

Index

A

AC drives, 194
Acceleration current, 201
Acceleration estimator, 206
Accuracy, 180
Activated sludge model No. 1 (ASM1), 129
Activated sludge process, 127, 128
Active parameters, 47
Active state, 374
Activity, 370
Actuator, 301, 323
Adaptation, 161
Advanced control algorithms, 77
Advanced control methods, 290
Agent-based systems, 328
Airflow controller, 138
Always action, 375
Ammonia controller, 128, 130, 136
Analysis, 229
Anti-windup, 292, 293
Anti-windup protection, 132, 139
Armature current, 193
Armature voltage, 196
ASPECT, 328, 329
Augmented model, 82, 83
Auto-tuning, 161
Automatic code generation, 364
Automatic experimentation, 329

B

Balanced tuning (BT), 306
Basic control, 363, 370, 403
Basic parameters, 44
Bearing faults, 229
Bearings, 221, 224
Beating phenomenon, 235
Benchmark simulation model, 128

Bioheat equation, 261, 267
Bisection method, 145
Blended multiple controller, 121
Blended multiple model, 110
Blending functions, 110
Bumpless, 292
Burn injuries, 262, 263, 278
Burn integral, 263

C

Calcinate grinding, 383
Cancellation, 55
Cascade control, 130, 138, 325
Cascade control loop, 292
Characterisation of the gap, 4
Chien–Hrones–Reswick, 306
Closed loop transfer function, 55, 57
Closed-loop control, 13
Code generation template, 378
Code generator, 378
CoDeSys, 377
Cold rolling mill, 185
Combined multi-source dependencie, 375
Commissioning, 210, 218
Comparison of the ammonia controllers, 135, 147
Compensator, 292
Complexity, 28
Complexity-reduction, 96
Composite dependency, 374, 390, 392
Computational load, 271, 282
Computational time, 275
Computationally undemanding task, 58
Concurrent design, 14
Conditional dependency, 375
Configuration tool, 329, 349
Constrained linear systems, 79

- Constraints, 12, 21, 26
- Constraints-handling, 96
- Construct by correction, 402
- Construction, 10
- Continuous stirred tank reactor, 113
- Continuous transfer function, 60
- Continuous-time model, 108
- Control, 327
- Control design, 102, 108, 289
- Control diagram, 191
- Control efficiency, 290
- Control engineering, 29
- Control engineering practice, 5, 108
- Control performance, 72
- Control performance monitor, 343
- Control performance monitoring, 329
- Control system, 8, 363, 371
- Control system life cycle, 8
- Control theory, 11, 26
- Controlled system/process, 6
- Controller design, 57
- Controller parameters, 57, 62, 69
- Controller tuning, 210, 290, 306
- Correct by construction, 403
- Cost function, 133, 145
- Crank–Nicholson, 264, 274
- Cross-validation, 335
- Cultural factors, 25
- Custom-made solution, 195

- D**
- Damping ratio, 168
- DC drive, 189, 194
- DC drive control, 203
- Decomposition, 370
- Decoupler, 292, 294, 308, 320
- Delayed propagation, 375
- Dependency relation, 373, 385
- Design, 10
- Design effort, 151
- Design goal, 55
- Designer decision, 71
- Desired closed-loop transfer function, 62
- Development activity, 380
- Device-centric, 364, 367
- Diagnosis, 223
- Diagnostic accuracy, 224
- Diagnostic methods, 20
- Diagnostic resolution, 224
- Diagnostic sensitivity, 225, 237, 241
- Diagnostic stability, 225, 228, 237, 241
- Diagnostic system, 246, 248, 250, 251, 254, 255
- Diophantine equation, 55

- Disburdening loop, 186, 187
- Discontinuous, 58, 60
- Discrete time transfer function, 60
- Discrete-time model, 108, 114
- Disposal, 11
- Distributed systems, 404
- Distribution of burns, 275
- Disturbance, 174
- Disturbance estimation, 82
- Disturbance model, 145
- Disturbance rejection, 292, 306, 316
- Disturbance-estimation, 78
- Disturbance-rejection, 92
- Divide-and-conquer (D&C), 101, 102, 103, 108, 124
- Domain engineering, 368
- Domain-specific modelling language (DSML), 366
- Drift, 65, 66
- Durative state, 375
- Dynamic behaviour, 371

