

Patrizio Colaneri: CV and Publications

CURRENT POSITION

- Full professor of Automatica at the Politecnico di Milano (2000 –)

PREVIOUS POSITIONS

- Head of the PhD school in Information Technology at Politecnico di Milano (2007 – 2009)
- Associate professor of Automatica at the Politecnico di Milano (1992 – 2000)
- Researcher at the National Research Council (1984 – 1992)
- Control Engineer at Elettromeccanica Parizzi (1982 – 1984)

EDUCATION

- Dottorato degree (Ph.D) in Automatic Control (1988 – Politecnico di Milano)
- Laurea degree in Electrical Engineering (1981 – Politecnico di Milano)

AWARDS

- Among the five finalists for the YAP (Young Author Prize) at the IFAC world Congress, Tallin, URSS (2000)
- Quazza prize for the Laurea thesis (Politecnico di Milano, 1981).
- IEEE Fellow for “Contribution in Periodic and Switching Control”, class 2011.
- IFAC Fellow, class 2011

INDUSTRIAL EXPERIENCE

- Simulation and control of electrical power plants, antiskid apparatuses for railway vehicles, control of induction machines (1982-1984 Elettromeccanica Parizzi, Milano)

TEACHING ACTIVITY

- Since 1984 regular teaching activity (undergraduate/graduate) in the field of Automatica.
- Regular PhD courses in Milano (Italy) and Linz (Austria) on Robust and Switching Control since 2000.

SERVICE AS JOURNAL EDITOR

- Associate Editor of AUTOMATICA, the IFAC Journal (outstanding service certificate) (1999 - 2005).
- Editorial board of Applied and Computational Mathematics (2004 -)
- Subject Editor International Journal Robust and Nonlinear (2008 –)
- Associate Editor of IEEE Transaction on Automatic Control (2008–2009)
- Senior Editor of IEEE Transaction on Automatic Control (2009–)

ORGANIZATION OF INTERNATIONAL CONFERENCES

- In the IPC of many International Conferences (not listed), including IEEE Conf. Dec. Control, 1999, 2008.
- General Chair of the 4rd IFAC Symposium on Robust Control Design (ROCOND), Milano, 2003.
- NOC Chair the IFAC Workshop PSYCO 2001, Cernobbio, Italy, 2001.
- Co-Organizer of the International Workshop: "The Riccati Equation in Control, Systems, and Signals", Como, Italy, 1989.
- Co-chair (with S. Bittanti) of the 2011 IFAC World Congress

INTERNATIONAL TECHNICAL COMMITTEES

- Chair of the IFAC Coordinating Committee on Design Methods (2008 – 2014)
- Chair of the IFAC Technical Committee on Control Design (2002 – 2008).
- Member of the IFAC Technical Committee on Robust Control.
- Member of the IEEE Technical Committee on Computer aided control system design (CACSD).
- Member of the IEEE Technical Committee on Systems with uncertainties (SU).
- Member of International Promotion & PhD Graduation Committees (not listed)

VISITING POSITIONS

- University of Maryland (1989/1990)
- University of Linz (periodically, since 2000)
- Hamilton Institute, Maynooth (Ireland) (2009)

PLENARIES & INVITED TALKS

- Dwell time analysis of deterministic and stochastic switched systems, European Control Conference, Budapest, 2009.
- Analysis and control of switched linear systems, 2nd Inter. Conf. on Control and Optimization with Ind. Applications, Baku, Azerbaijan, 2008.
- Deterministic and stochastic switched linear systems, Workshop on Robust control, Aiwaj Japan, 2008.
- Dwell time and time and Lyapunov Metzler inequalities in switching control of linear systems Robust Control Workshop, Delft 2005.
- Control Design, IFAC Milestone, Prague, 2005.
- Periodic Control Systems: theoretical aspects, 2nd IFAC workshop on Periodic Systems and Control, Yokohama, JP, 2004.
- Hinf smoothing in discrete-time: a direct approach", Workshop on Robust control, Cascais Portugal, 2002.
- Invariant representations of discrete-time periodic system: a survey", V Workshop on Nonlinear, Adaptive and Linear Systems, CINVESTAV, Mexico D.F. 1998.
- Full information mixed H₂-Hinf control problem, Robust Control Workshop (Napa Valley), 1996.
- Recent advances in optimal filtering and control: periodic LQG theory and lifting isomorphism", SIAM Conf. on Linear Algebra in Systems, Signals and Control, S.Francisco, 1990.
- Reachability and Controllability subspaces of discrete-time linear periodic systems", Workshop on Linear and Nonlinear Math. Contr. Theory, Torino, 1886.

