Niall Mangan

Northwestern University, Technological Institute M450, 2145 Sheridan Rd. Evanston, Illinois 60208-3120
niall.mangan@northwestern.edu   website: niallmangan.com

Research Areas	Data characterization and data-driven model inference for mechanistic understanding Structural uncertainty and model selection in dynamical systems Modeling and engineering of metabolic biological networks Modeling and characterization of energy and environmental materials Computation for device physics, ODE systems, and reaction-diffusion equations Analytic methods for model reduction and systems analysis

Professional Appointments

Assistant Professor of Eng. Sci. & Appl. Math, *Northwestern* NSF-Simons Center for Quantitative Biology, Member	01/2018 - present
Acting Assistant Professor, *University of Washington* with Nathan Kutz in Dept. Applied Mathematics	01/2016- 12/2017
Research Associate Consultant, *Institute for Disease Modeling* with Joshua Proctor	06/2016 - 09/2017
Visiting Lecturer, *Brown University* with Shreyas Mandre in School of Engineering	10/2015 - 12/2015
Postdoctoral Associate, *Massachusetts Institute of Technology* with Tonio Buonassisi's Photovoltaics Lab	09/2013-09/2015

Professional Preparation

PhD, Nov. 2013	Systems Biology	*Harvard University*

Advisor: Michael Brenner *Harvard School of Engineering and Applied Science*
Thesis: Organization and diffusion in biological and material fabrication problems

BS, May 2008	Physics and Math, Minor Chemistry	*Clarkson University*

Advisor: Daniel ben-Avraham *Clarkson University, Physics*
Thesis: Random walks and analysis of diffusion

Publications

C M Jakobson, D Tullman-Ercek, N M Mangan. *Spatially Organizing biochemistry: choosing a strategy to translate synthetic biology to the factory.* Scientific Reports (2018) 8:8196 doi:10.1038/s41598-018-26399-0

T G Boatman, **N M Mangan**, T Lawson, and R J Geider. *Inorganic carbon and pH dependency of photosynthetic rates in Trichodesmium.* Journal of experimental botany (2018): ery141.

M Dong, **N M Mangan**, J N Kutz, S T Cundiff, H G Winful. *Traveling Wave Model for Frequency Comb Generation in Single Section Quantum Well Diode Lasers.* (2017) IEEE Journal of Quantum Electronics 53(6), 1-11. doi: 10.1109/JQE.2017.2756641

N M Mangan, J N Kutz, S L Brunton, J L Proctor, *Model selection for dynamical systems via sparse regression and information criteria.*(2017) , Proc. R. Soc. London A Math. Phys. Eng. Sci., vol. 473, no. 2204. doi: 10.1098/rspa.2017.0009

C M Jakobson, M F Slininger, D Tullman-Ercek, **N M Mangan**[†]. *A systems-level model reveals that 1,2-propanediol utilization microcompartments enhance pathway*

flux through intermediate sequestration. PLoS Comp. Bio. 13(5), e1005525 (2017). doi: 10.1371/journal.pcbi.1005525

R E Brandt, **N M Mangan**, J V Li, Y S Lee, and T Buonassisi. *Determining interface limits to open-circuit voltage in thin-film oxide solar cells* J. App. Phys. 121(18), 185301 (2017). doi: 10.1063/1.4982752

A Polizzotti, A Faghaninia, J R Poindexter, L Nienhaus, V Steinmann, R LZ Hoye, A Felten, A Deyine, **N M Mangan**, J P Correa-Baena, S S Shin. *Improving the carrier lifetime of tin sulfide via prediction and mitigation of harmful point defects.*The Journal of Physical Chemistry Letters 8, no. 15 (2017): 3661-3667. doi: 10.1021/acs.jpclett.7b01406

N M Mangan S L Brunton, J L Proctor, and J N Kutz. *Inferring biological networks by sparse identification of nonlinear dynamics.* IEEE Transactions on Molecular, Biological and Multi-Scale Communications, 2(1), 52-63 (2016). doi: 10.1109/TMBMC.2016.2633265 Video Abstract

N M Mangan*, A Flamholz*, R D Hood, R Milo, and D F Savage *pH determines the energetic efficiency of the cyanobacterial CO2 concentrating mechanism* PNAS, 201525145 (2016). doi:10.1073/pnas.1525145113

