

Reading and Reference List

Optimized Behavioral Interventions: What Does Control Systems Engineering Have to Offer?

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An excellent introduction to the topic of adaptive interventions:

[1] Collins, L.M., S.A. Murphy, and K.L. Bierman, “A conceptual framework for adaptive preventive interventions,” *Prevention Science*, **5**, No. 3, pgs. 185-196, 2004.

Our initial paper, inspired by [1], on the relationship between adaptive interventions and control engineering:

[2] Rivera, D.E., M.D. Pew, and L.M. Collins, “Using engineering control principles to inform the design of adaptive interventions: a conceptual introduction,” *Drug and Alcohol Dependence*, **88**, Suppl. 2, May 2007, pgs. S31 - S40.

A report that describes the technical content in [2] in more detail:

[3] Rivera, D.E., M.D. Pew, L.M. Collins and S.A. Murphy, “Engineering control approaches for the design and analysis of adaptive, time-varying interventions,” Technical Report 05-73, The Methodology Center, Penn State University, available from <http://csel.asu.edu/adaptiveintervention> (select item 4).

A plenary talk I gave in July 2012 at the 16th IFAC Symposium on System Identification (SYSID 2012). This paper summarizes much of our efforts to date:

[4] Rivera, D.E., “Optimized behavioral interventions: what does system identification and control engineering have to offer? *16th IFAC Symposium on System Identification (SYSID 2012)*, Brussels, Belgium, July 11-13, 2012. Preprint available from <http://csel.asu.edu/adaptiveintervention> (select item 30).

Work from our laboratory showing how Model Predictive Control can be used for decision-making in adaptive behavioral interventions:

[5] Nandola, N. and D.E. Rivera, “A novel Model Predictive Control formulation for hybrid systems with application to adaptive behavioral interventions,” *Proceedings of the 2010 American Control Conference*, Baltimore, MD, June 30 - July 2, 2010. Preprint available from <http://csel.asu.edu/adaptiveintervention> (select item 13).

[6] Nandola, N. and D.E. Rivera, “An improved formulation of hybrid Model Predictive Control with application to production-inventory systems, *IEEE Transactions on Control Systems Technology*, <http://dx.doi.org/10.1109/TCST.2011.2177525>, Vol. 21, No. 1., pgs. 121 - 135, Jan. 2013.

Paper appearing in the inaugural issue of TBM focused on mobile health interventions, to which we contributed some dynamical systems and control engineering perspectives:

[7] Riley, W.T., D.E. Rivera, A. A. Autienza, W. Nilsson, S. Allison, and R. Mermelstein, “Health behavior models in the age of mobile interventions: are our theories up to the task? <http://dx.doi.org/10.1007/s13142-011-0021-7>, *Translational Behavioral Medicine: Practice, Policy, Research*, Vol. 1, No. 1, pgs. 53–71, March 2011.

These papers show how to represent the Theory of Planned Behavior as a dynamical system, as well as describe approaches to engineering modeling of weight change interventions:

[8] Navarro-Barrientos, J.E., D.E. Rivera, and L.M. Collins, “A dynamical systems model for understanding behavioral interventions for weight loss,” S.-K. Chai, J.J. Salerno, and P.L. Mabry (Eds.): *2010 International Conference on Social Computing, Behavioral Modeling, and Prediction (SBP 2010)*, LNCS 6007, pp. 170-179. Springer, Heidelberg (2010). Preprint available from <http://tsel.asu.edu/adaptiveintervention> (select item 7).

[9] Navarro-Barrientos, J.E., D.E. Rivera, and L.M. Collins, “A dynamical model for describing behavioural interventions for weight loss and body composition change, *Mathematical and Computer Modelling of Dynamical Systems*, <http://dx.doi.org/10.1080/13873954.2010.520409>, Vol. 17, No. 2, pgs. 183-203, April 2011.

[10] Dong, Y., D.E. Rivera, D. M. Thomas, J.E. Navarro-Barrientos, D.S. Downs, J.S. Savage, L.M. Collins, “A Dynamical Systems Model for Gestational Weight Gain Behavioral Interventions, *2012 American Control Conference*, Montreal, Canada, June 27-29, 2012. Preprint available from <http://tsel.asu.edu/adaptiveintervention> (select item 27).