- E**
- Economic justification, 23
- ED, 373, 384
- Electrical faults, 224, 242
- Elementary state, 374, 378
- EMF, 378
- EMPC control, 88, 93
- EMPC controller, 96
- End-quality, 221
- End-testing, 226
- Engineering process, 6
- Engineers, 7
- Entry action, 375
- Envelope analysis, 230
- Equilibria, 104, 105, 107, 115
- Equilibrium points, 102, 103
- Estimation, 51, 207
- Evolution of burns, 258
- Evolving systems, 329
- Excitation signal, 40, 68, 71
- Excited section, 40
- Exit action, 375
- Experimental environment, 146
- Explicit model predictive control, 16

- F**
- Faults, 224
- FBD, 378, 401
- Feature extraction, 229, 233, 234
- Feed-forward control loop, 292
- Feedback control, 77, 146
- Feedforward compensator, 193

Feedforward control, 131
 Feedforward controller, 140
 Feedforward relation, 203
 Feedforward-feedback control, 138
 Feedforward-feedback controller, 131, 140
 Ferromagnetic material, 63
 Filtering, 140, 146
 Finite-state machine (FSM), 373, 374
 Flash fire, 275, 284
 Fuel cell, 309
 Functional requirements, 9, 12, 13, 186
 Fuzzy model, 331

G

Gain-scheduling, 101, 102, 120
 Gain-scheduling controller, 109, 111, 115
 Gap, 3, 28
 Gas mixing process, 67
 Gas-liquid separator, 117
 General linear controller, 54
 Global nonlinear controller, 108
 Global nonlinear model, 104, 108
 Global optimisation, 114
 GPML, 365, 366, 368

H

Hammerstein model, 37–39
 Hardware, 21
 Heat equation, 266
 Heat flux, 267, 278
 Hilbert transform, 232, 233
 HMI, 176, 296
 Human factors, 24
 Human-machine interface, 329

I

IDE, 364, 376
 Identification, 15, 87
 IEC 61131-3, 365, 378
 IEC 61499, 365
 Imbalance, 242, 249
 Implementation, 10
 Implementation issues, 211
 Impulse response, 273
 Inactive parameters, 47, 48
 Initial estimates, 53
 Instruction list, 378
 Instrumental variables, 303, 323
 Instrumented mannequin, 257
 Integral action, 81
 Interaction, 170
 Interdependence, 373
 Interdisciplinary, 281
 Internal model control (IMC), 132, 140

Inversion, 58
 Inversion of a piecewise-linear function, 41

J

Jog mode, 205

K

Kalman filter, 81, 82, 88
 Key entities, 6

L

Ladder diagram, 378
 Life-cycle model, 2, 8
 Linear model, 140, 331
 Linear parameters, 44
 Linear speed control, 199
 Linear speed control mode, 189
 Local linear analysis, 78
 Local linear models, 104
 Local optimisation, 114
 Long-tail detector, 169
 Look-up table, 209
 Loop action, 375
 Low-cost solution, 195

M

Magnitude optimum multiple integration (MOMI), 306, 308, 312, 320
 Maintainability, 20
 Maintenance, 218
 Management, 23
 Manipulative signal, 299
 Mannequin, 275
 Manufacturing, 222
 Mathematical modelling, 14
 MDE, 366
 Measurable disturbance, 149, 152
 Measurement noise, 71
 Mechanical faults, 224, 227, 249
 Mitsubishi, 377, 378
 Model based estimation, 206
 Model editor, 377
 Model error, 303, 312, 320
 Model identification, 92, 329, 332, 334
 Model inaccuracy, 151
 Model predictive control (MPC), 77, 145
 Model predictive controller (MPC), 133
 Model repository, 376, 378
 Model transformation, 366
 Model transformation rules, 378
 Model validation, 87
 Model verification, 335
 Model-based, 127
 Modelling, 87, 102
 Modelling of behaviour, 381

Modelling of interdependent behaviour, 381
 Modularisation, 370, 373
 Moment of inertia, 197
 Monte Carlo, 259, 271, 275, 281, 282
 Motor torque, 196
 Multi-faceted model, 330
 Multiparametric quadratic programming, 77
 Multivariable control, 292

