

14th IFAC Symposium on Dynamics and Control of Process Systems Including Biosystems (DYCOPS 2025)

IFAC PapersOnline Volume 59, Issue 6

Bratislava, Slovakia
16-19 June 2025

Editors:

**Ali Mesbah
Rudiyanto Gunawan
Leo H. Chiang**

**Radoslav Paulen
Miroslav Fikar
Martin Klaučo**

ISBN: 979-8-3313-2549-7

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

To the extent permissible under applicable laws, no responsibility is assumed by the Owner, the Publisher or the Licensee for any injury and/or damage to persons or property as a result of any actual or alleged libelous statements, infringement of intellectual property or privacy rights, or products liability, whether resulting from negligence or otherwise, or from any use or operation of any ideas, instructions, procedures, products or methods contained in the material therein.

The publication of an advertisement in the POD Edition does not constitute on the part of the Owner, the Publisher or the Licensee a guarantee or endorsement of the quality or value of the advertised products or services described therein or of any of the representations or the claims made by the advertisers with respect to such products or services.

Copyright© (2025) by the authors
Open access publication under the CC-BY-NC-ND License
<https://creativecommons.org/licenses/by-nc-nd/4.0/>
All rights reserved.

Printed with permission by Curran Associates, Inc. (2025)

For permission requests, please contact the publisher, Elsevier Limited
at the address below.

Elsevier Limited
The Boulevard, Langford Lane
Kidlington
Oxford OX5 1GB UK

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

Privacy-Preserving Federated Learning for Robust Approximate MPC	1
<i>Joshua Adamek, Janis Adamek, Moritz Schulze Darup, Sergio Lucia</i>	
Analysing Control-Theoretic Properties of Nonlinear Synthetic Biology Circuits	7
<i>Antón Pardo, Sandra Díaz Seoane, Dorin A. Ionescu, Antonis Papachristodoulou, Alejandro F. Villaverde</i>	
Robust Predictive Control for NARX Models from Input-Output Data.....	13
<i>Ali Azarbahram, Mohammad Al Khatib, Vikas Kumar Mishra, Markus Thommes, Naim Bajcinca</i>	
Automatic Design of Robust Model Predictive Control of a Bioreactor Via Bayesian Optimization	19
<i>Tobias Brockhoff, Moritz Heinlein, Georg Hubmann, Stephan Lütz, Sergio Lucia</i>	
Economic Data-Enabled Predictive Control Using Machine Learning	25
<i>Mingxue Yan, Xuewen Zhang, Kaixiang Zhang, Zhaojian Li, Xunyuan Yin</i>	
A Zonotope-Based Big Data-driven Predictive Control Approach for Nonlinear Processes.....	31
<i>Shuangyu Han, Yitao Yan, Jie Bao, Biao Huang</i>	
Linear-Quadratic Model Predictive Control for Continuous-time Systems with Time Delays and Piecewise Constant Inputs.....	37
<i>Zhanhao Zhang, Anders H. D. Christensen, Jan Lorenz Svensen, Steen Hørsholt, John Bagterp Jørgensen</i>	
Task-Optimal Data-driven Surrogate Models for eNMPC Via Differentiable Simulation and Optimization.....	43
<i>Daniel Mayfrank, Na Young Ahn, Alexander Mitsos, Manuel Dahmen</i>	
Combining Hybrid Modelling and Transfer Learning to Simulate Fed-Batch Bioprocess Under Uncertainty	49
<i>Oliver Pennington, Youping Xie, Keju Jing, Dongda Zhang</i>	
Enhancing Purple Non-Sulfur Bacteria Modeling with Physics-informed Neural Networks.....	55
<i>Matheus C. R. Nunes, Laurent Dewasme, Manon Gilson, Guillaume Bayon-Vicente, Alain Vande Wouwer</i>	
Enhancing Reinforcement Learning for Population Setpoint Tracking in Co-Cultures	61
<i>Sebastián Espinel-Ríos, Joyce Qiaoxi Mo, Dongda Zhang, Ehecatl Antonio Del Rio-Chanona, José L. Avalos</i>	
Offline Reinforcement Learning for Bioprocess Optimization with Historical Data	67
<i>Haiting Wang, Cleo Kontoravdi, Antonio Del Rio Chanona</i>	
Sparse Regression Approach to Modelling the Effect of Ionic Liquid Acidity in Biomass Fractionation.....	73
<i>Suhaib Nisar, Sarah Seidner, Agnieszka Brandt-Talbot, Jason P. Hallett, Benoît Chachuat</i>	
Blending Physics and Data to Model Hemodynamic Effects Under General Anesthesia	79
<i>Mattia Fregolent, Michele Schiavo, Nicola Latronico, Massimiliano Paltenghi, Antonio Visioli</i>	