N M Mangan, R E Brandt, V Steinmann, R Jaramillo, C Yang, R Chakraborty, J R Poindexter, R G Gordon, and T Buonassisi *A framework to predict optimal buffer-layer pairing with solar cell absorbers: A case study for zinc oxysulfide/ tin sulfide.* J. App. Phys. 118(11), 115102 (2015). doi:10.1063/1.4930581

R Chakraborty, V Steinman, **N M Mangan**, R E Brandt, J R Poindexter, R Jaramillo, J P Mailoa, K Hartman, A Polizzoti, C Yang, R G Gordon, and T Buonassisi, *Non-monotonic effect of growth temperature on carrier collection in SnS solar cells.* App. Phys. Lett., 106(20), 203901 (2015). doi:10.1063/1.4921326

D B Needleman, J P Mailoa, R E Brandt, **N M Mangan**, and T Buonassisi *Sensitivity Analysis of Optical Metrics for Spectral Splitting of Photovoltaic Systems: A Case Study* IEEE Journal of Photovoltaics 5(5), 1380-1388 (2015) doi: 10.1109/JPHOTOV.2015.2457292

M-J Sher, **N M Mangan**, M J Smith, YT Lin, S Marbach, T M Schneider, S Gradecak, M P Brenner and E Mazur *Femtosecond-laser hyperdoping silicion in a SF_6 atmosphere: Dopant incorporation mechanism.* J. App. Phys., 117(12), 125301 (2015). doi:10.1063/1.4914520

Y-T Lin, **N Mangan**, S Marbach, T M Schneider, G. Deng, S. Zhou, M P Brenner and E Mazur *Hyperdoped silicon with a flat doping profile: theoretical design and experimental realization.* App. Phys. Lett., 106(6), 062105 (2015). doi:10.1063/1.4907988

N M Mangan[†] and M P Brenner *Systems analysis of the CO2 concentrating mechanism in cyanobacteria..* eLife, 2014(3). doi:10.7554/eLife.02043

N Mangan, C Reichhardt, C J Olson Reichhardt *Reversible to Irreversible Flow Transition in Periodically Driven Vortices.* Phys. Rev. Lett. 2008; 100 (18):187002

Y Y Kievsky, B Carey, S Naik, **N Mangan**, D Ben-Avraham, I Sokolov. *Dynamics of molecular diffusion of rhodamine 6G in silica nanochannels.* J. Chem. Phys. 2008;

128 (15):151102

M Reason, Y Jin, H A McKay, **N Mangan**, D Mao, R S Goldman, X Bai, and C Kurdak. *Influence of N on the electronic properties of GaAsN alloy films and heterostructures.* J. Appl. Phys., 102 (10), 103710 (2007)

Conference Proceedings	M Dong, **N Mangan**, J N Kutz, S T Cundiff, H G Winful. *Model for frequency comb generation in single-section quantum well diode lasers.* CLEO:QELS_Fundamental Science, Optical Society of Amereica, JTu5A 102, May 2017, doi:10.1364/CLEO_AT.2017.JTu5A.102

N Mangan and S Mandre. *Optimal distribution of riverine turbines in a linear array with systematic flow manipulation.* XXIV ICTAM, 21-26th August 2016, Montreal, Canada.

S Mandre, **N M Mangan**, T Derecktor, and S Winckler. *A comparison of hydrokinetic turbines forming a vertical fence along the length of a river or tidal channel with a conventional rectangular turbine array.* METS, 25-27th April 2016, Washington, D.C.

<u>R E Brandt</u>, **N M Mangan**, J V Li, R C Kurchin, T Milakovich, S Levcenco, E A Fitzgerald, T Unold, T Buonassisi, *Temperature-and intensity-dependent photovoltaic measurements to identify dominant recombination pathways.* IEEE 43rd Photovoltaic Specialist Conference (PVSC) (pp. 1997-2001). IEEE. (2016) 10.1109/PVSC.2016.7749978

<u>J R Poindexter</u>, <u>R E Brandt</u>, **N M Mangan**, and T Buonassisi, *Extracting mobility-lifetime product in SnS thin films using quantum efficiency analysis.* MRS Proceedings, 1771, mrss15-2131250. (2015) doi:10.1557/opl.2015.483