PI of INTERNATIONAL PROJECTS

- HCM project: "System identification and modelling network -SIMONET" (1994 –1997)
- Joint project between Politecnico di Milano and Trnka Laboratory of the University of Praga (1997–2000)
- European Network of Excellence “Europoly” (1996–1999)
- Air Research Office "Control of systems with periodic coefficients, with application to active rotor control" (2001–2005).

MEMBERSHIP

- Member of SIDRA (Italian Association of Automatica Researchers)
- Member of the Council of the European Association of Automatic Control (EUCA) (2005-2009).

RESEARCH ACTIVITY

The research activity covers the following points:

- Analysis, filtering and control of periodic systems

Lyapunov and Riccati equations for periodic systems were intensively studied, with special focus on the inertia theory and to the conditions for the existence of periodic solutions. As far as the analysis of periodic systems is concerned, a lot of attention has been devoted to the algebraic properties and various characterizations of the structural properties were introduced. These arguments were useful for the definition of system zeros, for the study of the state-space realization problem, for the definition of the “transfer function” and for the introduction of various time-invariant reformulations. Moreover, stabilization and regulation problems were studied and moreover, the model matching problem and the constrained stabilization problem. Further studies have interested the LQG problem, the chap control and LTR problems and the H2 and Hinf problems. Finally, some important contributions were given to the memoryless output feedback stabilization problem, to the periodic LMI techniques, to factorisation problems and to the singular filtering problem. The importance of the studies in the area of periodic systems is witnessed by a chapter in an international Encyclopedia, many papers, the organization of one IFAC Workhop. and the book “Periodic Systems: filtering and control”, published in 2009 by Springer.

- Multirate control systems

Multirate control systems arise when it is necessary to sample or update the various input-output variables with different intervals of time. The research on these systems has hinged on the issues of stabilization, regulation and LQG optimization.

- Robust filtering of time-invariant systems

The issue of robust H2 filtering of linear uncertain systems has been studied through the analysis of existence and convergence of the relevant Riccati equation. Then, Hinf robustness has been considered

and studied through the properties of the solution of a parameter-dependent Riccati equation. A different way to solve the filtering problem is the one based on the system factorization. In particular, for Hinf problems. The relevant tool is given by the so-called J-spectral factorisation. The theory has been enriched by the introduction of J-unitary functions for the elimination of unstable zeros/poles in the Jspectral factor.

- Adaptive filtering

Typical system theory mathematical tools have been used to design adaptive filters for uncertain or noisy parameters. Particular attention has been devoted to the critical comparison between the robustness properties of the celebrated Kalman filter and the central Hinf filter as a function of the noise intensity and attenuation value.

- Singular filtering of time-invariant systems

The singular filtering problem arises when the intensity of the measurement noise is not invertible. Concerning this problem a new concept has been introduced, namely the concept of spectral interactor matrix. This is a polynomial matrix capable of eliminating the zeros at infinity of the given system without affecting the associated spectrum. In the case of Hinf filtering the definition of J-spectral interactor matrix has been introduced.

- Analysis and control of time-invariant systems

The research arguments dealing with robust control of time-invariant systems have been tackled when writing the book "Control Theory and Design. A RH2-RHinf viewpoint", published by Academic Press in 1997. New contributions have been given to the robustness of uncertain systems, parametrization of static controllers, output feedback stabilization and mixed H2/ Hinf optimisation, both in the linear and nonlinear cases. The IV IFAC Symposium on Robust Control was held in Milano in 2003.

- Switching Control

This research interest initiated in 2003 and came to full maturity in the last few years. It can be roughly subdivided into two main topics. The first one concerns with the almost sure stability and stabilization of Markov jump linear systems. In this field a new necessary and sufficient condition has been found in terms of m-steps average contractivity of the transition matrix. The second line of research concerns the deterministic setting. A new algorithm has been devised for the computation of a less conservative upper bound of the dwell time. Moreover, the stabilization problem has been studied via the so-called Lyapunov-Metzler inequalities. Both the state-feedback and the output dynamic feedback have been considered. Currently the research on switched systems is continuing on the problem of switching control of hierarchical and distributed systems.