Ratio and Bidirectional Control Applied to Distillation Columns	85
<i>Brage Bang, Sigurd Skogestad</i>	
Standard MPC and Inputs-Target MPC Implementation Comparison in ESP Systems	91
<i>Erbet Almeida Costa, Odilon Santana Luiz De Abreu, Galdir Reges, Carine Menezes Rebello, Leizer Schnitman</i>	
Comparative Analysis of Control Structures in Core Annular Flow Systems: A CFD Simulation Study.....	97
<i>Patrick Souza Lima, Lucas Ferreira Bernardino, Sigurd Skogestad, Idelfonso Bessa Dos Reis Nogueira</i>	
A Nonlinear Approach for Input Signal Design with Persistent Excitation Applied to pH Modelling in Microalgae Raceway Reactors	103
<i>F. Campregher, M. Caparroz, J. L. Guzmán, A. Visioli</i>	
Stochastic Data-Driven NMPC for Partially Observable Systems Using Gaussian Processes: A Mineral Flotation Case Study.....	109
<i>Yicong Wang, Antonio Del Río Chanona, Paulina Quintanilla</i>	
State Estimation for Gas Purity Monitoring and Control in Water Electrolysis Systems.....	115
<i>Lucas Cammann, Johannes Jäschke</i>	
How Dynamics Improve Fault Detection: A Gaussian LTI Case	121
<i>Xinrui Gao, Anbang Hu, Yuri A. W. Shardt</i>	
Decentralized Causal-Based Monitoring for Large-scale Systems: Sensitivity and Robustness Assessment	127
<i>Rodrigo Paredes, Wei-Ting Yang, Marco S. Reis</i>	
Performance Change Recovery in Soft-Sensor Control Loops	133
<i>Xuanhui Zhai, Yuri A. W. Shardt</i>	
Soft Sensor Design Using Hierarchical Multi-Fidelity Modeling with Bayesian Optimization for Input Variable Selection.....	139
<i>Johannes Lips, Hendrik Lens, Paolo Conti</i>	
Improved Stiction Detection Via Hybrid Residual Embedded Inception Module Networks	145
<i>Muhammad Faisal Aftab, Wahiba Bounoua, Muhammad Hamza Zafar, Filippo Sanfilippo</i>	
A Wavelet Neural Network Assisted Framework for Active Fault Detection and Diagnosis of Process Systems	151
<i>Piyush Dasrao Hambarde, Santhosh Kumar Varanasi</i>	
Towards Scalable Bayesian Optimization Via Gradient-Informed Bayesian Neural Networks	157
<i>Georgios Makrygiorgos, Joshua Hang Sai Ip, Ali Mesbah</i>	
Hybrid Optimization Methods for Parameter Estimation of Reactive Transport Systems	163
<i>Marcus Johan Schytt, Halldór Gauti Pétursson, John Bagterp Jørgensen</i>	
Benchmarking of Multi-Agent Reinforcement Learning Strategies for Optimizing Cutting Plane Selection	169
<i>Arjun M., Hariprasad Kodamana, Manojkumar Ramteke</i>	
Toward Efficient Global Solutions to Optimal Control Problems Via Second-Order Polynomial Approximations	175
<i>Diogo Rodrigues</i>	

