Ishanu Chattopadhyay

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ACADEMIC APPOINTMENTS

2016- Assistant Professor, Department of Medicine, University of Chicago, Chicago IL

- **Ph.D.-Granting Committee, Program, Institute, and Center Appointments**

2016- Institute for Genomics & Systems Biology
2018- Committee on Genetics, Genomics and Systems Biology
2019- Committee on Quantitative Methods in Social, Behavioral, and Health Sciences
2021- Center for Health Statistics

OTHER PROFESSIONAL APPOINTMENTS

2014-2015 Research Scientist, Computation Institute, University of Chicago, Chicago IL
2015-2016 Director of Quantitative Research, Guggenheim Partners, Liquid Strategies Division, NYC, NY

ACADEMIC TRAINING

1997-2001	B.S., Mechanical Engineering, **Jadavpur University**, Kolkata, India
2003-2005	M.S., Mechanical Engineering, **The Pennsylvania State University**, State College, PA
2004-2006	M.A., Mathematics, **The Pennsylvania State University**
2001-2006	PhD. Mechanical Engineering, **The Pennsylvania State University**, State College, PA
2006-2008	Post Doctoral Fellow, Dept. of Mechical Engg., **The Pennsylvania State University**, State College, PA
2008-2011	Research Associate, Dept. of Mechical Engg., **The Pennsylvania State University**, State College, PA
2011-2013	Post Doctoral Fellow, Department of Computer Science, **Cornell University**, Ithaca, NY

PROFESSIONAL SOCIETIES

Society for Industrial and Applied Mathematics

HONORS, PRIZES AND AWARDS

- Defense Adavnced Research Projects Agency (DARPA) Young Faculty Award 2020
  - $1M Award, www.darpa.mil/attachments/YFAAwardees2020.pdf

- Best Paper In Session *"Learning-Control"* American Control Conference 2010
  - I. Chattopadhyay, Y. Wen and A. Ray, *Pattern Classification In Symbolic Streams Via Semantic Annihilation of Information*, American Control Conference, 2010, Baltimore, MD, June 30-July 2

  (Official list of best session paper award recipients at ACC 2009 can be publicly viewed online at: http://www.a2c2.org/conferences/acc2010/SessionBest.html)
- Best Paper In Session *"Path-Planning"* American Control Conference 2009
  - I. Chattopadhyay and A. Ray, *Optimal Path-Planning under Finite Memory Obstacle Dynamics Based on Probabilistic Finite State Automata Models*, American Control Conference 2009
- Best Paper In Session *"Large Scale Systems"* American Control Conference 2009
  - I. Chattopadhyay and A. Ray, *Supervised Self-Organization of Large Homogeneous Swarms Using Ergodic Projections of Markov Chains*, American Control Conference 2009
- Best Paper In Session *"Agent Based Systems II"* American Control Conference 2009
  - W. Lu, I. Chattopadhyay, G. Mallapragada and A. Ray, *A Real Time Implementable All-Pair Dynamic Planning Algorithm for Robot Navigation Based on the Renormalized Measure of Probabilistic Regular Languages*, American Control Conference 2009

  (Official list of best session paper award recipients at ACC 2009 can be publicly viewed online at: http://a2c2.org/conferences/acc2009/BestPresentationAwards2_061209am.pdf)
- Paper Chosen as Sole Editorial Pick in IEEE Control Systems Society Discrete Event Systems Technical Committee (DESTC) Newsletter (August 2008) The newsletter can be viewed online at: http://www.cas.mcmaster.ca/destc/nl/nl_aug08.php#jrnl
  - I. Chattopadhyay and A. Ray, *Generalized projections in finite state automata & decidability of state determinacy*, Int. J. Control **81** (2008), no. 10, 1626–1644.

SCHOLARSHIP

Published Journal Papers

1) I. Chattopadhyay and A. Ray, *A complex measure for linear grammars*, Demonstratio Mathematica **38** (2005), no. 3, 761–775.
2) I. Chattopadhyay and A. Ray, *A language measure for partially observed discrete event systems*, Int. J. Control **79** (2006), no. 9, 1074–1086.
3) I. Chattopadhyay and A. Ray, *Renormalized measure of regular languages*, Int. J. Control**79** (2006), no. 9, 1107–1117.
4) I. Chattopadhyay and A. Ray, *Generalized language measure for finite state logical systems*, Int. J. Control **80** (2007), no. 5, 789–799.
5) I. Chattopadhyay and A. Ray, *Language-measure-theoretic optimal control of probabilistic finite-state systems*, Int. J. Control **80** (2007), no. 8, 1271–1290.

6) G. Mallapragada, I. Chattopadhyay, and A. Ray, *Automated behavior recognition in mobile robots using symbolic dynamic filtering*, Proceedings of the I Mech E Part I: Journal of Systems & Control Engineering **222** (2008), no. 6, 409–424.

7) I. Chattopadhyay and A. Ray, *Structural transformations of probabilistic finite state machines*, Int. J. Control **81** (2008), no. 5, 820–835.

8) I. Chattopadhyay and A. Ray, *Generalized projections in finite state automata & decidability of state determinacy*, Int. J. Control **81** (2008), no. 10, 1626–1644.