- Quantized control

This problem has been tackled mainly in the discrete-time case, by looking at the smallest invariant sets. First a condition of attractiveness and practical stability has been formulated in terms of the L2 norm (ellipsoidal sets) through the stabilizing solution of a Riccati equation. Finally, the L1 norm has been studied and interesting properties of such a norm has been found with reference to positive systems. These properties will be useful to work out a feedback rule that minimizes the L1 norm (polytopic invariant sets).

- Applications

Among the application studies, it is worth quoting the control of binary distillation columns, the behaviour and active control of vibrations of four-bladed helicopters, the control of the longitudinal flight of aircrafts, the filtering of the urea concentration during dialysis and the control of induction motors.

PUBLICATIONS

(A) INTERNATIONAL BOOKS

- [A2] S. Bittanti, P. Colaneri, "Periodic Systems: Filtering and Control", Springer-Verlag, 2009.
 [A1] P. Colaneri, A. Locatelli, J.C. Geromel, "Control Theory and Design. A RH2-RHinf viewpoint", Academic Press, 1997.

(B) INTERNATIONAL JOURNALS

- [B76] P. Bolzern, P. Colaneri, G. De Nicolao, "Almost sure stability of Markov jump linear systems with deterministic switching", *IEEE Transactions Automatic Control*, preliminary accepted, 2012.
 [B75] F. Blanchini, P. Colaneri, M.E. Valcher, "Co-positive Lyapunov functions for the stabilization of positive switched systems", *IEEE Transactions Automatic Control*, preliminary accepted, 2012.
 [B74] A. Zappavigna, P. Colaneri, S. Kirkland, R. Shorten, "Essentially negative news about positive systems", *Linear Algebra and Its Applications*, in print, 2012.
 [B73] J.C. Geromel, P. Colaneri, P. Bolzern, "Passivity of switched linear systems: analysis and control design", *Systems & Control Letters*, preliminary accepted, 2012.
 [B69] C. Fuertmueller, P. Colaneri, L. Del Re, Adaptive Robust Stabilization of a Continuous Casting Process, *Automatica*, Vol.48, pp. 225-232, 2012.
 [B72] G. Chesi, P. Colaneri, J.C. Geromel, R. Middleton, R. Shorten, "A non-conservative LMI condition for stability of switched systems with guaranteed dwell time", *IEEE Transaction on Automatic Control*, Vol. 57, 2012.
 [B71] P. Colaneri, J.C. Geromel, P. Bolzern, "Root mean square gain of discrete-time switched linear systems under dwell time constraints", *Automatica*, Vol. 47, N.8, 2011.
 [B70] F. Rossi, P. Colaneri, R. Shorten, "Pade' discretization for linear systems with polyhedral Lyapunov functions", *IEEE Transaction on Automatic Control*, Vol. 56, pp. 2717 - 2722 , 2011.
 [B68] E. Hernandez-Vargas, P. Colaneri, R. Middleton, F. Blanchini, "Discrete-time control for switched positive systems with application to mitigating viral escape", *International Journal of Robust and Nonlinear Control*, Vol. 21, N. 10, pp.1093-1111, 2011.
 [B67] P. Bolzern, P. Colaneri, G. De Nicolao, "Markov jump linear systems with switching transition rates: Mean square stability with dwell-time", *Automatica*, Vol. 46, N. 6, pp. 1081-1088, 2010.
 [B66] B. Picasso, D. De Vito, R. Scattolini, P. Colaneri, "An MPC approach to the design of two-layer hierarchical control systems", *Automatica*, Vol. 46, N. 5, pp. 823-831, 2010.
 [B65] I. Boniolo, P. Colaneri, P. Bolzern, M. Corless, R. Shorten, "On the design and synthesis of limit cycles using switching linear systems", *Int. J. Control.*, Vol. 83 - v8383, N. 5 , pp. 915-927, 2010.
 [B64] M. Tanelli, B. Picasso, P. Bolzern, P. Colaneri, "Almost Sure Stabilization of Uncertain Continuous-Time Markov Jump Linear Systems", *IEEE Transaction on Automatic Control*, Vol. 55, pp. 195-201, 2010.
 [B63] J.C. Geromel, P. Colaneri, "H-infinity and dwell time specifications of continuous switched linear systems", *IEEE Transaction on Automatic Control*, Vol. 55, pp. 207-212, 2010.
 [B62] P. Colaneri, "Dwell time analysis of deterministic and stochastic switched systems", *European Journal of Control*, Vol. 15, pp. 228-248, 2009.