This paper presents a control engineering approach focused on pain interventions:

[11] Deshpande, S., N. Nandola, D.E. Rivera, and J. Younger, “A control engineering approach to designing an optimized treatment plan for fibromyalgia, *Proc. of the 2011 American Control Conference*, San Francisco, CA, June 29–July 1, 2011. Preprint available from <http://tsel.asu.edu/adaptiveintervention> (select item 22).

This paper and presentation study smoking cessation interventions:

[12] Timms, K.P., D.E. Rivera, L.M. Collins, and M.E. Piper, “System identification modeling of a smoking cessation intervention,” *16th IFAC Symposium on System Identification (SYSID 2012)*, Brussels, Belgium, July 11-13, 2012. Preprint available from <http://tsel.asu.edu/adaptiveintervention> (select item 28).

[13] Rivera, D.E., K.P. Timms, J.B. Trail, M.E. Piper, and L.M. Collins, “Dynamical Systems Modeling using EMA Data: An Illustration from Smoking Cessation,” 2012 SRNT Annual Mtg. Pre-conference Workshop on New Methods, Houston, Texas, March 13, 2012. Presentation available from <http://tsel.asu.edu/adaptiveintervention> (select item 26).

Two tutorials on engineering control theory. One was presented at the 2010 Annual Meeting of the Society for Prevention Research; the one at SAMSI (presented in 2007) focuses on mechanistic modeling issues.

[14] Rivera, D.E., “Engineering control theory: can it impact adaptive interventions?” tutorial presentation at the pre-conference workshop on systems science methodologies in prevention, 18th Annual Mtg. of the Society for Prevention Research, Denver, CO, June 1, 2010.

Can be downloaded from <http://csel.asu.edu/adaptiveintervention> (select item 10).

[15] Rivera, D.E., “An introduction to mechanistic models and control theory,” tutorial presentation at the SAMSI Summer 2007 Program on Challenges in Dynamic Treatment Regimes and Multistage Decision-Making, June 18 - 29, 2007. Can be downloaded from <http://csel.asu.edu/controleducation> (select item 9).

A tutorial on system identification (i.e., dynamic modeling from data):

[16] Rivera, D.E., “A Brief Introduction to System Identification,” Penn State Methodology Center Brown Bag presentation, March 20, 2008. Can be downloaded from <http://csel.asu.edu/controleducation> (select item 9).

A good web-based reference for introductory control engineering theory:

[17] Åström, K. J. and R. M. Murray, **Feedback systems: an introduction for scientists and engineers**, <http://www.cds.caltech.edu/~murray/amwiki>.

Some good process modeling and control texts; these focus on mechanistic models of engineering systems, and require prior working knowledge of differential equations:

[18] B.A. Ogunnaike and W.H. Ray, **Process Dynamics, Modeling, and Control**, Oxford University Press, 1994, ISBN 0-19-509119-1.

[19] Seborg, D.E., T.E. Edgar, and D.A. Mellichamp, **Process Dynamics and Control**, 1989, Wiley, ISBN 0-471-86389-0; (2nd Edition released in 2004, ISBN 0-471-00077-9).

[20] Bequette, B.W. **Process Dynamics: Modeling, Analysis, and Simulation**. Prentice-Hall, 1998. ISBN 0-13-206889-3.

Some good references on Internal Model Control and Model Predictive Control:

[21] Rivera, D.E., M. Morari, and S. Skogestad, “Internal Model Control 4. PID controller design,” *Ind. Eng. Chem. Proc. Des. and Dev.*, **25**, 252, 1986.

[22] Morari, M. and E. Zafiriou. **Robust Process Control**. Englewood Cliffs, New Jersey: Prentice Hall, 1989.

[23] García, C. E., D. M. Prett, and M. Morari, “Model Predictive Control: Theory and Practice- a Survey.” *Automatica* 25(3), 335–348, 1989.

[24] Camacho, E. F. and C. Bordons. **Model Predictive Control in the Process Industry. Advances in Industrial Control**. London: Springer, 2004.

Some system identification texts written (or co-authored) by Lennart Ljung, an eminent scholar in the field and developer of Matlab’s System Identification Toolbox:

[25] Ljung, L. and T. Glad, **Modeling of Dynamic Systems**, Prentice-Hall, 1994, (ISBN 0-13-597097-0).

[26] Ljung, L. **System Identification: Theory for the User**, 2nd Edition, Prentice-Hall, 1999 (ISBN 0-13-656695-2).