9) I. Chattopadhyay, G. Mallapragada, and A. Ray, $\nu^\star$*: A robot path planning algorithm based on renormalized measure of probabilistic regular languages*, Int. J. Control **82** (2009), no. 5, 849–867.

10) G. Mallapragada, I. Chattopadhyay, and A. Ray, *Autonomous robot navigation using optimal control of probabilistic regular languages*, Int. J. Control **82** (2009), no. 1, 13–26.

11) I. Chattopadhyay and A. Ray, *Supervised self-organization of homogeneous swarms using projections of Markov chains*, IEEE Transactions on Systems, Man, and Cybernetics, Part B (2009), **39**, No. 6, 2009, pp 1505–1515.

12) I. Chattopadhyay and A. Ray, *Measure-theoretic Optimal Control of Infinite Horizon Partially Observable Decision Processes Modeled as Generators of Probabilistic Regular Languages*, Int. J. Control, **83**, No. 3, March 2010, pp 457–483.

13) I. Chattopadhyay and H. Lipson, *Abductive Learning of Quantized Stochastic Processes Using Probabilistic Automata*, Philosophical Transactions A of the Royal Society, **371** (1984), Feb 2013, pp 20110543.

14) I. Chattopadhyay, A. Kuchina, G. Suel and H. Lipson , *Inverse Gillespie for inferring stochastic reaction mechanisms from intermittent samples*, Proceedings of the National Academy of Sciences, USA, **110** (32), July 2013, pp 12990-5.

15) I. Chattopadhyay, *Scalable ϵ-Optimal Decision-making and Stochastic Routing In Large Networks Via Distributed Supervision of Probabilistic Automata*, SIAM Journal of Control & Optimization, SIAM Journal on Control and Optimization 2014 52:4, 2512-2547)

16) I. Chattopadhyay and H. Lipson, "Data Smashing: Uncovering Lurking Order In Data" *Jnl. of Royal Society: Interface*, 2014 11:101 http://dx.doi.org/10.1098/rsif.2014.0826

17) I. Chattopadhyay, E. Kiciman, J. W. Elliott, J. L. Shaman, A. Rzhetsky, "Conjunction of factors triggering waves of seasonal influenza." *ELife*, **7** (2018): e30756, doi:10.7554/eLife.30756, 2018

18) Gengjie Jia, Yu Li, Hanxin Zhang, I. Chattopadhyay, Anders Boeck Jensen, David R. Blair, Lea Davis, Peter N. Robinson, Torsten Dahlén, Soren Brunak, Mikael Benson, Gustaf Edgren, Nancy J. Cox, Xin Gao & Andrey Rzhetsky, Estimating heritability and genetic correlations from large health datasets in the absence of genetic data, Nature Communications volume 10, Article number: 5508 (2019)

19) Gibbons, Robert D., Ishanu Chattopadhyay, Herbert Y. Meltzer, John M. Kane, and Daniel Guinart. "Development of a computerized adaptive diagnostic screening tool for psychosis." Schizophrenia Research (2021) https://doi.org/10.1016/j.schres.2021.03.020

20) Brenner, Lisa A., Lisa M. Betthauser, Molly Penzenik, Anne Germain, Jin Jun Li, Ishanu Chattopadhyay, Ellen Frank, David J. Kupfer, and Robert D. Gibbons. "Development and Validation of Computerized Adaptive Assessment Tools for the Measurement of Posttraumatic Stress Disorder Among US Military Veterans." JAMA Network Open 4, no. 7 (2021): e2115707-e2115707.

21) D. Onishchenko, Y. Huang, J. van Horne, P. J. Smith, M. M. Msall, I. Chattopadhyay, "Reduced false positives in autism screening via digital biomarkers inferred from deep comorbidity patterns." Science

Adv. 7, eabf0354 (2021).

22) Manuel F. Lopez-Aranda, Ishanu Chattopadhyay, Gayle M. Boxx, Elizabeth R. Fraley, Tawnie K Silva, Miou Zhou, Miranda Phan, Isaiah Herrera, Sunrae Taloma, Rochelle Mandanas, Karen Bach, Michael Gandal, Daniel H. Geschwind, Genhong Cheng, Andrey Rzhetsky, Stephanie A. White and Alcino J. Silva. "Post-natal immune activation causes social deficits in a mouse model of Tuberous Sclerosis: role of microglia and clinical implications." Science Adv. 7, eabf2073 (2021)

23) Chattopadhyay, Ishanu, and Yi Huang. "Universal Risk Phenotype Of US Counties For Flu-like Transmission To Improve County-specific COVID-19 Incidence Forecasts." PLOS Computational Biology (2021) In Press.

24) V. Rotaru, Y. Huang, T. Li, J. Evans and I. Chattopadhyay, "Precise Event-level Prediction of Urban Crime Reveals Signature of Enforcement Bias", Nature Human Behavior, (2021). In Press.