- [B61] P. Colaneri, V. De Souza, "Relations between stochastic stability of Markovian jump linear systems and stabilization of deterministic switched linear systems", *Appl. Comput. Math.*, Vol. 7, 2008.
- [B60] E. Gruenbacher, P. Colaneri, L. Del Re, "Nonlinear Control with Guaranteed Robustness Bounds of a Dynamical Engine Test Bench", *Automatica*, Vol. 44, N. 9, pp. 2230-2240, 2008.
- [B59] P. Bolzern, P. Colaneri, G. De Nicolao, "Almost sure stability of stochastic linear systems with ergodic parameters", *European Journal of Control*, Vol. 14, N. 2, pp. 114-123, 2008.
- [B58] J.C. Geromel, P. Colaneri, P. Bolzern, "Dynamic output feedback control of switched linear systems", *IEEE Transaction on Automatic Control*, Vol. 53, N. 3, pp. 720-733, 2008.
- [B57] Franco Blanchini, Patrizio Colaneri, Felice Andrea Pellegrino, "Simultaneous performance achievement via compensator blending", *Automatica*, 44, 1, pp. 1-14, 2008.
- [B56] P. Colaneri, J. C. Geromel, A. Astolfi, "Stabilization of continuous-time switched nonlinear Systems", *Systems and Control Letters*, 57, pp. 95-103, 2008.
- [B55] M. Lovera, P. Colaneri, R. Celi, C. Malpica, "Discrete-time, closed-loop aeromechanical stability analysis of helicopters with higher harmonic control", *Journal of Guidance, Control, and Dynamics*, Vol. 30, N.5, pp. 1249-1260, 2007.
- [B54] Bars, Ruth; Colaneri, Patrizio; de Souza, Carlos E.; Dugard, Luc; Allgöwer, Frank; Kleimenov, Anatolii; Theory, algorithms and technology in the design of control systems, *Annual Reviews in Control* Volume: 30, Issue: 1, pp. 19-30, 2006.
- [B53] J.C. Geromel, P. Colaneri, "Stability and stabilization of continuous-time switched systems", *SIAM J. contr. And Opt.*, Vol. 45, N. 5, pp. 1915-1930, 2006.
- [B52] J.C. Geromel, P. Colaneri, "Stability and stabilization of discrete-time switched systems", *International Journal of Control*, 79, 7, pp. 719-728, 2006.
- [B51] P. Bolzern, P. Colaneri, G. De Nicolao, "On almost sure stability of continuous-time Markov jump linear systems", *Automatica*, 42, pp.983-988, 2006.
- [B50] P. Colaneri, A. Ferrante, "Algebraic Riccati equation and J-spectral factorization for Hinf smoothing and deconvolution", *SIAM J. Control and Optimization*, 45, pp.123-145, 2006.
- [B49] J.C. Geromel, P. Colaneri, "Robust stability of time varying polytopic systems", *Systems and Control Letters*, 55, pp. 81-85, 226, 2006.
- [B48] M. Lovera, P. Colaneri, C. Malpica, R. Celi, "Closed-loop aeromechanical stability of a hingeless rotor helicopter with higher harmonic control", *Journal of Guidance Control and Dynamics*, Vol. 29, N. 1, pp. 179-199, 2006.
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- [B46] P. Colaneri, "Theoretical aspects of continuous-time periodic systems", *Annual Reviews in Control*, pp. 206-215, 2005.
- [B45] P. Colaneri, "Periodic Control Systems: theoretical Aspects", *Int. J. Applied and Computational Mathematics*, Vol. 3, N.2, pp- 84-94, 2004.
- [B44] A.Astolfi, P.Colaneri, A note on the existence of positive realizations, *Linear Algebra and its applications*, 390, pp. 329-343, 2004.
- [B43] M. Lovera, P. Colaneri, R. Celi, "On the role of zeros in rotorcraft aeromechanics", *Journal of the American Helicopter Society*, 49, 3, pp. 318-327, 2004.
- [B42] P. Colaneri, A. Ferrante, "Algebraic Riccati equation and J-spectral factorization in Hinf estimation", *Systems and Control Letters*, Vol. 51, pp. 383-393, 2004.
- [B41] P. Bolzern, P. Colaneri, G. De Nicolao, "On discrete-time Hinf fixed-lag smoothing", *IEEE Trans. on Signal processing*, 52, pp. 132-141, 2004.
- [B40] P.Colaneri, V. Kucera, S. Longhi, "Polynomial approach to the control of SISO periodic systems subject to input constraint", *Automatica*, Vol. 39, pp., 1417-1424, 2003.
- [B39] P.Colaneri, A.Ferrante, A J-spectral factorization approach for Hinf estimation problems in discrete-time, *IEEE Trans. on Automatic Control*, Vol. 47, N. 12, pp. 2108- 2113, 2002.
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- [B35] P.Colaneri, "State-feedback problems in H2 and Hinf for continuous-time periodic systems. Part II: feedback problems", *Kybernetika*, Vol. 36, N. 2, pp. 211-242, 2000.
- [B34] P.Colaneri, "State-feedback problems in H2 and Hinf for continuous-time periodic systems. Part I: theoretical aspects", *Kybernetika*, Vol. 36, N. 12, pp. 1777-1793, 2000.
- [B33] S.Bittanti, P.Colaneri, "Invariant representations of discrete-time periodic systems – A survey", *Automatica*, Vol. 36, N. 12, pp. 1777-1793, 2000.
- [B32] P.Bolzern, P.Colaneri, G.De Nicolao, "Tradeoff between mean square and worst case performances in adaptive filtering ", *European Journal of Control*, 2000.
- [B31] P.Bolzern, P.Colaneri, G.De Nicolao, "Hinf robustness of adaptive filters against measurement noise and parameter drift", *Automatica*, Vol. 35, N. 9, pp. 1509-1520, 1999.
- [B30] S.Bittanti, P.Colaneri, M.F.Mongiovi, "From singular to non-singular filtering for periodic systems: filling the gap with the spectral interactor matrix", *IEEE Trans. on Aut. Control*, Vol. AC-44, pp. 222-227, 1999.
- [B29] P.Bolzern, P.Colaneri, G. De Nicolao, "Transient and asymptotic analysis of discrete-time Hinf filters", *European Journal of Control*, Vol. 3, pp. 317-324, 1997.
- [B28] P.Colaneri, V.Kucera, "The model matching problem for periodic discrete-time systems", *IEEE Trans. Aut. Control*, Vol. 42, 10, pp. 1472-1476, 1997.
- [B27] P.Bolzern, P.Colaneri, G.De Nicolao, "Finite escapes and convergence of robust H2 filters", *AUTOMATICA*, Vol.33, N.1, pp. 31-47, 1997.
- [B26] P.Bolzern P.Colaneri, G.De Nicolao, "Hinf differential Riccati equations: convergence properties and finite-escapes phenomena", *IEEE Trans. on Aut. Control*, Vol. 42, N. 1, pp. 113-118, 1997.
- [B25] P.Bolzern, P.Colaneri, G.De Nicolao, "Optimal robust filtering with time-varying parameter perturbations", *Int. J. of Control* , Vol. 63, N. 3, pp. 557-576, 1996.
- [B24] S.Bittanti, P.Colaneri, M.F.Mongiovi, "Singular filtering via spectral interactor matrix", *IEEE Trans. Auto. Contr.*, Vol. 40, pp.1492-1497, 1995.
- [B23] P.Bolzern, P.Colaneri, G.De Nicolao, "Optimal design of robust predictors for linear discrete-time systems", *Systems and Control Letters* , Vol. 26, pp. 25-31, 1995.
- [B22] P.Colaneri, S.Longhi, "The realization problem for linear periodic systems", *AUTOMATICA*, Vol.31, N.5, pp.779, 1995.
- [B21] P.Colaneri, G.De Nicolao, "Multirate LQG control of continuous-time stochastic systems". *AUTOMATICA*, Vol. 31, N.4, pp.591-596, 1995.
- [B20] P.Bolzern, P.Colaneri, G.De Nicolao, "Covariance bounds discrete-time linear systems, with parameter uncertainty", *Int. J. of Control*, Vol. 60, N. 6, pp. 1307-1317, 1994.
- [B19] P.Bolzern, P.Colaneri, G. De Nicolao, "On the computation of covariance bounds for perturbed linear systems", *IEEE Trans. Aut. Contr.*, AC-39, pp. 623-626, 1994.
- [B18] P.Colaneri, R.Scattolini, N.Schiavoni, "Regulation of multirate sampled-data systems", *C-TAT (Control Theory and Advanced Technology)*, Mita Press, 7, 3, pp. 429-441, 1994.
- [B17] P.Colaneri, R.Scattolini, N.Schiavoni, "LQG optimal control for multirate sampled-data systems", *IEEE Trans. Aut. Contr.*, AC-37, 5, pp. 675-682, 1992.
- [B16] P.Colaneri, "Zero-error regulation of discrete-time linear periodic systems", *Systems and Control Letters*, 15, 2, pp. 377-380, 1990.
- [B15] P.Colaneri, "Output stabilization via pole-placement of discrete-time linear periodic systems", *IEEE Trans. Aut. Contr.*, AC-36, 6, pp. 739-742, 1991.
- [B14] P.Colaneri, R.Scattolini, N.Schiavoni, "Stabilization of multirate sampled-data systems", *AUTOMATICA*, 26, 2, pp. 377-380, 1990.
- [B13] S.Bittanti, P.Colaneri, G.De Nicolao, "An algebraic Riccati equation for the discrete-time periodic prediction problem", *Systems and Control Letters*, 14, pp. 71-78, 1990.

