Highlights of Research Contributions of Panos Antsaklis

In Cyber-Physical Systems, Model-Based Networked Control, Hybrid Dynamical Systems, Supervisory Control of Discrete Event Sytems, Autonomous Intelligent Systems, Multivariable Feedback Control.

Notable contributions include:

His work on a general theory for the analysis and robustdesign of Cyber-Physical Systems using the energy like concepts of passivity (passivity indices) and dissipativity.

• E. Agarwal, S. Sivaranjani, V. Gupta, P. J. Antsaklis, "Distributed synthesis of local controllers for networked systems with arbitrary interconnection topologies," IEEE Trans.Auto.Contr, Vol.66, Issue 2, pp. 683-698, Febr. 2021. https://doi.org/10.1109/TAC.2020.2990754

• Arash Rahnama, Panos J. Antsaklis," Learning-Based Event-Triggered Control for Synchronization of Passive Multi-Agent Systems under Attack," IEEE Trans.Auto.Contr, Vol.65, pp.4170-4185, Oct. 2020. https://doi.org/10.1109/TAC.2019.2957338

• Meng Xia, Arash Rahnama, Shige Wang, Panos J. Antsaklis, "Control Design Using Passivation for Stability and Performance," IEEE Trans.Auto.Contr, Vol. 63, Issue 9, pp. 2987-2993, Sept 2018. https://doi.org/10.1109/TAC.2018.2789681

• Meng Xia, Panos J. Antsaklis, Vijay Gupta and Feng Zhu, "Passivity and Dissipativity Analysis of a System and its Approximation," IEEE TAC, Vol. 62, No. 2, pp. 620-635, February 2017. http://dx.doi.org/10.1109/TAC.2016.2562919

• Michael J. McCourt and Panos J. Antsaklis, "Control of Networked Switched Systems using Passivity and Dissipativity," Special Issue on Cyber-Physical Systems, B. Vogel-Heuser and S. Kowalewski Eds., Automatisierungtechnik, pp. 712-721, October 2013.

• Han Yu and P.J. Antsaklis, "Event-Triggered Output Feedback Control for Networked Control Systems Using Passivity: Achieving L2 Stability in the Presence of Comm. Delays and Signal Quantization," Automatica, Vol.49, pp.30-38, Jan 2013.

The model-based networked control approach that uses an explicit approximate model of the plant in the controller that significantly reduces demands on feedback information over a network;

• Eloy Garcia and Panos J. Antsaklis, "Model-Based Event-Triggered Control for Systems with Quantization and Time-Varying Network Delays," IEEE TAC, Vol.58, No.2, pp. 422-434, February 2013. *https://doi.org/10.1109/TAC.2012.2211411*

• LA Montestruque, P J Antsaklis, "Stability of Model-Based Networked Control Systems withTimeVarying Transmission Times," in *IEEE TAC,* vol.49, no.9, pp. 1562-1572, Sept. 2004. https://doi.org/10.1109/TAC.2004.834107

• LA Montestruque, P J Antsaklis, "On the Model-Based Control of Networked Systems," *Automatica*, Vol.39, pp.1837-1843,2003*;* https://doi.org/10.1016/S0005-1098(03)00186-9

• *Model-Based Control of Networked Systems (Springer 2014; with E. Garcia and L. Montestruque) https://www.springer.com/us/book/9783319078021*

Hybrid dynamical system approaches to controlling continuous systems using abstractions and discrete event controllers with contributions also to optimal control of switched systems and piecewise affine systems;

• Hai Lin and P.J. Antsaklis, "Hybrid Dynamical Systems: An Introduction to Control and Verification," Foundations and Trends in Systems and Control, vol. 1, no. 1, pp. 1-172, March 2014. https://doi.org/10.1561/2600000001

• Hai Lin, P.J. Antsaklis, "Stability and Stabilizability of Switched Linear Systems: A Survey of Recent Results," *IEEE Trans. on Auto.Control*, Vol.54, No.2, pp.308-322, February 2009. https://doi.org/10.1109/TAC.2008.2012009

• Xuping Xu and P.J. Antsaklis, "Optimal Control of Switched Systems Based on Parameterization of the Switching Instants," *IEEE TAC*, Vol.49, No.1, pp.2-16, January 2004.

https://doi.org/10.1109/TAC.2003.821417
• Xuping Xu and P.J. Antsaklis, "Stabilization of Second-Order LTI Switched Systems," *International Journal of Control*, Vol.73, No.14, pp.1261-1279, 2000. https://doi.org/10.1080/002071700421664
• X.D. Koutsoukos, P.J. Antsaklis, J.A. Stiver and M.D. Lemmon, "Supervisory Control of Hybrid Systems," Proceedings of IEEE, Vol.88, No.7, pp. 1026-1049, July 2000. https://doi.org/10.1109/5.871307
• X.D. Koutsoukos K. He, M.D. Lemmon and P.J. Antsaklis, "Timed Petri nets in Hybrid Systems: Stability and Supervisory Control," *J. Discrete Event Dynamic Systems* (JDEDS), Special Issue on Hybrid Systems, Vol. 8, No. 2, pp. 137-173, June 1998.
• J. A. Stiver, P. J. Antsaklis and M. D. Lemmon , "A Logical DES Approach to the Design of Hybrid Control Systems," *Mathematical and Computer Modeling*, , Vol 23, Number 11/12, pp. 55-76, June 1996.
• *Hybrid Dynamical Systems: Fundamentals and Methods* (Springer 2021; with Hai Lin) https://www.springer.com/us/book/9783030787295