State and Parameter Estimation in Dynamic Real-Time Optimization with Embedded MPC	181
<i>José Matias, Anthony W. K. Quarshie, Andrew Solano, Christopher L. E. Swartz</i>	
Fault Detection and Diagnosis Using Reconstruction-Based DiGLPP: Application to Industrial Distillation System	187
<i>Husnain Ali, Furong Gao</i>	
Image-Based Battery Health Monitoring for Capacity Degradation Analysis.....	193
<i>Ji Young Yun, Haechang Kim, Jong Min Lee</i>	
Improving Process Monitoring Via Dynamic Multi-Fidelity Modeling	199
<i>Rastislav Fábér, Marco Vaccari, Riccardo Bacci Di Capaci, Karol Lubušký, Radoslav Paulen</i>	
Predictive Modelling of Desiccant Drying Processes Using Multi-Feature k-Nearest Neighbours Algorithm	205
<i>Yasser Algoufily, Francesco Borghesan, Mehmet Mercangöz</i>	
Data-Driven Material Removal Rate Estimation in Bonnet Polishing Process	211
<i>Michał Darowski, Muhammad Faisal Aftab, David Walker, Hongyu Li, Christian W. Omlin</i>	
A Hierarchical Multimode Dynamic Process Monitoring Scheme and Its Application to the Tennessee Eastman Process.....	217
<i>Jiaorao Wang, Lishuai Li, S. Joe Qin</i>	
Estimating Growth Rate from Sparse and Noisy Data: A Bayesian Approach.....	223
<i>David Andersson, Anton Verneršson, Anne Richelle</i>	
Hierarchical RL-MPC for Demand Response Scheduling	229
<i>Maximilian Bloor, Ehecatl Antonio Del Rio Chanona, Calvin Tsay</i>	
MORSE: An Adaptive Decision-Making Framework Combining Reinforcement Learning and Multi-Objective Evolutionary Algorithms for Dynamic Inventory Control	235
<i>Niki Kotecha, Antonio Del Rio Chanona</i>	
Machine Learning-Driven Optimisation of Operational Spaces for Uncertainty Management in Process Industries	241
<i>Sam Kay, Mengjia Zhu, Oliver Pennington, Dongda Zhang</i>	
A Reinforcement Learning Approach for Simultaneous Generation, Design and Control of Reaction-Separation Process Flowsheets	247
<i>Simone Reynoso-Donzelli, Luis A. Ricardez-Sandoval</i>	
Evaluating Demand Response Particibility Potential of Process Systems Using Levelized Cost Analysis.....	253
<i>Yu Liu, Ahmet Palazoglu, Nael H. El-Farra</i>	
Hybrid Deep Reinforcement Learning Agent for Online Scheduling and Control for Chemical Batch Plants.....	259
<i>Daniel Rangel-Martinez, Luis Ricardez-Sandoval</i>	
IGFA: Improved Glycosylation Flux Analysis	265
<i>Shriramprasad Venkatesan, Sriram Neelamegham, Rudiyanto Gunawan</i>	
Bilevel Optimisation for Targeted Metabolic Network Reduction	271
<i>Mariana Monteiro, Fengqi You, Cleo Kontoravdi</i>	

Model-Based Analysis of Membrane-Enhanced Liquid-Phase Oligonucleotide Synthesis	277
<i>Alberto Saccardo, Benoît Chachuat</i>	
A New Generic Mass Balance Model with Multi-Layer Perceptron-Based Kinetics and Stoichiometry	283
<i>Ph. Bogaerts</i>	
Parameter Estimation and Model Selection for the Quantitative Analysis of Oncolytic Virus Therapy in Zebrafish	289
<i>Yuhong Liu, Dilan Pathirana, Jan Hasenauer</i>	
Model-Based Protein Estimation During Dough Formation in a Farinograph	295
<i>A. Schaum, S. Tronci, M. Grosso</i>	
Learning Approximate Symbolic Solutions to Burgers' Equation Using Symbolic Regression	301
<i>Benjamin G. Cohen, Burcu Beykal, George M. Bollas</i>	
LSTM-Based Hybrid Modeling Approach for Control Application of Evaporator Involving Phase Transition.....	307
<i>Jisung Byun, Hyein Jung, Jong Min Lee</i>	
Sparse Optimization Assisted Hybrid Data Driven Modeling of Process Systems	313
<i>Abhishek Raj, Ankit Ajay Mandpe, Santhosh Kumar Varanasi</i>	
Modular Surrogate Models for Simulating the Amine Scrubbing Process	319
<i>Ricardo Rendall, Paris Papavasileiou, Preshit Dandekar, Ivan Castillo, You Peng</i>	
Heterogeneous Transfer Learning from Batch to Continuous Direct Compression Tablet Manufacturing	325
<i>Yuki Kobayashi, Takuya Nagato, Takuya Oishi, Sanghong Kim, Manabu Kano</i>	
Predictive Control of a Chemical Reactor Using Multiple Linear Models.....	331
<i>Jozef Vargan, Wachira Daosud, Mehmet Arici, Abderrazak Latifi, Miroslav Fikar</i>	
Batch-To-batch Optimization of an Industrial Reactor Using Modifier Adaptation.....	337
<i>Mohamed Aboelnour, Ala Bouaswaig, Sebastian Engell</i>	
Surrogate Modeling and Control Optimization of Batch Crystallization Process of B Form LGA.....	343
<i>Bo Song, Tao Liu, Mingyan Zhao, Yan Cui, Yuanjun Li</i>	
Autonomous Industrial Control Using an Agentic Framework with Large Language Models	349
<i>Javal Vyas, Mehmet Mercangöz</i>	
Dynamic Optimization of Molecular Weight Distribution in Industrial Batch Polymerization.....	355
<i>Xinmiao Lan, Chenchen Zhou, Simin Li, Shuang-Hua Yang</i>	
A Flow Rate Soft Sensor for Pumps with Complex Characteristics	361
<i>Sebastian Leonow, Qi Zhang, Martin Mönnigmann</i>	
Optimizing Parallel Gas Compressor Operations Under Flow Disturbances	367
<i>Liqiu Dong, Marta Zagorowska, Mehmet Mercangöz</i>	
Controlling Paracetamol Batch Crystallization in Ethanol by Reinforcement Learning	373
<i>Fernando Arrais R. D. Lima, Ruan R. Faria, Marcellus G. F. De Moraes, Argimiro R. Secchi, Mauricio B. De Souza Jr.</i>	