N M Mangan, <u>R E Brandt</u>, V Steinmann, R Jaramillo, J V Li, <u>J R Poindexter</u>, <u>K Hartman</u>, L Sun, R G Gordon, and T Buonassisi, *A path to 10% efficiency for tin sulfide devices.* IEEE 40th Photovoltaic Specialist Conference (PVSC) (pp. 2373-2378). IEEE. (2014) doi:10.1109/PVSC.2014.6925404

Pre-prints	S Mandre and **N M Mangan** *Framework and limits on energy density in wind, tidal, and riverine device arrays using systematic flow manipulation* (2016) arXiv:1601.05462 [physics.flu-dyn]

[†] corresponding author. <u>Mentored students.</u>

Invited talks	N M Mangan, *Identification of Hybrid Dynamical Systems via Clustering and Sparse Regression* Computations in Science Seminars. May 23, 2018. University of Chicago, Chicago, IL.

N M Mangan, *Data-Driven Model Selection for Dynamic, Biological Systems.* Wednesdays@NICO seminar at Northwestern Institute on Complex Systems. February 21, 2018. Northwestern University, Evanston, IL

N M Mangan, *Principled, data-driven identification of dynamical systems for biological networks* UC Merced Dept. Applied Mathematics. Feb. 8, 2017.

N M Mangan, *Principled, data-driven identification of dynamical systems for biological networks* ESAM Northwestern. Jan. 9, 2017.

N M Mangan, *Principled, data-driven identification of dynamical systems for biological networks* ESAM Northwestern. Jan. 9, 2017.

N M Mangan *Systems analysis of reactions in bacterial microcompartments.* CCM9: The IXth International Symposium on Inorganic Carbon Utilization by Aquatic Photosynthetic Organisms. August 2016. Clare College, Cambridge, UK.

N M Mangan, S L Bruton, J L Proctor, and J N Kutz, *Inferring biological networks by sparse identification of nonlinear dynamics* Institute for Disease Modeling. June 2016. Bellevue, WA.

N M Mangan, M P Brenner, A Flamholz, R Milo, and D Savage. *Organization of metabolic reactions for improved efficiency: carbon fixation and bioengineering applications.* Energy Biosciences at University of California, Berkeley. July 2015. Berkeley, CA.

N M Mangan, M P Brenner *RuBisCO, carbonic anyhdrase, cellular organization and the carbon concentrating mechanism,* Massachusetts Institute of Technology CO_2 seminar series, May 2013. Cambridge, MA.

Contributed Talks N M Mangan, T Askham, S L Brunton, J N Kutz, J L Proctor. *Identification of Hybrid Dynamical Systems via Clustering and Sparse Regression* Mini-symposium organizer and speaker at SIAM Annual. Portland, OR. July 2018.

N M Mangan, J N Kutz, S L Brunton, J L Proctor. *Model selection for dynamical systems via sparse regression and information criteria.* AMS Sectional Meeting, Washington State University. Pullman, WA. April 22-23, 2017.

N M Mangan *Model inference in epidemiology and biological networks using sparse identification of nonlinear dynamics* Mini-symposium speaker at SIAM Conference on Computational Science and Engineering. Atlanta, GA. Feb 27- March 3, 2017.

N Mangan and S Mandre. *Optimal distribution of riverine turbines in a linear array with systematic flow manipulation.* Poster at XXIV ICTAM, Montreal, Canada 21-26th August 2016

N M Mangan, S L Brunton, J L Proctor, and J N Kutz. *Inferring biological networks by sparse identification of nonlinear dynamics* Mini-symposium speaker at SIAM Annual Meeting. Boston, MA July 15, 2016.

N M Mangan and Michael Brenner. *Organization of metabolic reactions for improved efficiency: carbon fixation and bioengineering applications* Mini-symposium organizer and speaker at SIAM Applications of dynamical systems conference. Snowbird, UT. May 2015.

N M Mangan, R E Brandt, V Steinmann, R Jaramillo, J R Poindexter, K Hartman, C Yang, R G Gordon, and T Buonassisi *Systematic Determination of the Efficiency Limiting Factors to Accelerate the Development of Photovoltaic Materials* Poster, presented at Fall Materials Research Society Meeting Dec. 2nd 2014, Boston, MA

N M Mangan, R E Brandt, V Steinmann, R Jaramillo, J V Li, J R Poindexter, K Hartman, L Sun, R G Gordon, and T Buonassisi, *A path to 10% efficiency for tin sulfide devices.* Poster presented at IEEE 40th Photovoltaic Specialist Conference

(PVSC). Denver, CO June 2014.

