

# Travis E. Gibson

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I study biological systems leveraging tools from (statistical) machine learning and control theory.

## Education

- 2014 (PhD) **Massachusetts Institute of Technology**, Mechanical Engineering, minor Mathematics  
Thesis: Closed-loop Reference Model Adaptive Control: with Application to Very Flexible Aircraft  
Advisor: Anuradha Annaswamy
- 2008 (SM) **Massachusetts Institute of Technology**, Mechanical Engineering  
Thesis: Adaptive Control of Hypersonic Vehicles  
Advisor: Anuradha Annaswamy
- 2006 (BS) **Georgia Institute of Technology**, Mechanical Engineering

## Appointments held

- 2019- Harvard Medical School & Brigham and Women's Hospital, Instructor (Faculty) in Pathology
- 2016-2018 Harvard Medical School & Brigham and Women's Hospital, Research Fellow in Pathology
- 2014-2016 Harvard Medical School & Brigham and Women's Hospital, Research Fellow in Medicine
- 2007-2013 Active Adaptive Control Lab, MIT, Research Assistant
- 2010, summer Boeing, Research Engineer
- 2009, spring Technische Universität München, Visiting Scholar
- 2008-2009, summers NASA, Research Summer Scholar
- 2005-2006 Georgia Tech, Undergraduate Research Assistant
- 2004-2006 summers Vistakon, Engineering Intern

## Teaching

- 2013 Spring Adaptive Control, MIT Course 2.S997 (1/2 Lecturer)

## Publications & Talks

### IN REVISION OR SUBMITTED

- accepted B.B. Hsu, T.E. Gibson, V. Yeliseyev, Q. Liu, L. Bry, P.A. Silver, G.K. Gerber, "Bacteriophages dynamically modulate the gut microbiota and metabolome" bioRxiv 454579
- submitted NeurIPS J.E. Gaudio, T.E. Gibson, A.M. Annaswamy, and M.A. Bolender "Provably Correct Learning Algorithms in the Presence of Time-Varying Features Using a Variational Perspective" arXiv 1903.04666
- submitted M.Ziesack, T.E. Gibson, ... G.K. Gerber "Inducible Cooperation in a Synthetic Gut Bacterial Consortium Introduces Population Balance and Stability" bioRxiv 426171
- submitted CDC J.E. Gaudio, T.E. Gibson, A.M. Annaswamy, M.A. Bolender, and E.Lavretsky r "Connections Between Adaptive Control and Optimization in Machine Learning", arXiv 1904.05856
- under revision T.E. Gibson et al. "On the Stability Landscape of the Human Gut Microbiome: Implications for Microbiome-based Therapies", bioRxiv 176941

### JOURNAL ARTICLES

- 2018 B.M. Jenkins, A.M. Annaswamy, E. Lavretsky, T.E. Gibson (2018) "Convergence Properties of Adaptive Systems and the Definition of Exponential Stability" *SIAM Journal on Control and Optimization*, arXiv:1511:03222

- 2017 Hong-Tai Cao, T.E. Gibson, et al (2017) "Inferring human microbial dynamics from temporal metagenomics data: Pitfalls and lessons", *BioEssays*, 39 (2), bioRxiv:073254
- 2016 A. Bashan, T.E. Gibson, et al. (2016) "Universality of Human Microbial Dynamics", *Nature* 534.7606: 259-262.
- 2016 V. Arunachalam, T.E. Gibson, et al. (2016) "Controllability analysis of the directed protein-protein interaction network identifies human disease genes", *Proceedings of the National Academy of Sciences* 113 (18) 4976-4981
- 2016 T.E. Gibson, et al. "On the Origins and Control of Community Types in the Human Microbiome" (2016) *PLoS Computational Biology*, arXiv:1506.05171
- 2016 M.J. McGeachie, J.E. Sordillo, T.E. Gibson, et al. (2016) "Longitudinal Prediction of the Infant Gut Microbiome with Dynamic Bayesian Networks" *Scientific Reports* 6 .
- 2015 T.E. Gibson, Z. Qu, A.M. Annaswamy, E. Lavretsky, (2015), "Adaptive Output Feedback based on Closed-loop Reference Models" *IEEE Transactions on Automatic Control*, arXiv:1410.1944
- 2013 T.E. Gibson, A.M. Annaswamy E. Lavretsky, (2013) "On Adaptive Control with Closed-loop Reference Models: Transients, Oscillations and Peaking," *IEEE Access*, arXiv:1304.7278
- 2012 A.M. Annaswamy, E. Lavretsky, Z.T. Dydek, T.E. Gibson and M. Matsutani, (2012) "Recent Results in Robust Adaptive Flight Control", *International Journal of Adaptive Control and Signal Processing*
- 2009 X. Huang, T.E. Gibson, M. Zhang, and R.W. Neu, (2009) "Fretting on the Cubic Face of a Single-Crystal Ni-base Superalloy at Room Temperature," *Tribology International*

