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Input Shaping Predictive Functional Control for Different Types of Challenging Dynamics Processes

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Abstract

Predictive functional control (PFC) is a fast and effective controller that is widely used for processes with simple dynamics. This paper proposes some techniques for improving its reliability when applied to systems with more challenging dynamics, such as those with open-loop unstable poles, oscillatory modes, or integrating modes. One historical proposal considered is to eliminate or cancel the undesirable poles via input shaping of the predictions, but this approach is shown to sometimes result in relatively poor performance. Consequently, this paper proposes to shape these poles, rather than cancelling them, to further enhance the tuning, feasibility, and stability properties of PFC. The proposed modification is analysed and evaluated on several numerical examples and also a hardware application.

Keywords

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1. [Development of Constrained Predictive Functional Control using Laguerre Function Based Prediction](#)

Times Cited: 1

By: Abdullah, M.; Rossiter, J. A.; Haber, R.

IFAC PAPERSONLINE Volume: 50 Issue: 1 Pages: 10705-10710 Published: 2017

2. **Utilising Laguerre function in predictive functional control to ensure prediction consistency** Times Cited: [1](#)
 By: Abdullah, M.; Rossiter, J.A.
 P 2016 UKACC 11 INT Published: 2016

3. **Handling input and state constraints in predictive functional control** Times Cited: [11](#)
 By: Abu el, A.-D.S.; Fiani, P.; Richalet, J.
 Proceedings of the 30th IEEE Conference on Decision and Control (Cat. No.91CH3076-7) Pages: 985-90 vol.1 Published: 1991

4. **Instructor Workbook, 1 DOF Torsion Experiment for MATLAB/Simulink Users** Times Cited: [3](#)
 By: Apkarian, J.
 INSTRUCTOR WORKBOOK Published: 2012
 Publisher: Quanser Inc, Markham, Ontario

5. **PROPERTIES OF GENERALIZED PREDICTIVE CONTROL** Times Cited: [333](#)
 By: CLARKE, DW; MOHTADI, C
 AUTOMATICA Volume: 25 Issue: 6 Pages: 859-875 Published: NOV 1989

6. **LINEAR-SYSTEMS WITH STATE AND CONTROL CONSTRAINTS - THE THEORY AND APPLICATION OF MAXIMAL OUTPUT ADMISSIBLE-SETS** Times Cited: [766](#)
 By: GILBERT, EG; TAN, KT
 IEEE TRANSACTIONS ON AUTOMATIC CONTROL Volume: 36 Issue: 9 Pages: 1008-1020 Published: SEP 1991

7. **An Alternative for PID control: Predictive Functional Control - A Tutorial** Times Cited: [4](#)
 By: Haber, R.; Rossiter, J. A.; Zabet, K.
 2016 AMERICAN CONTROL CONFERENCE (ACC) Book Series: Proceedings of the American Control Conference Pages: 6935-6940 Published: 2016

8. **Predictive Control in Process Engineering: From the Basics to the Applications** Times Cited: [41](#)
 By: Haber, R; Bars, R; Schmitz, U
 PREDICTIVE CONTROL IN PROCESS ENGINEERING: FROM THE BASICS TO THE APPLICATIONS Pages: 1-600 Published: 2011
 Publisher: WILEY-V C H VERLAG GMBH, PAPPELALLEE 3, W-69469 WEINHEIM, GERMANY

9. **Nonlinear control of a fluidized bed reactor using approximate feedback linearization** Times Cited: [14](#)
 By: Kendi, TA; Doyle, FJ
 INDUSTRIAL & ENGINEERING CHEMISTRY RESEARCH Volume: 35 Issue: 3 Pages: 746-757 Published: MAR 1996

10. Title: [not available] Times Cited: [3](#)
 By: KHADIR M
 P INT C COMP SYST IN Pages: 174 Published: 2005

11. **Extension of first order predictive functional controllers to handle higher order internal models** Times Cited: [14](#)
 By: Khadir, Mohamed Tarek; Ringwood, John V.
 INTERNATIONAL JOURNAL OF APPLIED MATHEMATICS AND COMPUTER SCIENCE Volume: 18 Issue: 2 Pages: 229-239 Published: 2008

12. **STABLE REDESIGN OF PREDICTIVE CONTROL** Times Cited: [80](#)
 By: MOSCA, E; ZHANG, JX
 AUTOMATICA Volume: 28 Issue: 6 Pages: 1229-1233 Published: NOV 1992