A Data Driven Approach for Resolving Time-Dependent Differential Equations with Noise	379
<i>Donglin Liu, Alexandros Sopasakis</i>	
Robust Predictable Control (RPC) for Optimizing Fed-Batch Penicillin Production.....	385
<i>Gary Simethy, Margret Bauer, Ruomu Tan, Fabian Buelow</i>	
Metabolic Modeling of <i>Arthrospira</i> Sp. PCC 8005 - Network Definition and Experimental Validation	391
<i>M. Maton, B. Leroy, A. Vande Wouwer</i>	
Generalizability of Concept Knowledge in Machine Learning Using TCAV Scores: A Case Study Using Different Skin-Lesion Datasets	397
<i>Moritz C. Schwinghammer, Laines Schmalwasser, Sireesha Chamarthi, Yuri A. W. Shardt</i>	
Application of pqEDMD for Modeling Open Raceway Ponds	403
<i>Camilo Garcia-Tenorio, José Luis Guzmán, Laurent Dewasme, Alain Vande Wouwer</i>	
Early Fault Diagnosis in Chemical Processes Through Multistep Multivariable Prediction.....	409
<i>Djogaf F. Chrysler J., Moncef Chioua</i>	
Evaporation Rate Independent State Estimation for a Spray Drying Process	415
<i>Arthur Lepsien, Héctor Hernández-Escoto, Alexander Schaum</i>	
Systematic Tuning of PI Averaging Level Control for Recycle Systems	421
<i>Aayush Gupta, Prakhar Srivastava, Nitin Kaistha</i>	
Accelerated Process Optimization of Chromatographic Separations Using a Hybrid Modeling Approach	427
<i>Foteini Michalopoulou, Maria M. Papathanasiou</i>	
Nonlinear Model Predictive Control for Dynamic Operation of an Alkaline Electrolyzer.....	433
<i>Anders Hilmar Damm Christensen, Nicola Cantisani, Shi You, John Bagterp Jørgensen</i>	
Smart Optimization of Post-Combustion CO ₂ Capture from a Coal-fired Power Plant: A Bayesian Framework with Wavelet Neural Networks	439
<i>Prince Kumar Jain, Santhosh Kumar Varanasi</i>	
Modelling and Simulation of a Trickling Filter Bioreactor for Ex-Situ Hydrogenotrophic Methanation.....	445
<i>F. A. Ortiz-Ricárdez, K. M. Muñoz-Páez, A. Vargas</i>	
Robust Reaction Rate Estimation with Application to Mammalian Cell Cultures	451
<i>Guilherme A. Pimentel, Fernando N. Santos-Navarro, Laurent Dewasme, Alain Vande Wouwer</i>	
Trajectory Tracking Control of a Batch Process Using Deep Reinforcement Learning.....	457
<i>M U Abuthahir, Nabil Magbool Jan</i>	
Fault Diagnosis for Drilling Using a Multitask Physics-Informed Neural Network	463
<i>Marios Gkionis, Nils Christian Aars Wilhelmsen, Ole Morten Aamo</i>	
Training Neural ODEs Using Fully Discretized Simultaneous Optimization	469
<i>Mariia Shapovalova, Calvin Tsay</i>	
On Regularized System Identification from a Martingale Distributional Robustness Perspective	475
<i>Xianyu Li, Hao Ye, Dexian Huang, Chao Shang</i>	