#### ARXIV ONLY

- 2015 T.E. Gibson "Sign Stability via Root-Locus Analysis," (arXiv:1512.06026)
- 2012 T.E. Gibson, A.M. Annaswamy, E. Lavretsky, "Output Feedback Adaptive Control with Closed-Loop Reference Models," (arXiv:1210.8220)
- 2012 T.E. Gibson, A.M. Annaswamy, E. Lavretsky, "Closed-loop Reference Model Adaptive Control: Transients Performance and Robustness," (arXiv:1201.4897)
- 2011 E. Lavretsky, T.E. Gibson, A.M. Annaswamy "Projection Operator in Adaptive Systems" (arXiv:1112.4232)

#### CONFERENCE PAPERS

- 2018 T.E. Gibson and G.K. Gerber (2018) "Robust and Scalable Models of Microbial Dynamics", *International Conference on Machine Learning*
- 2016 Hong-Tai Cao, T.E. Gibson, et al (2016) "Impacts of Network Topology on the Performance of a Distributed Algorithm Solving Linear Equations", *Conference on Decision and Control*
- 2016 T.E. Gibson (2016), "Adaptation and Synchronization over a Network: Asymptotic Error Convergence and Pinning", *Conference on Decision and Control*
- 2016 T.E. Gibson (2016), "Adaptation and Synchronization over a Network: Stabilization without a Reference Model", *Conference on Decision and Control*
- 2016 T.E. Gibson (2016), "Opportunities for Systems and Control in the Human Microbiome", *American Control Conference*
- 2015 T.E. Gibson and E. Lavretsky (2015), "Robust and Adaptive Control Technologies for Flight Critical Systems", *17th Yale Workshop on Adaptive and Learning Systems*, New Haven Connecticut
- 2015 T.E. Gibson and A.M. Annaswamy (2015), "Learning and Consensus in Adaptive and Networked Systems", *17th Yale Workshop on Adaptive and Learning Systems*, New Haven Connecticut
- 2015 T.E. Gibson and A.M. Annaswamy (2015), "Adaptive Control and the Definition of Exponential Stability", *American Control Conference*
- 2013 A.M. Annaswamy, T.E. Gibson, H.S. Hussain and E. Lavretsky, (2013) "Practical Adaptive Control," *16th Yale Workshop on Adaptive and Learning Systems* New Haven Connecticut
- 2013 T.E. Gibson, A.M. Annaswamy, and E. Lavretsky (2013), "Closed-Loop Reference Models in Adaptive Control: Composite Control and Observer Feedback," *11th IFAC International Workshop on Adaptation and Learning in Control and Signal Processing*
- 2013 B.M. Jenkins, T.E. Gibson, A.M. Annaswamy, and E. Lavretsky (2013) "Uniform Asymptotic Stability and Slow Convergence in Adaptive Systems," *11th IFAC International Workshop on Adaptation and Learning in Control and Signal Processing*