N M Mangan, M P Brenner *Organizing biochemical reactions: Lessons from cyanobacteria.* Poster, presented at Boston Bacterial Meeting. Cambridge, Massachusetts June 2012.

N M Mangan, M P Brenner *Organizing biochemical reactions: Lessons from cyanobacteria.* Talk, presented at APS March Meeting. Boston, MA February 2012.

N M Mangan, M P Brenner *Organizing biochemical reactions: Lessons from cyanobacteria.* Poster, presented at Dyanamics Days. Baltimore, MD January 2012.

N M Mangan, T M Schneider, and M P Brenner, in collaboration with M-J Sher, Y-T Lin, A Aspuru-Guzik, C Friend, and E Mazur. *Modeling femto-second laser doping: A path to high efficiency solar cells.* Poster, presented at Scialog sponsored by Research Corporation. Biosphere 2, Tuscon, AZ October 2011.

Teaching	Honors Engineering Analysis 4 (ODEs and Applications), Northwestern

Honors Engineering Analysis 4 (ODEs and Applications), Northwestern
Department of Engineering Sciences and Applied Mathematics, Northwestern
Course Website: Spring 2018
Textbook: *Differential Equations and Boundary Value Problems* by Edwards & Penney

Applied Linear Algebra, Winter 2018
Department of Engineering Sciences and Applied Mathematics, Northwestern
Course Website: Winter 2018
Textbook: *Numerical Linear Algebra with Applications* by W.Ford

Applied Linear Algebra and Numerical Analysis, (Professor) Spring and Fall 2016
Department of Applied Mathematics, University of Washington
Course Websites: Spring 2016, Fall 2016
YouTube Example Lecture: Finite Differences for Higher-Order Derivatives

Mathematical Modeling (Teaching Assistant) Fall 2011
with William Bossert, Harvard School of Engineering and Applied Science

Applied Mathematics (Teaching Assistant) Fall 2010
with Michael Brenner, Harvard School of Engineering and Applied Science

Honors and Awards
Lynch Foundation Fellowship 2009
NSF Graduate Fellowship August 2008

Service
Professional Societies SIAM, APS
Review Papers for: SIAM J.Appl Math.; J. Comp. Phys.; Biological Cybernetics; Chem. Eng. Sci.
Advisory activities:
Women in ESAM, Faculty advisor, Jan 2018- present
Simons Foundation Panel on Cellular Physiology, NYC Jan 2018
Clarkson Honors Program Alumni Affinity Group, May 2017-present

Synergistic Activities
Comprehensive Environmental Assessment and Synthetic Biology Applications
Woodrow Wilson International Center for Scholars, Science, Technology & Innovation Program

July 28th, 2011
Joined bioengineers, ecologists, industry representatives, regulators, and public interest groups in an evaluation of a scenario of the release of cyanobacteria engineered to produce sugars at an industrial scale are released into the environment. Aided in leading discussion on the use of a comprehensive environmental assessment to evaluate the risks associated with genetically modified organisms and identify knowledge gaps and future areas of research needed to mitigate identified risks.

Black Silicon development meetings with academia, industry, and government
MIT, Harvard, SiOnyx, and Benét Laboratories
Fall 2009 to Spring 2013
Participate in discussions of ongoing research at monthly meetings, for the purpose of advancing control of formation and understanding of physical properties of Black Silicon. Designed a train of laser pulses to produce optimal material properties.

Harvard Graduate Consortium on Energy and the Environment
Sept 2009 to April 2011
Learned about all aspects of climate change and energy from the science and technology to the economic and social issues. Included courses on energy technology (Mike Aziz), climate and environmental science (Dan Schrag), and energy economics and policy (Bill Hogan). Participated in weekly seminars and discussions lead by experts doing research in a related area.

Other Writing   Mangan, Niall. *Green Energy from Bacteria.* Science in the News Flash. August 15, 2011, Online Access, Retrieved October 1, 2016.

Kevin Vora and Niall Mangan. Jeffery Sachs: *Calling Academics, Research Communities and Companies to Make Up for Political Shortcomings.* The Energy Collective. April 14, 2011. Online Access Retrieved October 1, 2016.