Marco Tulio Angulo

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RESEARCH INTERESTS

One sentence summary: I aim to understand, diagnose and control complex systems by blending systems theory (e.g., control theory and system identification) with network science.

Controllability and synthetic ecology of microbial communities • Fundamental limitations of network reconstruction • Interplay between network structure and functionality in complex systems • Optimization of uncertain systems • Performance tradeoffs in the differentiation of noisy signals • Observability and observer design for uncertain systems • Robust control with emphasis on discontinuous algorithms.

PUBLICATION SUMMARY

11 Journal / 12 Conference papers with 173 citations (h-index 8).

EDUCATION

Harvard Medical School, Channing Division of Network Medicine, Brigham and Women's Hospital, Boston, MA.

Sponsored Staff Collaborator 2015 – 2016
- Project title: *Interplay between network structure and dynamics in complex networks*.
- Supervision by Prof. Yang-Yu Liu.

Center for Complex Network Research, Northeastern University, Boston, MA.
Postdoctoral Research Associate 2015 – 2016
Visiting Research Scholar 2014 – 2015
- Project title: *Sensitivity of Complex Networks*.
- Supervision by Prof. Albert-László Barabási.

UNAM, Universidad Nacional Autónoma de México, México City, México.
Dr. Eng. in Automatic Control 2009 – 2012
- Thesis title: *Robustness and fragility in the control and observation of systems with noise and perturbations.*
- Supervision by Prof. Leonid Fridman and Prof. Jaime Moreno.

M. Eng. in Electrical Engineering and Automatic Control 2007 – 2009
- Thesis title: *Output-feedback exact finite-time stabilization of disturbed LTI systems.*
- Supervision by Prof. Leonid Fridman.

UAQ, Universidad Autónoma de Querétaro, Querétaro, México.
Bachelors' Degree in Automation and Mechatronic Systems 2002 – 2007
- Thesis title: *Disturbance Rejection using Iterated Integrals*.
- Supervision by Prof. Victor Manuel Hernández

PROFESSIONAL EXPERIENCE

UNAM, Universidad Nacional Autónoma de México, México City, México.
CONACyT Research Fellow, Institute of Mathematics 07/16 to date

UAQ, Universidad Autónoma de Querétaro, Querétaro, México.
Full-time Professor, Faculty of Engineering 02/15/16 – 03/06/16
Full-time Professor, Faculty of Engineering 2012 – 2013

ACADEMIC DISTINCTIONS

2014	Level 1 Member of the Mexican **National System of Researchers** (SNI)
2014	Postdoc **Scholarship** from the Mexican National Council of Science and Technology
2012	Dr. Eng degree with **summa cum laude**
2010	**Alfonso Caso Medal** to the academic merit, given to the most distinguished graduate of the program
2009	M. Eng degree with **summa cum laude**
2007	**Diploma to the Academic Excellence**, given to the most distinguished graduate of the Bachelor program
2007	**Best** Bachelor Thesis
2007	Bachelor degree with **summa cum laude**
2005	**First Prize in the Mechatronic Contest**, first International Engineering Congress

SCIENTIFIC VISITS/ INVITED TALKS

RIM17, Invited talk, Special Session on Mathematical Ecology and Epidemiology, 2017
Third Pacific Rim Mathematical Association Congress, Oaxaca, México 2017
NetSci, Invited talk, Symposium of Controlling Complex Systems 2017
International School and Conference on Network Science, Indianapolis, Indiana, US.
Max Planck, Invited talk, Workshop on Multistability and Tipping: From Mathematics and Physics to Climate and Brain (best poster presentation) 2016
Max Planck Institute for the Physics of Complex Systems, Dresden, Germany
MBI, Invited talk, Workshop on Control and Observability of Network Dynamics 2016
Mathematical Biosciences Institute (MBI), The Ohio State University, US.
MIT, Invited talk, Networks Control Group, Boston, US. 2015
Prof. Domitilla DelVecchio
Harvard Medical School, Invited talk, Channing Division of Network Science 2014 & 2015
Prof. Yang-Yu Liu
Boston University, Visit to the Center for Information & Systems Engineering, Boston, US. 2013
Prof. Christos Cassandras
IRCCyN, Visit to the Institut de Recherche en Communications et Cybernétique de Nantes, France.
Prof. Claude Moog 2009 and 2011