- 2013 T.E. Gibson, A.M. Annaswamy, and E. Lavretsky (2013), "Output Feedback Adaptive Control with Closed-Loop Reference Models," *European Control Conference*
- 2013 T.E. Gibson, A.M. Annaswamy, and E. Lavretsky (2013), "Closed-Loop Reference Models in Adaptive Control, Part 1: Transient Performance," *American Control Conference*
- 2013 B.M. Jenkins, T.E. Gibson, A.M. Annaswamy, and E. Lavretsky (2013), "Accuracy, Smoothness, and Speed in Adaptive Systems with Closed-loop Reference Models," *AIAA Guidance Navigation and Control Conference*
- 2012 T.E. Gibson, A.M. Annaswamy, and E. Lavretsky (2012), "Improved Transient Response in Adaptive Control Using Projection Algorithms and Closed Loop Reference Models," *AIAA Guidance Navigation and Control Conference*
- 2011 M. Matsutani, A.M. Annaswamy, T.E. Gibson, E. Lavretsky (2011), "Trustable Autonomous Systems using Adaptive Control," *50th IEEE Conference on Decision and Control and European Control Conference*
- 2011 T.E. Gibson, A.M. Annaswamy, and E. Lavretsky (2011), "Modeling for Control of Very Flexible Aircraft," *Guidance Navigation and Control Conference*
- 2011 S. Baur, T. Gibson, A. Annaswamy, L. Hoecht, and F. Holzapfel (2011), "Simulation and Adaptive Control of a High Agility Model Airplane in the Presence of Severe Structural Damage and Failures," *AIAA Guidance, Navigation and Controls Conference*
- 2011 A.M. Annaswamy, M. Matsutani, T.E. Gibson and E. Lavretsky, (2011) "Trustable Autonomous Systems Using Adaptive Control," *15th Yale Workshop on Adaptive and Learning Systems*
- 2011 S. Baur, T. Gibson, A. Annaswamy, L. Hoecht, T. Bierling and F. Holzapfel, (2011) "Adaptive Control of a High Agility Model Airplane in the Presence of Severe Structural Damage and Failure" *Council of European Aerospace Societies EuroGNC*, Muenchen Germany.
- 2010 T.E. Gibson, M. Matsutani, L.G. Crespo and A.M. Annaswamy (2010) "Internal Algorithm Monitor for Adaptive Systems" *AIAA Infotech Aerospace Conference*
- 2009 L.G. Crespo, M. Matsutani, J. Jang, T.E. Gibson and A.M. Annaswamy (2009), "Design and Verification of an Adaptive Controller for the Generic Transport Model," *AIAA Guidance Navigation and Control Conference*
- 2009 M. Matsutani, T. E. Gibson, J. Jang, L. G. Crespo, and A.M. Annaswamy (2009) "An Adaptive Control Technology for Safety of a GTM-like Aircraft," *American Control Conference*
- 2009 T.E. Gibson, L.G. Crespo, and A.M. Annaswamy, (2009) "Adaptive control of hypersonic vehicles in the presence of modeling uncertainties," *American Control Conference*
- 2008 T.E. Gibson and A.M. Annaswamy, (2008) "Adaptive control of hypersonic vehicles in the presence of thrust and actuator uncertainties," *AIAA Guidance Navigation and Control Conference*

#### WORKSHOP PAPERS AND ABSTRACTS (PEER REVIEWED)

- 2018 R. Creswell, M.K. Gibson, T.E. Gibson, J.W. Leff, and G.K. Gerber (2018) "A multi-level Bayesian nonparametric model of longitudinal responses of the human microbiota to dietary interventions", *Workshop on Computational Biology at International Conference on Machine Learning*
- 2017 T.E. Gibson and G.K. Gerber (2017) "Robust and Scalable Models of Microbiome Dynamics for Bacteriotherapy Design", *NIPS Workshop on Machine Learning in Computational Biology* (oral presentation)

#### INVITED TALKS

- 2019 *Learning microbial dynamics for therapeutic applications: Scalable inference, robustness, and control* Bioinformatics Seminar, MIT, Cambridge, MA, 2018
- 2018 *Towards rational bacteriotherapy design with machine learning models* Frontiers in Microbiome Interactions, Harvard Digestive Disease Center, Boston, MA, 2018
- 2018 *From Airplanes to Microbes: Adaptive Control and Bayesian Inference* Google, Mountain View CA, 2018
- 2015 *On Synchronization and Learning over Networks*, NetSci Satellite Conference, Controlling Complex Networks: When Control Theory Meets Network Science, Zaragoza Spain, 2015
- 2014 *Open- and Closed-Loop Reference Models in Adaptive Control*, Emerging Frontiers in Adaptive Systems and Learning, American Control Conference, June 3, 2014

- 2014 *Verification and Validation of Adaptive Systems*, Emerging Frontiers in Adaptive Systems and Learning, American Control Conference, June 3, 2014
- 2014 *Adaptive Control of Networked Control Systems*, Emerging Frontiers in Adaptive Systems and Learning, American Control Conference, June 3, 2014
- 2013 *Transients, Learning, and Stability in Adaptive Systems*, Caltech, Pasadena California, November 25, 2013
- 2009 *Adaptive Control of Elastic Hypersonic Vehicles*, Institute of Automatic Control Engineering (LSR) Technische Universität Muenchen, Muenchen Germany, May 8, 2009
- 2009 *Internal Algorithm Monitors for Adaptive Systems*, Aviation Safety Annual Review, Washington DC, November 18, 2009