Computationally efficient supervisory control approach for discrete event dynamical systems using Petri nets;
• M.V. Iordache, J.O. Moody and P.J. Antsaklis, "Synthesis of Deadlock Prevention Supervisors using Petri Nets," *IEEE Transactions on Robotics and Automation*, Vol.18, No.1, pp. 59-68, February 2002. https://doi.org/10.1109/70.988975
• J.O. Moody and P.J. Antsaklis, "Petri Net Supervisors for DES with Uncontrollable and Unobservable Transitions," *IEEE Trans. Automatic Control,* Vol.45, No.3, pp. 462-476, March 2000. https://doi.org/10.1109/9.847725
• K.Yamalidou, J. Moody, M.D. Lemmon and P.J. Antsaklis, "Feedback Control of Petri Nets Based on Place Invariants," *Automatica*, Vol 32, No 1, pp 15-28, January 1996*).* https://doi.org/10.1016/0005-1098(95)00103-4
• *Supervisory Control of Concurrent Systems: A Petri Net Structural Approach* (Springer 2006; with M.V. Iordache) https://www.springer.com/us/book/9780817643577
• *Supervisory Control of Discrete Event Systems using Petri Nets* Springer 1998; with J.O. Moody) https://www.springer.com/us/book/9780792381990

Starting with Intelligent Control and Control for High Autonomy Systems in the late 1980s, he correctly identified autonomy as the goal in advanced control systems design and intelligence as a way to achieve high autonomy goals and he headed an IEEE Control Systems Society committee that reported on this point of view. **Report of Task Force on Intelligent Control:** P. J. Antsaklis, "Defining Intelligent Control," Report of the Task Force on Intelligent Control, P.J Antsaklis, Chair. In *IEEE Control Systems Magazine*, pp. 4-5 & 58-66, June 1994*).*

His contributions to intelligent control and autonomy include:
• Panos Antsaklis.,"Autonomy and Metrics of Autonomy," Annual Reviews in Control, Vol. 49, pp. 15-26, 2020. https://doi.org/10.1016/j.arcontrol.2020.05.001
• P.J. Antsaklis, K.M. Passino and S.J. Wang, "Towards Intelligent Autonomous Control Systems: Architecture and Fundamental Issues," *Journal of Intelligent and Robotic Systems*, Vol. 1, pp. 315-342, 1989 https://doi.org/10.1007/BF00126465
• *An Introduction to Intelligent and Autonomous Control* (Kluwer Academic 1993 with K.M.Passino)

Contributions to Neural Networks include
• J. O. Moody and P. J. Antsaklis, "The Dependence Identification Neural Network Construction Algorithm," *IEEE Transactions on Neural Networks*, Vol 7, No 1, pp. 3-15, January 1996. https://doi.org/10.1109/72.478388

His work on functional architectures for autonomous systems naturally led him to study learning via Neural Networks, Discrete Event Systems, Hybrid Systems, Networked Systems and Cyber-Physical Systems as described previously.

His contributions to the relation of the parameterization of all stabilizing controllers to the internal polynomial matrix descriptions; contributions to recongiguarable cotrol; the polynomial matrix interpolation theory.

• P.J. Antsaklis and Z. Gao, "Polynomial and Rational Matrix Interpolation: Theory and Control Applications," *International Journal of Control*, vol 58, no. 2, 349-404, August 1993.
https://doi.org/10.1080/00207179308923007

• Z. Gao and P.J. Antsaklis,"On the Stability of the Pseudo-Inverse Method for Reconfigurable Control Systems," *Intern. Journal of Control*, pp.717-729, Vol.53, No.3, 1991.
https://doi.org/10.1080/00207179108953643

• P. J. Antsaklis, "Some Relations Satisfied by Prime Polynomial Matrices and their Role in Linear Multivariable System Theory," *IEEE Trans. Automatic Control,* Vol. AC-24, No. 4, pp. 611-616, Aug. 1979. https://doi.org/10.1109/TAC.1979.1102126 characterizing all stabilizing controllers using dual prime polynomial matrix descriptions and polynomial matrix transfer function factorizations.

- *Linear Systems* (Springer 2006; with A.N. Michel)
  https://www.springer.com/us/book/9780817644345
- *A Linear Systems* Primer (Springer 2007; with A.N. Michel).
  https://www.springer.com/us/book/9780817644604

Co-Edited six books:

- *Hybrid Systems II* (Springer-Verlag 1995).
  Co-edited with W. Kohn, A. Nerode and S. Sastry
- *Hybrid Systems IV* (Springer-Verlag 1997).
  Co-edited with W. Kohn, A. Nerode and S. Sastry
- *Hybrid Systems V* (Springer-Verlag 1999).
  Co-edited with W. Kohn, M. Lemmon, A. Nerode and S. Sastry

- *Stability and Control of Dynamical Systems with Applications: A Tribute to Anthony N. Michel* (Springer 2003; with D. Liu)
  https://www.springer.com/us/book/9780817632335

- *Networked Embedded Sensing and Control* (Springer 2006; with P. Tabuada)
  https://www.springer.com/us/book/9783540327943