PROFESSIONAL SERVICES

Reviewer for International Congresses (CDC, ACC, VSS, etc) and Journals (Europhysics Letters, IEEE Transactions on Network Science and Engineering, Automatica, IJC, IJSS, etc).
Co-organizer of the symposium "Controlling Complex Networks" in NetSci2016 (Korea, 2016).
Co-organizer of the workshop "Analysis and control of biological networked systems" (México, October 13 and 14, 2016).

SKILLS

Operating systems: MacOS and Linux.
Programming: MATLAB, Simulink, LaTeX, C and Mathematica.
Hardware description languages: VHDL.
Languages: Spanish (native), English (proficient).

REFERENCES

Professor Albert-László Barabási
Robert Gray Dodge Professor of Network Science and Director of the Center for Complex Network Research, Northeastern University.
Department of Medicine and Network Medicine, Harvard Medical School.
Center for Cancer Systems Biology, Dana Farber Cancer Institute.
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Professor Yang-Yu Liu
Assistant Professor, Harvard Medical School.
Associate Scientist, Channing Division of Network Medicine, Brigham and Women's Hospital.
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Professor Jaime A. Moreno
Head of the Division of Electric and Computer Engineering.
Institute of Engineering, Universidad Nacional Autónoma de México (UNAM).
Building 12, Circuito Exterior, Ciudad Universitaria, México City, México 04510
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Professor Leonid Fridman
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Faculty of Engineering, UNAM.
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PUBLICATION LIST

Journal: 1 Royal Society, 1 NatPhys, 2 IJSS, 4 Automatica, 1 IEEE-TAC, 1 JFI, 1 IET.
International conferences: 5 CDC, 1 IFAC, 2 VSS, 1 CCE, 1 ACC, 1 ADHS, 1 SysTol

Journal papers

[1] Marco Tulio Angulo, Jaime A. Moreno, Gabor Lippner, Albert-László Barabási and Yang-Yu Liu. "Fundamental limitations of network reconstruction from temporal data". *Journal of the Royal Society Interface*, 14 (127), 20160966, 2017.

[2] Marco Tulio Angulo and Jean-Jacques Slotine. "Qualitative Stability of Nonlinear Networked Systems". *IEEE Transactions on Automatic Control*, DOI: 10.1109/TAC.2016.2617780 (in press).

[3] Marco Tulio Angulo. "Nonlinear extremum seeking inspired on second order sliding modes". *Automatica*, vol. 57, pp. 51-55, 2015.

[4] Marco Tulio Angulo, Yang-Yu Liu, and Jean-Jacques Slotine. "Network motifs emerge from interconnections that favour stability". *Nature Physics*, vol. 11, pp. 848-852, 2015.

[5] Marco Tulio Angulo and Valentin Carrillo-Serrano. "Estimating rotor parameters in induction motors using high-order sliding mode algorithms". *IET Control Theory & Applications*, vol. 9, iss. 4, pp. 573-578, 2014.

[6] Marco Tulio Angulo, Jaime A. Moreno and Leonid Fridman. "On functional observers for linear systems with unknown inputs and HOSM differentiators". *Journal of the Franklin Institute*, vol. 351 (4), pp. 1982-1994, 2014.

[7] Marco Tulio Angulo, Leonid Fridman and Jaime A. Moreno. "Output-feedback finite-time stabilization of disturbed feedback linearizable nonlinear systems". *Automatica*, vol. 49 (9), pp. 2767-2773, 2013.

[8] Marco Tulio Angulo, Jaime A. Moreno and and Leonid Fridman. "Robust exact uniformly convergent arbitrary order differentiator". *Automatica*, vol. 49 (8), pp.2489-2495, 2013.

[9] Marco Tulio Angulo, Leonid Fridman and Arie Levant. "Output-feedback finite-time stabilization of disturbed LTI systems". *Automatica*, vol 48(4), pp. 606-611, 2012.