IN REVIEW JOURNAL PAPERS

1) Curtis Ginder, J. Li, R. Tung, MD, I. Chattopadhyay, and G. Upadhyay, "Predicting Appropriate ICD Therapies with Daily Remote Home Monitoring in the IMPACT Trial: A comparison of classical modelling versus machine-learning based approaches", Journal of the American College of Cardiology, Under Review

2) D. Onishchenko, J. Mastrianni and I. Chattopadhyay, "Bloodwork-free Early Screening for Alzheimer's Disease via Comorbid Pattern Recognition in Electronic Health Records", Cell Reports Medicine, Under Review

3) D. Onishchenko, R. Marlowe, G. Hunninghake, F. Martinez and I. Chattopadhyay, "Screening for Idiopathic Pulmonary Fibrosis with Comorbid Pattern Recognition in Electronic Health Records", Nature Medicine, Second Revision

4) Y. Huang, J. Evans and I. Chattopadhyay,"Deep Learning Without Neural Networks: Fractal-nets for Rare Event Modeling", Nature Machine Intelligence, Under Review

5) Y. Huang, V. Rotaru and I. Chattopadhyay, "Sequence Likelihood Divergence For Fast Time Series Comparison", IEEE Transcations of Knowledge & Data Engineering, Under Review

6) D. Onishchenko, D. Rubin, and I. Chattopadhyay, "Deep Co-morbidity Pattern Recognition to Predict Major Adverse Cardiac Events after Total Hip and Knee Arthroplasty", J. of American Heart Assoc, Under review

7) J. Li, E. White, A. Esser-Kahn and I. Chattopadhyay, "Predicting Future Mutations To Inform Vaccine Design", Nature Communications, Under Review

8) C. Lewis, C. Graziul, A. Belikov, I. Chattopadyay, Z. Chen, H. Fang A. Girdhar, X. Jia, P. Krafft, M. Kleiman-Weiner, C. Liang, J. Muchovej, A. Vientós, M. Young and J. Evans, "Does Big Data Serve Policy? Not Without Context. An Experiment with in silico Social Science", Computational & Mathematical Organization Theory, Under Review

9) D. Onishchenko, R. Gibbons, L. Royce, and I. Chattopadhyay, "Predicting the First Imminent Manic Episode from Deep Co-morbidity Patterns", JAMA Psychiatry, Submitted

Dissertation Topics

- I. Chattopadhyay, "*Quantitative Control of Probabilistic Discrete Event Systems: A Formal Measure-theoretic Approach*", PhD Dissertation, Dept. of Mech. Engg. Pennsylvania State University, http:// etda.libraries.psu.edu / theses / approved / WorldWideIndex / ETD-1443 (August 2006).
- I. Chattopadhyay, "*Decidability Of Monadic Second Order Theory Of Two Successors*", Masters Paper for M.A. (Mathematics), The Pennsylvania State University (March 2006)

Book Chapter

- I. Chattopadhyay, X. Wang and A. Ray, *Advanced topics in Supervisory Control Theory, Chapter 4: Quantitative Measure for Discrete Event Supervisory Control: Theory and Applications*, Springer 2005, ISBN 0387021086

Refereed Conference Publications

1) D. Friedlander, I. Chattopadhyay, A. Ray. S. Phoha. N. Jacobson, *Anomaly prediction in mechanical systems using symbolic dynamics*, Proceedings of the American Control Conference, Denver, Colorado, June 4-6, 2003, pp 4275 - 4280
2) I. Chattopadhyay, X. Wang and A. Ray, *A complex measure for non-regular languages for Discrete-event Supervisory Control*, Proceedings of the American Control Conference, Boston, Massachusetts, June 30-July 2, 2004, pp 5120-5125
3) I. Chattopadhyay and A. Ray, *A language measure for partially observable discrete event systems*, Proceedings of the 43rd IEEE Conference on Decision & Control, December 14-17, 2004, Atlantis, Paradise Island, Bahamas, pp 4794-4799
4) X. Wang, I. Chattopadhyay and A. Ray, *Probabilistic Fault Diagnosis in Discrete Event Systems*, Proceedings of the 43rd IEEE Conference on Decision & Control, December 14-17, 2004, Atlantis, Paradise Island, Bahamas, pp 45 - 50
5) I. Chattopadhyay, Subhadeep Chakraborty and A. Ray, *Autonomous Navigation in Space*, Infotech @Aero-space, AIAA 5th Aviation, Technology, Integration and Operations Conference, Arlington, Virginia, September 26-29, 2005
6) I. Chattopadhyay and A. Ray, *Renormalized Measure of Regular Languages*, 8th International Workshop on Discrete Event Systems (WODES) 2006, Ann Arbor, Michigan, July 9-10
7) I. Chattopadhyay and A. Ray, *Generalized Formal Measure Families in Finite State Logical Systems*, 8th International Workshop on Discrete Event Systems (WODES) 2006, Ann Arbor, Michigan, July 9-10
8) G. Mallapragada, I. Chattopadhyay and A. Ray, *Autonomous Navigation in Mobile Robotic Platforms using Formal Language Measures*, 45th IEEE Conference on Decision & control, San Diego CA, December 13-15, 2006.
9) I. Chattopadhyay and A. Ray, *Generalized Unobservability Maps in DES*, American Control Conference 2007, New York NY July 11 - 13.
10) I. Chattopadhyay and A. Ray, *Language-measure-theoretic Optimal Control of Probabilistic Finite State Systems*, 46th IEEE Conference on Decision & control, New Orleans LA, December 12-14, 2007.
11) I. Chattopadhyay, G. Mallapragada and A. Ray, *A Measure-theoretic Path Planning Algorithm for Mobile Robots*, American Control Conference 2008, Seattle Washington June 11 - 13.
12) I. Chattopadhyay and A. Ray, *Optimal Path-Planning under Finite Memory Obstacle Dynamics Based on Probabilistic Finite State Automata Models*, American Control Conference 2008, Seattle Washington June 11 - 13.