Experimental Design for Missing Physics.....	481
<i>Arno Strouwen, Sebastian Micluta-Câmpeanu</i>	
Improved Model Order Selection in Dynamical System Identification Based on Trend Extraction	487
<i>Ju Liu, Jiayi Zhao, Chao Shang, Dexian Huang</i>	
Nonasymptotic E-Optimal Design of Experiments for System Identification Using Sign-Perturbed Sums	493
<i>Masanori Oshima, Sanghong Kim, Yuri A. W. Shardt, Ken-Ichiro Sotowa</i>	
Unknown Inputs and Reaction Rates Estimation in a CSTR with Full Concentration Vector Measurement	499
<i>Fernando López-Caamal, Jaime A. Moreno</i>	
Optimal Experiment Campaigns Under Uncertainty Minimizing Bayes Risk	504
<i>Benoît Chachuat, Marco Sandrin, Constantinos C. Pantelides</i>	
Symmetric Kullback Leibler Divergence-Based Design of Experiments with Estimation of Unspecified Values	510
<i>Brijesh Kumar, Mani Bhushan</i>	
Adaptive Optimal Control of Lettuce Growth in Greenhouses Using Sensitivity-Driven Measurement Collection.....	516
<i>Patrik Valábek, Jozef Vargan, Radoslav Paulen</i>	
Robust Economic Model Predictive Control for Continuous Fermentation Processes	522
<i>Ali Ghodba, Chris McCready, Mahshad Valipour, Luis Ricardez-Sandoval, Hector Budman</i>	
Optimal Control of a Microbial Growth Model by Means of Substrate Concentration and Resource Allocation	528
<i>J. Innerarity Imizcoz, W. Djema, F. Mairet, J.-L. Gouzé</i>	
Observer Based Extremum Seeking Control for Cell Population Models with Uncertain Growth Dynamics.....	534
<i>P. Jerono, M. Guay, T. Meurer</i>	
Reconstructing Governing Equations of Influenza Virus Dynamics from Incomplete Measurements	540
<i>Martin Steiger, Ion Victor Gosea, Daniel Rüdiger, Peter Benner, Udo Reichl</i>	
A Digital Tool for the Automatic Identification of Anomalous Cell Cultures in Biopharmaceutical Process Development	546
<i>G. Barberi, P. Diaz-Fernandez, D. Lega, P. Kotidis, P. Facco</i>	
Split Parallel Control - A Little Known Control Structure	552
<i>Krister Forsman, Mohammed Adlouni, Sigurd Skogestad</i>	
Generic Model Control of Diffusion-Reaction Systems.....	558
<i>A. Maidi, R. Paulen, J.-P. Corriou</i>	
A Non-Linear PI Averaging Level Controller for Plantwide Systems.....	564
<i>Aayush Gupta, Nitin Kaistha</i>	
Control Structures for Heat Delivery in Compact Bottoming Cycles for Heat and Power Production	570
<i>Lucas F. Bernardino, William Davidsen, Adriana Reyes-Lúa, Rubén M. Montañés</i>	

Identifying Drivers of Downstream Yield Variability Using Integrated Process Models: An Application to API Manufacturing	576
<i>Tobias Overgaard, Maria-Ona Bertran, John Bagterp Jørgensen, Bo Friis Nielsen</i>	
Steady State Process Optimization of an Electric Flash Clay Calcination Plant	582
<i>Nicola Cantisani, Jan Lorenz Svensen, Shanmugam Perumal, John Bagterp Jørgensen</i>	
Fast Startup Dynamics of Diabatic Distillation with Electric Heating	588
<i>Samuel Mercer, Michael Baldea</i>	
Improved Understanding of Experimental Campaigns in Catalyst Development Through Machine Learning	594
<i>Edoardo Tamiazzo, Alberto Biasin, Pierantonio Facco</i>	
Modeling of Biodiesel Production Via Transesterification Using Inline Raman Spectroscopy	600
<i>Ilias Bouchkira, Mohammad El Wajeh, Adel Mhamdi</i>	
An Integrated Optimization Method for Heavy Haul Trains with Virtual Coupling Based on Genetic Algorithm	606
<i>Lezhou Wu, Hao Ye, Zhihua Xiong, Wei Dong</i>	

Author Index