13. Title: [not available] Times Cited: [25](#)
 By: Nise, N. S.
 Control system engineering Published: 2011
 Publisher: John Wiley & Sons. Inc, New York

14. **THE STABILITY OF CONSTRAINED RECEDING HORIZON CONTROL** Times Cited: [527](#)
 By: RAWLINGS, JB; MUSKE, KR
 IEEE TRANSACTIONS ON AUTOMATIC CONTROL Volume: 38 Issue: 10 Pages: 1512-1516 Published: OCT 1993

15. **Elementary predictive functional control: a tutorial** Times Cited: [6](#)
 By: Richalet, J.; O'Donovan, D.
 2011 International Symposium on Advanced Control of Industrial Processes (ADCONIP 2011) Pages: 306-13 Published: 2011

16. **INDUSTRIAL APPLICATIONS OF MODEL-BASED PREDICTIVE CONTROL** Times Cited: [406](#)
 By: RICHALET, J
 AUTOMATICA Volume: 29 Issue: 5 Pages: 1251-1274 Published: SEP 1993

17. **MODEL PREDICTIVE HEURISTIC CONTROL - APPLICATIONS TO INDUSTRIAL PROCESSES** Times Cited: [959](#)
 By: RICHALET, J; RAULT, A; TESTUD, JL; et al.
 AUTOMATICA Volume: 14 Issue: 5 Pages: 413-428 Published: 1978

Why Predictive Control?

18. By: Richalet, Jacques; O'Donovan, Donal
PREDICTIVE FUNCTIONAL CONTROL: PRINCIPLES AND INDUSTRIAL APPLICATIONS Book Series: Advances in Industrial Control Pages: 1-+ Published: 2009 **Times Cited: 79**
19. Title: [not available] **Times Cited: 3**
By: Rossiter, J.
A First Course in Predictive Control Published: 2018
Publisher: CRC Press
20. **A priori stability results for PFC** **Times Cited: 3**
By: Rossiter, J. A.
INTERNATIONAL JOURNAL OF CONTROL Volume: 90 Issue: 2 Pages: 305-313 Published: 2017
21. **Pole-placement Predictive Functional Control for over-damped systems with real poles** **Times Cited: 13**
By: Rossiter, J. A.; Haber, R.; Zabet, K.
ISA TRANSACTIONS Volume: 61 Pages: 229-239 Published: MAR 2016
22. **Input shaping for pfc: How and why?** **Times Cited: 3**
By: Rossiter, J.A.
J. Control Decis. Volume: 3 Pages: 105-118 Published: 2015
23. **Predictive functional control: more than one way to prestabilise** **Times Cited: 2**
By: Rossiter, J. A.
P 15 TRIENN WORLD C Pages: 289-294 Published: 2002
24. **NUMERICAL ROBUSTNESS AND EFFICIENCY OF GENERALIZED PREDICTIVE CONTROL ALGORITHMS WITH GUARANTEED STABILITY** **Times Cited: 13**
By: ROSSITER, JA; KOUVARITAKIS, B
IEE PROCEEDINGS-CONTROL THEORY AND APPLICATIONS Volume: 141 Issue: 3 Pages: 154-162 Published: MAY 1994
25. **The Effect of Coincidence Horizon on Predictive Functional Control** **Times Cited: 16**
By: Rossiter, John Anthony; Haber, Robert
PROCESSES Volume: 3 Issue: 1 Pages: 25-45 Published: MAR 2015
26. **Constrained linear quadratic regulation** **Times Cited: 272**
By: Scokaert, POM; Rawlings, JB
IEEE TRANSACTIONS ON AUTOMATIC CONTROL Volume: 43 Issue: 8 Pages: 1163-1169 Published: AUG 1998
27. **Pole-placement Predictive Functional Control for under-damped systems with real numbers algebra** **Times Cited: 2**
By: Zabet, K.; Rossiter, J. A.; Haber, R.; et al.
ISA TRANSACTIONS Volume: 71 Pages: 403-414 Part: 2 Published: NOV 2017
28. Title: [not available] **Times Cited: 1**
By: Zhang, Z.; Rossiter, J.A.; Xie, L.; et al.
Predictive Functional Control for Integral Systems Published: 2018
Publisher: PSE, Bellevue, WD, USA
[Show additional data]
29. **Simulation of control of water level in boiler drum** **Times Cited: 1**
By: Zhuo, W.; Shichao, W.; Yanyan, J.
P WORLD AUT C 2012 Published: 2012

Showing 29 of 29 [View All in Cited References page](#)