13) I. Chattopadhyay and A. Ray, *Generalization of $\nu^\star$-Path Planning for Accommodation of Amortized Dynamic Uncertainties in Plan Execution*, American Control Conference 2009, St. Louis Missouri June 10 - 12.

14) I. Chattopadhyay and A. Ray, *Supervised Self-Organization of Large Homogeneous Swarms Using Ergodic Projections of Markov Chains*, American Control Conference 2009, St. Louis Missouri June 10 - 12.

15) W. Lu, I. Chattopadhyay, G. Mallapragada and A. Ray, *A Real Time Implementable All-Pair Dynamic Planning Algorithm for Robot Navigation Based on the Renormalized Measure of Probabilistic Regular Languages*, American Control Conference 2009, St. Louis Missouri June 10 - 12.

16) K. Mukherjee, A. Ray, T. Wettergreen, I. Chattopadhyay and S. Phoha, *Signal Threshold Estimation in a Sensor Field for Undersea Target Tracking*, American Control Conference 2009, St. Louis Missouri June 10 - 12.

17) I. Chattopadhyay, Y. Wen and A. Ray, *Pattern Classification In Symbolic Streams Via Semantic Annihilation of Information*, American Control Conference, 2010, Baltimore, MD, June 30-July 2

18) I. Chattopadhyay and S. Mohinta, *A Decision-theoretic Model Of Selection Modulated Intra-host Antigenic Variation For Multi-strain Pathogens*, American Control Conference, 2010, Baltimore, MD, June 30-July 2

19) I. Chattopadhyay, Y. Wen, S. Phoha and A. Ray, *Mathematical foundations of sensor network design based on linguistic informatics*, American Control Conference, 2010, Baltimore, MD, June 30-July 2

20) I. Chattopadhyay and A. Ray, *GODDeS: Globally ϵ-Optimal Routing Via Distributed Decision-theoretic Self-organization*, American Control Conference 2011, San Francisco, CA, June 29-July 01, 2011

21) I. Chattopadhyay, Y. Wen and A. Ray, *Unsupervised Inductive Learning In Symbolic Sequences via Recursive Identification of Self-Similar Semantics*, American Control Conference 2011, San Francisco, CA, June 29-July 01, 2011

22) Y. Wen, I. Chattopadhyay, A. Ray and S. Phoha , *Vector Space Formulation of Probabilistic Finite State Automata*, American Control Conference 2011, San Francisco, CA, June 29-July 01, 2011

23) Y. Wen, I. Chattopadhyay, A. Ray and S. Phoha , *Hilbert Space Formulation of Symbolic Systems for Model Identification and Order Reduction*, American Control Conference 2011, San Francisco, CA, June 29-July 01, 2011

24) A. Srivastav, Y. Wen, E. Hendrick, I. Chattopadhyay, A. Ray and S. Phoha , *Information Fusion for Object & Situation Assessment in Sensor Networks*, American Control Conference 2011, San Francisco, CA, June 29-July 01, 2011

25) I. Chattopadhyay, and A. Ray, *Scalable ϵ-optimal Control Of Engineered Swarms Using Probabilistic Automata*, American Control Conference 2012, Montreal, Canada, June 27-June 29, 2012

26) I. Chattopadhyay , *Scalable ϵ-optimal Control Of Engineered Swarms Using Probabilistic Automata*, American Control Conference 2012, Montreal, Canada, June 27-June 29, 2012

27) I. Chattopadhyay and H. Lipson, *De novo Inference of Stochastic Mechanisms*, q-bio 2013, Santa Fe, NM, August 2013

28) I. Chattopadhyay, A. Kuchina, G. Suel and H. Lipson, *Inverse Gillespie: Inference of Stochastic Mechanisms*, International Conference of Computational Cell Biology, Virgina Bioinformatics Institute, Blacksburg, Virginia, August 2013

29) I. Chattopadhyay and H. Lipson, *Computing Entropy Rate Of Symbol Sources & A Distribution-free Limit Theorem*, 48th Annual Conference of Information Science and Systems (CISS 2014), Princeton University, March 2014

30) I. Chattopadhyay and H. Lipson, *Distilling Evidence of Long-Range Direction-Specific Causal Cross-Talk in Molecular Evolution of Retro-Viral Genomes*, Discovery Informatics Workshop at the Twenty-Eighth AAAI Conference on Artificial Intelligence, Quebec City, Quebec, July 2014

31) I. Chattopadhyay, *Discrimination at the Edge of Noise: A Hilbert Space of Stationary Ergodic Processes*, IEEE International Conference on Data Mining Workshops, ICDM Workshops 2017, New Orleans, LA, USA, November 18-21, 2017

32) S. Asoodeh, Y. Huang, and I. Chattopadhyay, *On semi-universal tamper-free communication over deletion channels*, 57th IEEE Conference on Decision & Control, Florida USA, December 17-19, 2018, DOI: 10.1109/CDC.2018.8619215

33) V. Rotaru, Y. Huang, and I. Chattopadhyay, *Timesmash: Process-aware Fast Time Series Clustering and Classification Based on Hidden Stochastic Generators of Physical Processes*, Proceedings of the AAAI 2021 Spring Symposium on Combining Artificial Intelligence and Machine Learning with Physical Sciences, Stanford, CA, USA, March 22nd to 24th, 2021