[10] Marco Tulio Angulo, Leonid Fridman and Arie Levant. "Robust exact finite-time output based control using high-order sliding modes". *International Journal of Systems Science*, vol 42(11), pp 1847-1857, 2011.

[11] Vadim Azhmyakov and Marco Tulio Angulo. " Applications of the strong approximability property to a class of affine switched systems and to relaxed differential equations with affine structure". *International Journal of Systems Science*, vol 42(11), pp. 1899-1907, 2011.

Conference papers

[1] M.T. Angulo and C. Verde. "Second Order Sliding Mode Algorithms for the Reconstruction of Leaks". *2nd International Conference on Control and Fault-Tolerant Systems*, pp. 566 - 571, Nice, France, 2013.

[2] C. Kunusch, J.A. Moreno, and M.T. Angulo. "Identification and observation in the anode line of PEM fuel cell stacks". *52nd IEEE Annual Conference on Decision and Control (CDC)*, pp. 1665 - 1670, Florence, Italy, 2013.

[3] M.T. Angulo, J.A. Moreno, and L. Fridman. "Optimal gain for the Super-Twisting differentiator in the presence of measurement noise". *American Control Conference (ACC)*, pp. 6154-6159, Montreal, Canada, 2012.

[4] M.T. Angulo, J.A. Moreno, and L. Fridman. "Some remarks about the tradeoffs between exactness and robustness in control". *12th International Workshop on Variable Structure Systems (VSS)*, pp. 82-87, Mombay, India, 2012.

[6] M.T. Angulo, J.A. Moreno, and L. Fridman. "The differentiation error of noisy signals using the Generalized Super-Twisting differentiator". *51st IEEE Annual Conference on Decision and Control (CDC)*, pp. 7383-7388, Hawaii, USA, 2012.

[7] L. Fraguela, M.T. Angulo, J.A. Moreno, and L. Fridman. "Design of a prescribed convergence time uniform Robust Exact Observer in the presence of measurement noise". *51st IEEE Annual Conference on Decision and Control (CDC)*, pp. 6615-6620, Hawaii, USA, 2012.

[8] Marco Tulio Angulo, Jaime A Moreno, and Leonid Fridman. "On Functional Observers for Linear Systems with Unknown Inputs and HOSM Differentiators". *IFAC World Congress*, vol. 81(1), pp. 1922-1927, Milan, Italy, 2011.

[9] M.T. Angulo, J.A. Moreno, and L. Fridman. "An exact and uniformly convergent arbitrary order differentiator". *50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC)*, pp. 7629-7634, Orlando, USA, 2011.

[10] M.T. Angulo, L. Fridman, C.H. Moog, and J. Moreno. "Output feedback design for exact state stability of flat nonlinear systems". *11th International Workshop on Variable Structure Systems (VSS)*, pp. 32-38, México City, México, 2010.

[11] M.T. Angulo, J. Moreno, and R. Lazáro. "Robust dissipative observer design for nonlinear systems". *7th International Conference on Electrical Engineering Computing Science and Automatic Control (CCE)*, pp. 111-115, Mexico, 2010.

[12] Marco Tulio Angulo and Arie Levant. "On robust output based finite-time control of LTI systems using HOSMs". *IFAC Conference on Analysis and Design of Hybrid Systems*, vol. 3(1), pp. 222-227, Zaragaza, Spain, 2009.

[13] M.T. Angulo and L. Fridman. "Output-based Finite Time Control of LTI systems with matched perturbations using HOSM". *48th IEEE Conference on Decision and Control held jointly with the 28th Chinese Control Conference (CDC/CCC)*, pp. 6095-6100, Shangai, China, 2009.

In revision, preprints and preparation

[1] Yize Chen, Marco Tulio Angulo and Yang-Yu Liu. "Revealing complex ecological dynamics by Symbolic Regression". In preparation for its submission to Ecology Letters.

[2] Marco Tulio Angulo, Yang-Yu Liu and Albert-László Barabási. "Sensitivity of complex networks". In preparation for its submission to Physical Review Letters, 2017.

[3] Marco Tulio Angulo, "Dissipative design of Nonlinear Adaptive Observers". Submitted, International Journal of Control, 2017.

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