee Member
 2011 Ishan Barman (ME), Thesis Committee Member

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Associate Professor
77 Massachusetts Avenue
Building 16, Room 255
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Massachusetts Institute of Technology
Department of Biological Engineering
Laboratory for Computational
Biology & Biophysics
<http://icbb.mit.edu>

2012 Sungmin Son (ME), Thesis Committee Member
2013 Chia-Ching Chou (CEE), Thesis Committee Member
2013 Dimitrios Tzeranis (ME), Thesis Committee Member
2014 Thomas Gurry (CSB), Thesis Committee Member
2015 Christopher Negron (CSB), Thesis Committee Member
2016 William Hesse (BE), Thesis Committee Chair
2016 Kelly Brock (CSB), Thesis Committee Member
2016 Rotem Gura (CSB), Thesis Committee Member
2016 Joyce Yang (HMS), Thesis Committee Member
2016 Kento Masayuma (AA), Thesis Committee Member
2017 Anthony Kulesa (BE), Thesis Committee Chair
2017 Paul Reginato (BE), Thesis Committee Chair
2017 Aaron Dy (BE), Thesis Committee Chair
2017 Eric Ma (BE), Thesis Committee Chair

Collaborators

Alan Aspuru-Guzik, Ph.D. (Harvard University)
Edward Boyden, Ph.D. (MIT)
Anne Carpenter, Ph.D. (Broad Institute of MIT & Harvard)
Iain Cheeseman, Ph.D. (MIT)
Jeffrey Cottrell, Ph.D. (Broad Institute of MIT & Harvard)
Ethan Garner, Ph.D. (Harvard University)
Darrell Irvine, Ph.D. (MIT)
Douglas Lauffenburger, Ph.D. (MIT)
Silvi Rouskin, Ph.D. (MIT)
Leona Samson, Ph.D. (MIT)
Robert Singer, Ph.D. (Albert Einstein College of Medicine)
Nils Walter, Ph.D. (University of Michigan)
Thorsten Wohland, Ph.D. (Singapore National University)
Neal Woodbury, Ph.D. (Arizona State University)
Hao Yan, Ph.D. (Arizona State University)
Peng Yin, Ph.D. (Harvard Medical School)

Software and Servers

<http://cando-dna-origami.org>

Automated server to predict 3D solution shape of nucleic acid based nanostructures.

<http://cdyn.org>

Automated databank housing the structure, conformational flexibility, and correlated motions of high molecular weight protein assemblies deposited in the Electron Microscopy Data Bank.

<http://daedalus.org>

Automated server to compute DNA sequences needed to fold target DNA origami objects.

<http://fcs-bayes.org>

Software to perform objective Bayesian analysis of fluorescence correlation spectroscopy data of molecular binding and transport processes from living and non-living chemical systems.

<http://hmm-bayes.org>

Software to perform Bayesian model selection of the physical mode of motion of single-particles from single-step resolution trajectories measured from time-lapse sequences of particle positions.

<http://msd-bayes.org>

Software to perform Bayesian model selection of the physical mode of motion of single-particles from mean-square displacement curves measured from time-lapse sequences of particle positions.

<http://sapphire-hcs.org>

Software to perform Bayesian classification of live-cell imaging datasets based on cell shape segmentation and stochastic modeling of transition states using hidden Markov modeling.

Funded Research Grants

ONR DURIP N00014-13-1-0664

Role: PI
Navy-ONR
High Performance Computing for Nucleic Acids

Equipment Grant

6/15/2013–6/14/2014
\$313,969

ONR DURIP N00014-15-1-2830

Role: PI
Navy-ONR
High Performance Computing for Nucleic Acid Nanotechnology

Equipment Grant

2/29/2015–9/28/2016
\$179,676

Anonymous Foundation

Role: PI
Anonymous Foundation
Functional Synaptomics: Resolving the Taxonomy of Brain Synapses using Multi-scale Fluorescence Imaging

Equipment Grant

1/1/2015–12/31/2016
\$650,000

DOD-MURI W911NF-12-1-0420

Role: Co-PI (PI Yan)
DOD-ONR
Translating Biochemical Pathways to Non-Cellular Environments

7/1/2012–8/18/2017

\$624,750

Navy-ONR N00014-14-1-0609 & N00014-16-1-2181

Role: PI
Navy-ONR
Computer-Aided Engineering for Nucleic Acid-Based Nanotechnology

5/15/2014–5/14/2017

\$1,018,340

NSF DMREF CMMI-1334109

Role: PI
NSF DMREF (Subcontracts to Arizona State University and Harvard University)
DMREF: Computational Design Principles for Functional DNA-based Materials

(Total Award)

(Bathe Portion)

1/15/2014–12/31/2017

\$1,706,468

\$817,106

NIH U01-MH106011

Role: Co-PI (PI Boyden)

(Total Award)

9/26/2014–11/30/2017

\$2,154,250

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NIH BRAIN (Bathe Portion)
\$714,195
Ultra-Multiplexed Nanoscale In Situ Proteomics for Understanding Synapse Types

NSF EAGER CCF-1547999 8/1/2015–7/31/2017
Role: PI \$155,000
NSF EAGER
EAGER: Collaborative Research: Algorithmic Design Principles for Programmed DNA Nanocages

Navy-ONR N00014-16-1-2506 7/15/2016–7/14/2017
Role: PI Equipment Grant \$162,843
NAVY-ONR
High-throughput Assembly and Characterization Tools for Structural DNA Nanotechnology

NSF PoLS PHY-1305537 1/1/2014–3/31/2018
Role: PI \$540,000
NSF PoLS
Inferring the Physics of Living Systems from Dynamic Light Microscopy Data

HFSP RGP0029/2014 5/1/14–4/30/18
Role: Co-PI (PI Krishnan) \$337,500
Human Frontier Science Program
Dissecting the Mechanochemistry of Membrane Invagination with Designer DNA-Based Probes

DOE-Chicago DE-SC0001088 8/1/2015–7/31/2018
Role: Co-PI (PI Baldo) (Bathe Portion) \$329,893
DOE
RLE-Center for Excitonics

DOE DE-SC0016353 8/15/2016–6/14/2019
Role: Co-PI (PI Yan) (Bathe Portion) \$213,388
Arizona State University/DOE
DNA Nanostructure Directed Designer Excitonic Networks

Skoltech 1911/R 12/1/2016–11/30/2019
Role: Co-PI (PI Lempitsky) (Bathe Portion) \$492,945
Skolkovo Institute of Science and Technology
Deep Learning Toolbox for Cell Image Analysis

Navy-ONR N00014-16-1-2953 9/1/2016–8/31/2019
Role: PI (Total Award) \$786,856
NAVY-ONR (Subcontract to Baylor College of Medicine) (Bathe Portion) \$561,856
DNA Origami Scaffolds for Single-particle Cryo-Electron Microscopy of Viral RNA

NSF CCF-1564025 4/1/2016–3/31/2020
Role: PI \$638,493
NSF
AF: Medium: Collaborative Research: Top-down algorithmic design of structured nucleic acid assemblies.

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NIH R01-MH112694

Role: PI

(Total Award)

4/1/2017–2/28/2022

\$2,018,175

NIH R01

(Bathe Portion)

\$1,560,675

Simultaneous multiplexed in situ fluorescence imaging of neuronal proteins and messenger RNAs.