34) Ishanu Chattopadhyay, "Dissonance Measures: A Mathematical Theory of Belief Formation and Propagation in Social Collectives", 2020 International Conference of Social Computing Conference, Dec 14, 2020, China

PATENTS

- United States Provisional Application 62/198,849, filed on November 17, 2020 QNets: Scalable Learning from Genomic Sequences To Predict Future Mutations and New Strains of Evolving Pathogens
- U.S. Provisional Application No. 62/937,604, filed November 19, 2019 Method of Creating Zero-Burden Digital Biomarkers for Disorders, And Exploiting Co-morbidity Patterns to Drive Early Interventions
- 6259-01-US Stochastic Automata for Earthquake Prediction from Large Scale Surveys
- 6259-02-PC Systems and Methods for Abductive Learning of Quantized Stochastic Process
- 6024-03-PC System and Methods for Analysis of Data PCT/US13/62397
- 6998-01-US Causality Network Construction Algorithm (Application no. 62170063, EFS ID 2517508)

FUNDING

Note: Defense Advanced Research Projects Agency (DARPA) is part of the United States Department of Defense (DoD) responsible for the development of emerging technologies ranging from intelligent systems, to next generation aircraft engines, and since more recently, supports transformative research into biological and biomedical problems.

Current

1) W911NF2010302 **Defense Advanced Research Projects Agency**
•TITLE:*CReeD: Quantification and Dissipation of [C]ognitive Dissonance via [Re]cursiv[e] [D]ecision Forests* (07/31/20-07/30/22, $1M USD, 3.6 CM)
• ROLE: **Principal Investigator**
• GOAL: 1) Detecting and quantifying cognitive dissonance in populations, communities and individuals, irrespective of geography, social and demographic context, and 2) develop data-validated theoretical

models of belief shifts over time arising from the differential choice of dissonance reduction strategies employed by individuals.

2) HR00111890043/P00004 **Defense Advanced Research Projects Agency**
•TITLE:*Q-Nets: Accelerated Robust Learning Via Deep Knowledge Integration* (09/24/19-03/24/20, $1M USD, 2.4 CM)
• ROLE: **Principal Investigator**
• GOAL: Make definitive steps in effective modeling of high dimensional phenomena via the conceptual design, implementation and demonstration of a radically new approach to learning complex non-linear dynamical systems

3) **University of Chicago Women's Board**
•TITLE:*Universal Early Screening For Autism Risk using Comorbidity Pattern Discovery in Past Medical Encounters* (08/01/21-07/31/22, $87K USD, Student Support)
• ROLE: **Principal Investigator**
• GOAL: Universal screening for autism in primary care for children aged between 16-26 months.

4) **Big Ideas Generator Incubator**
•TITLE:*Escape-resistant Vaccine Design for COVID-19 Using Machine Learning on Emerging Sequence Patterns* (08/01/20-12/31/21, $80K USD, Student Support)
• ROLE: **Principal Investigator**
• GOAL: Predict escape mutants for evolving viruses, piloted for SARS-CoV2.

5) **P30 AG066619. NIH**
•TITLE:*Early Screening for Alzheimer's Disease* (8/31/2021-9/1/2022), $15K USD, 0.1CM)
• ROLE: **Principal Investigator**
• GOAL: Pilot program for universal early screening for Alzheimer's Disease

6) **852418 Alzheimer's Association**
•TITLE:*Universal Early Screening for Dementia Using Co-morbidity Footprint* (08/01/21-12/31/23, $150K USD, 0.2CM)
• ROLE: **Principal Investigator**
• GOAL: Universal screening for ADRD in primary Care.

7) R01 **NIH**
•TITLE:*Gut Microbiome Brain Axis and Preterm Infants* (08/01/21-07/31/26, $500K USD, 2.4 CM)
• ROLE: **Co-Investigator (PI: Erika Claud, Pediatrics)**
• GOAL: Use multiple modalities including a longitudinal preterm infant cohort with multiple points of neurodevelopment evaluation and microbiome analysis by 16S rRNA gene sequencing, metagenomics, metabonomics, and transfaunated mouse models to understand the mechanisms by which the microbiome impacts neurodevelopment and to improve preterm infant outcomes.

8) R01MH124805 **NIMH**
•TITLE:*B-SNIP: Algorithmic Diagnostics for Efficient Prescription of Treatments* (08/01/21-07/31/26, $500K USD, .5 CM)
• ROLE: **Co-Investigator (PI: Robert Gibbons, Medicine)**
• GOAL: Simplify the biotype classification of psychotic subjects to enable large-scale application in routine clinical practice.

9) **University of Chicago Women's Board**
•TITLE:*Agitation Detection in Dementia* (01/01/20-12/31/21, $72K USD, Student Support)

• ROLE: **Co-Principal Investigator (PI: James Mastrianni, Neurology)**
• GOAL: Detecting and predicting onset of agitation in dementia patients from multi-channel wearable sensor data

Pending

1) **Predictive Intelligence for Pandemic Prediction (PIPP) NSF Phase I**
•TITLE: *Cross-disciplinary Calibration of Emergence Risk (XCalibER)* (3/1/2022 - 12/31/2023, $1M USD, 1CM)
• ROLE: **Principal Investigator**
• GOAL: Predict the nect pandemic, develop "pandemic science" for a future NSF center grant.