- [B12] S.Bittanti, P.Colaneri, G.De Nicolao, "A note on the maximal solution of the periodic Riccati equation", *IEEE Trans. Aut. Contr.*, AC-34, 1, pp. 1316-1319, 1989.
- [B11] P.Bolzern, P.Colaneri, "The periodic Lyapunov equation", *SIAM J. Matrix Analysis Applications*, N.4, pp. 499-512, 1988.
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- [B8] S.Bittanti, P.Bolzern, P.Colaneri, G.Guardabassi, "Comments to 'Controllability, stabilizability and matrix Riccati equation for periodic systems' and to 'On solution of periodic Riccati equations'", *IEEE Trans. Aut. Contr.*, AC-32, 3, pp. 270-271, 1987.
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- [B5] S.Bittanti, P.Colaneri, G.De Nicolao, "Discrete-time linear periodic systems: a note on the reachability and controllability interval length", *Systems and Control Letters*, 8, pp. 75-78, 1986.
- [B4] S.Bittanti, P.Colaneri, "Lyapunov and Riccati equation; periodic inertia theorems", *IEEE Trans. Autom. Contr.*, AC-31, 7, pp. 659-661, 1986.
- [B3] S.Bittanti, P.Bolzern, P.Colaneri, "The extended periodic Lyapunov lemma", *Automatica*, 21, pp. 603-605, 1985.
- [B2] S.Bittanti, P.Colaneri, G.Guardabassi, "H-Controllability and observability of linear periodic systems", *SIAM Jour. Contr. and Optimization*, 22, pp. 889-893, 1984.
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(C) CHAPTER IN INTERNATIONAL ENCICLOPEDIAE