2) **NSF**
•TITLE: *ATD: Fractal-Nets for Rare and Extreme Event Prediction in Spatio-temporal Phenomena in Social and Geo-physical Systems* (9/1/2021 - 8/31/2023, $200K USD, 2CM)
• ROLE: **Co-Principal Investigator**
• GOAL: Complex event modeling in social systems

3) **NHLBI NIH**
•TITLE: *Universal Early Screening For Idiopathic Pulmonary Fibrosis using Comorbidity Pattern Discovery in Past Medical Encounters* (12/1/2021- 11/30/2023, $267K USD, 1.5CM)
• ROLE: **Principal Investigator**
• GOAL: Screening algorithm for Idiopathic Pulmonary Fibrosis

4) **NIA NIH**
•TITLE:*Universal Early Screening For Dementia* (12/1/2021- 11/30/2023, $328K USD, 2CM)
• ROLE: **Principal Investigator**
• GOAL: Screening algorithm for Dementia

5) **NIMH NIH**
•TITLE: *Universal Early Screening For Autism* (12/1/2021- 11/30/2023, $164K USD, 1CM)
• ROLE: **Principal Investigator**
• GOAL: Screening algorithm for Autism Spectrum Disorder

6) **NIAID NIH**
•TITLE: *LukinGlas: An AI for Predicting Future Mutations of Novel Pathogens Enabling Escape-resistant Vaccine Design* (3/1/2022- 02/29/2024, $451K USD, 2CM)
• ROLE: **Principal Investigator**
• GOAL: Predicting evolution trajectories and escape mutatnts for emerging pathogens and inform vaccine design strategies

7) **Predictive Intelligence for Pandemic Prediction (PIPP) Phase I: NSF**
•TITLE:*"NORAD" for Biological Threats* (7/1/2022- 12/31/2024, $1M USD, 2CM)
• ROLE: **Principal Investigator**
• GOAL: Predict pandemics before they happen and devise optimal intervention strategies

8) **MIM: NSF**
•TITLE:*Recursive Decision Forests To Uncover Emergent Rules of Early Maturation for Infant Microbiome* (9/1/2021 - 8/31/2026, $3M USD, 2CM)

- ROLE: **Principal Investigator**
- GOAL: Uncover rules of microbiome assemply, and maturation

9) **RFA-NS-22-009 U01 NIH**
•TITLE:*Rapid, Precise, Zero-time Dementia Screening in Primary Care* (3/1/2022 - 2/29/2027, $7.5M USD, 3CM)
- ROLE: **Principal Investigator**
- GOAL: Accurately and instanteneously screen for dementia or cognitive impairment in primary care

Past Support

- D19AC00004/N/A (Ariel Weinberger, Prime PI) 10/01/18-03/31/20 3.6 CM DARPA/Autonomous Therapeutics $124,522 • ROLE: (**Site PI**)
- FP064753-01-PR **Defense Advanced Research Projects Agency** , *ZeD: Zero-Knowledge Discovery Using Data Smashing*, (March 2017 to 2019, $450K, Effort 20%)
  • ROLE: (**Principal Investigator**)
- **Neubauer Collegium: Faculty Initiated Research**, *Crimes of Prediction*, (July 2017-2019, $165K, Faculty Salary Not Supp.)
  • ROLE: (**Principal Investigator**)
- **Defense Advanced Research Projects Agency** , *Big Mechanisms*, (August 2016 to 2017, Effort 60%)
  • ROLE: (**Co-Principal Investigator**)
- #W911NF-12-1-0499 **Army Research Office** (PM: Dr. V. Passour), *Mathematical Biology*, (August 2012 to 2015 at Cornell University, $300K)
  • ROLE: (**Co-Principal Investigator**)

INVITED SPEAKING

Invited speaker	Association for Computing Machinery (ACM) Penn State Chapter, *Rise of The machines: Toasters to Autonomous Robotics*, 18 September, 2007
Research Seminar	*Autonomous Navigation in Space*, Infotech @Aero-space, AIAA 5th Aviation, Technology, Integration and Operations Conference, Arlington, Virginia, September 26-29, 2005
Invited speaker	*A Cyber-physical Paradigm For Robust Intelligence*, March 2010, Invited Lecture, University Of Alabama, Huntsville
Invited speaker	*A Cyber-physical Paradigm For Situation Aware Decision Adaptation*, March 2010, Invited Lecture, University at Buffalo, State University Of New York
Invited Lecture	*Semantic Cross-compression: A Formal Linguistic Approach To Evolutionary Machine Sentience*, September 2010, Department of Mechanical & Aerospace Engineering, Creative Machines Laboratory, Cornell University
Invited Seminar	*Information Annihilation for Feature-free Classification*, AI Seminar, Department of Computer Science, Cornell University, Feb 8, 2013
Invited Seminar	*Data smashing: Finding causal similarity in natural data sets*, Workshop: Natural Algorithms and the Sciences, Center for Computational Intractability, Princeton University,

May 21, 2013

Invited speaker — *Inverse Gillespie Methods for Stochastic Inference*, Department of Mathematics, Rutgers University, Oct 16, 2013

Invited speaker — *Search For Causal Spatio-temporal Structure In Global Seismicity - Reverse-Engineering History To Predict The Future*, Center for Nonlinear Studies, Los Alamos National Laboratory, June 6 2014

Invited Symposium — *Data Smashing: Universal Similarity To Computational Causality In Complex Systems*, Center for Nonlinear Studies, Los Alamos National Laboratory, June 5 2014 Natural History Seminar, Department of Ecology and Evolution, University of Chicago, October 28 2014

Invited speaker — *Automating Scientific Discovery: From Machine Learning To Machine Science*,

Invited speaker — *Causality Streamlines: Uncovering Disease Etiology From Zero-knowledge Machine Inference of Statistical Causality*, Center for Nonlinear Studies, Los Alamos National Laboratory, April 1 2015
http://cnls.lanl.gov/External/showtalksummary.php?selection=6256

Invited speaker — *Automating ScienSIAM-AN18-Minisymposiatific Discovery: Anti-streams, Universal Causality & Statistical Causality*, Santa Fe Institute, Santa Fe, April 2 2015.
http://www.santafe.edu/gevent/detail/science/2057/

Invited speaker — *Automating Science: Anti-streams, Universal Similarity and Statistical Causality*, Argonne National Laboratory, Chicago, May 4 2015. http://www.anl.gov/events/automating-science-anti-streams-universal-similarity-and-statistical-causality

Invited speaker — *Deep Text-Mining for Cancer and Disease*, Inside The Discovery Cloud Speaker Series 2014-15, May 20 2015
https://ci.uchicago.edu/events/deep-text-mining-cancer-and-disease

Invited speaker — *Mining for Causality*, CSE Seminar Series, The Department of Computer Science and Engineering at the University of Notre Dame, https://cse.nd.edu/seminars/cse-seminar-series-ishanu-chattopadhyay-1

Invited speaker — *Granger Nets for Spatio-temporal Stochastic Inference: Predicting Earthquakes, Weather, and Crime*, in Session on Data-driven Modeling and Control of Complex Systems, in SIAM-AN18-Minisymposia 2018, July 9-13

Invited speaker — *DARPA Hackathon: INTERCEPT PI Meeting*, October 15-17, 2018, New York Academy of Medicine, New York City NY USA

Invited speaker — *16th annual Science@theInterface Symposium at the Institute of Biophysical Dynamics*, June 21, 2019, University ofChicago, Chicago IL, USA

Invited speaker — *Data and Information Fusion 2019*, August 20-22, 2019, Santa Fe Institute of Nonlinear Studies, Santa Fe, NM, USA

Guest Lecture — Machine Learning in Biomedicine, *Masters of Science Program in Biomedical Informatics, Graham School*, May 24, 2019

Invited Lecture — *Double Executive Masters in Health Policy program*, The University of Chicago Harris School of Public Policy, and The London School of Economics and Political Science, April 20, 2020

Invited speaker — *Comorbid risk scores*, *Chicago Biomedical Informatics Virtual Data Jam*, September

	14, 2020, University of Chicago, Chicago IL, USA
Invited Seminar	*Enabling Early Screening in Autism, Alzheimer's Disease, Pulmonary Fibrosis, Bipolar Disorder, and Perioperative Cardiac Risk*, *MScBMI Program , Graham School, University fo Chicago*, March 3, 2021, Chicago IL, USA
Invited Seminar	*Early Diagnosis in Complex Diseases*, Clinical Research Leadership Council (CRLC), March 23, 2021
Invited Speaker	*Bloodwork-free Universal Early Screening for Alzheimer's Disease and Related Dementia*, *Deep Dementia Phenotyping (DEMON) Network,Applied models and digital health group*, November, 2021, UK
Invited Speaker	*Universal Early Screening for Alzheimer's Disease Using Uncharted Co-morbidity Patterns*, *Alzheimer's Association, IL Chapter*, December 2021, Chicago, IL

INTRAMURAL SERVICE

- Faculty Search Committee for Research-Focused Faculty in Medicine/BSD with Social Sciences emphasis (2021)
- Member of the Committee on Committee on Quantitative Methods in Social, Behavioral, and Health Sciences (2019-)
- Member of the Committee on Genetics, Genomics and Systems Biology (GGSB) (2018-)
- Interviewed potential graduate students for GGSB (Qi Zhan, Skylar Wyant, Evelynn Henry, Zoe Feder, John Connolly, Sheng Qian) (2019 batch)
- Member of Research Committee in the Section of Hospital Medicine, Department of Medicine, University of Chicago (2016-)
- Interviewed candidates for the Clinical Informatics Fellowship in the Department of Medicine (2018) medicine.uchicago.edu/sections/general-internal-medicine/training-programs/
- Helped identify candidates for BSD Dean's faculty search (Spearheaded by T. Conrad Gilliam) in the area of clinical/bio-medical data science (September 2017)
- Reviewed and screened applicants for Summer Quantitative Biology Fellowship in the College along with Dmitry Kondrashov (2018)
- Organized "Crimes of Prediction Workshop", Friday Apil 26 at University of Chicago to investigate the social, ethical and policy implications that arise in the context of the possibility of predicting crime at the level of individual events.