- [C1] S.Bittanti, P.Colaneri, Periodic Control, Encyclopedia of Electrical and Electronics Engineering, J.G.Webster Ed., John Wiley and Sons, Inc., Vol. 16, pp. 59-73, 1999.

(D) CHAPTER IN INTERNATIONAL BOOKS

- [D13] P. Bolzern, P. Colaneri, J.C. Geromel, "Optimal switching of 1-DOF oscillating systems", in *Hybrid Systems: Computation and control*, Alberto Bemporad, Antonio Bicchi and Giorgio Buttazzo (Eds.), Lecture Notes in Computer Science, Springer, pp. 118-130, 2007.
- [D12] A.Astolfi, P.Colaneri, "Static output feedback stabilization: from linear to nonlinear and back", in "Nonlinear control in the year 2000", A. Isidori, F. Lamnabhi-Lagarrigue and W.Respondek Ed., Springer Verlag, Vol. 1, pp. 49-72, 2000.
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- [D9] P.Colaneri, R.Scattolini, N.Schiavoni, "Stabilization, regulation and optimization of multirate sampled-data systems", in *Control and Dynamic Systems*, Vol. 71, C.T.Leondes Ed., Academic Press Inc., pp. 95-130, 1995.
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[D3] S.Bittanti, P.Bolzern, P.Colaneri, "Inertia theorems for Lyapunov and Riccati equations: an updated view", on Linear Algebra in Signals, Systems and Control, SIAM pub. Philadelphia, pp. 11-35, 1988.

[D2] S.Bittanti, P.Colaneri, G.De Nicolao, "Two techniques for the solution of the discrete-time periodic Riccati equation", on Linear Algebra in Signals, Systems and Control, SIAM pub. Philadelphia, pp. 315-331, 1988.

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