EXTRAMURAL SERVICE

- Organized Workshop on Crimes of Prediction, Neubauer Collegium, April 26, 2019, Chicago, IL
- Organized Workshop on Data-driven Discovery of Models (D3M) at ICDM 2017, November 18-21, New Orleans, USA
- Chaired session entitled *"Disease Modeling and Control"*, June 30, 2010, at the American Control Conference, 2010.

- Co-chaired session in American Control Conference 2004 Boston Massachusetts June 29-July 3
- Co-chaired session in American Control Conference 2009 St. Louis Missouri June 10 - 12

TEACHING & MENTORING

- **For the College and Graduate programs (BA,BS,PhD):**
  - CCTS 40500/ CCTS 20500 / BIOS 29208 Machine Learning in Biomedicine (2019-current, offered every Winter Quarter, 30 hrs, 100 units)
    - 15 students
  - Mentored and guided research projects for undergraduate students (2016-):
    - Jaydeep Dhanoa (Current status: Facebook)
    - Angela Zhang (Current status: PA student
    - Warren Mo (Current status: Columbia CS grad, Researcher at “Treasury Prime”, Finance Startup)
    - Jasmine Mithani (Current status: ML Researcher at Non-profit)
    - Timmy Li (Current status: Finance Startup)
    - Jin Li (Current status: Facebook)
    - Ruolin Zhang (Current status: Salesforce)
    - Aditya Yellumahanti
    - Alice Sarapov
    - Drew Vlasnik
    - David Yang

- **Doctoral Dissertation Committee Member:**
  - Weerapat Pittayakanchit (Physics, Graduation 2021)

- **For the Pritzker School of Medicine (M.D.):**
  - MEDC/ISTP 42000 Topics In Biomedical Data Analysis - Big Data 2017 (6 hrs)
  - Mentoring undergraduate student (J. Lee) as a part of the Collegiate Translational Medicine Program (CTMP) (2018-2019)

- **Co-Mentor on K Grant:**
  - Rachael Melamed (Post-doctoral Scholar, Medicine, 2017-2019, Current Status: Assistant Professor at University of Massachusetts, Lowell)

- **Research Trainees:**
  - Nicholas Sizemore (2021-), Postdoctoral Scholar
  - Yi Huang (2017-2020), Postdoctoral Scholar (Current Status: Researcher at Brookhaven National Laboratory)
  - Shahab Asoodeh (2017-2018), Postdoctoral Scholar (Current Status: Research Associate at Harvard University)
  - Dmytro Onishchenko (2018-2019), Graduate Student at Computer Science, University of Chicago (Current Status: Research Staff in UChicago)
  - Victor Rotaru (2018-2020), Graduate Student at Computer Science, University of Chicago (Current Status: ML Researcher in Banking)
  - Timmy Li (2018-2020), Graduate Student at Computer Science, University of Chicago

- **At Previous Appointments**
  - Served on the Doctoral Dissertation Committee for *Yicheng Wen* (Graduation: 2011)
    - Dissertation Topic: *Information Space Modeling & Design In Large Scale Sensor Networks* (M.E.)
  - Served on the Doctoral Dissertation Committee for *Dr. Goutham Mallapragada* (Graduation: August 2009)
    - Dissertation Title: *A language-theoretic framework for decision & control of autonomous systems* (M.E.)
  - Served on the Masters Committee for *Anthony Cascone* (Graduation: 2010)
    - Topic: *Formal Language-theoretic Control Algorithms for Large Scale Systems* (M.E.)
  - Served on the Masters Committee for *Wei Lu* (Graduation: May 2009)
    - Topic: *Real Time All Pair Dynamic Path Planning Using* $\nu^\star$ (M.E.)
  - Mentoring Undergraduate/Graduate Students Interested in Robotics
    - Young Bum (Senior Year Project, Mechanical Engineering, Cornell University)
    - Amit K. Patel (Masters Student, Mechanical Engineering, Penn State)
    - Jeremy G. Bridon (Senior, Computer Science & Engineering, Penn State)

SENIOR COLLABORATORS (FACULTY CO-AUTHORS OR GRANT CO-PIS*)

- Pulmonary Care

1) Fernando Martinez, Pulmonary Care, Weill Cornell
2) Gary Hunninghake, Pulmonary Care, Harvard
3) Anna Podolanczuk, Pulmonary Care, Weill Cornell

- Psychiatry

4) Alex Leow, Psychiatry, University of Illinois, Chicago

5) Royce Lee, Psychiatry, University of Chicago
6) Robert Gibbons, Hospital Medicine, University of Chicago
   - Pediatric Development
7) Peter J. Smith, Pediatrics, University of Chicago
8) Michael Msall, Pediatrics, University of Chicago
   - Perioperative Cardiac Risk
9) Daniel Rubins, Anesthesia and Critical Care, University of Chicago
10) R. Parker Ward, Cardiology, University of Chicago
    - Cardiology
11) Gaurav Upadhyay, Cardiology, University of Chicago
    - Infant Microbiome
12) Erika Claud, Pediatrics, University of Chicago
13) James Mastrianni, Neurology, University of Chicago
    - Alzheimer's Disease
14) Kenneth Rockwood, Neurology, Dalhousie University
15) James Evans, Sociology, University of Chicago
    - Viral Emergence
16) Aaron Esser-Kahn, Molecular Engineering, University of Chicago
    - Data Science
17) Andrey Rzhetsky, Genetic Medicine, University of Chicago