N

Noise, 140, 151
 Noise detector, 167
 Non-functional requirements, 9, 28
 Non-oscillatory performance, 140
 Non-technical aspects, 283
 Nonlinear, 327
 Nonlinear model, 142
 Nonlinear static function, 39, 67
 Normal distribution, 274

O

Observer, 82
 Offset-free tracking, 78, 81, 82
 Online learning, 329, 332
 OPC, 147, 289, 297
 OPC server, 297
 OpenArchitectureWare, 378
 Operating points, 104
 Operation, 11, 367, 370, 380, 384
 Optimisation, 114
 Optimisation algorithm, 143
 Organisation of work, 25
 Oscillation-decay detector, 168
 Output constraints, 89
 Overlapping super-state, 375, 390
 Overshoot detector, 167
 Oxygen concentration control, 63
 Oxygen concentration sensor, 64
 Oxygen controller, 130

P

P&ID, 380, 382, 404
 Parameter estimation, 39
 Parameter offset, 49
 Parameterisation of the Hammerstein model, 42
 Parison, 159
 PCE, 373, 378, 381, 385
 Performance, 17
 Performance criteria, 135, 148
 Phases in the life cycle, 8
 Physical and social environment, 7
 PI controller, 131, 139
 PID control, 78, 96

PID controller, 70, 83, 87, 160, 338
 Piecewise-linear, 37
 Piecewise-linear approximation, 38
 Piecewise-linear functions, 41
 Piecewise-linear Hammerstein model, 39, 57
 Plastic extruders, 157
 Plastic material, 157
 Pole placement method, 55
 Portability, 254
 Position of knots, 60
 Prediction horizon, 133
 Prediction interval, 145, 146
 Predictive control, 339
 Predictive functional control, 339
 Procedural control, 363, 367, 369, 370
 Process model, 163, 294, 303
 Process model identification, 290
 Process-centric, 365, 367
 ProcGraph, 364, 368
 Programmable logic controller (PLC), 64, 65, 66, 158, 191, 212, 329, 363, 365, 377, 382, 400
 Project organisation, 23
 Propagational dependency, 375
 Purpose of the model, 14

Q

Qualities, 12, 26
 Quality assessment, 257
 Quality control, 222
 Quality requirements, 17

R

Rapid control prototyping (RCP), 291
 Rapid prototyping, 213, 290
 Reactive system, 371
 Real-time system, 371
 Receding-horizon, 79
 Recoiler, 186
 Recursive least squares method (RLS), 47
 Reduced model, 130, 143
 Redundancy of basic parameters, 44
 Redundancy of linear parameters, 45
 Reference pre-filter, 293
 Regulations, 23
 Relay, 162
 Reliability, 19, 185
 Report generation, 308
 Requirements analysis, 9
 Robustness, 17, 225, 228
 Rubbing, 224, 234, 238
 Run-time module, 329

S

Safe-switching, 340
 Safety, 19
 Sampling time, 143, 181
 Scheduling variable, 111, 113, 338
 Scheduling vector, 103, 109, 111, 113, 115
 SDD, 373, 375, 390
 SE, 367
 Self-tuning, 329
 Sensitivity function, 92
 Sensor, 215
 Sensor failure, 144, 151
 Sequential function chart, 378
 Signal envelope, 229
 Signal interfacing, 214
 Simulated annealing, 343
 Simulation, 88
 Single-loop control, 291
 Sintering furnace, 63, 64
 Sintering process, 63
 Skin burn injuries, 257
 Skin injuries, 284
 Skin parameters, 270, 284
 Skin thermal model, 264
 Slack variable, 133
 Slitter, 186
 Slitter acceleration, 206
 Slitting line, 186
 Soft constraints, 96
 Software, 22
 Software agents, 328
 Software engineering, 363, 364, 367, 376, 380
 Software lifecycle, 364
 Software tools, 289
 Sparking analyser, 249
 Sparking intensity, 244
 Specific entry action, 375
 Speed mode, 205
 ST, 375, 381, 385
 Stability, 173
 Standard deviation, 50
 Standards, 23
 State estimation, 82
 State-space process model, 79
 State-variable filter, 303
 Static nonlinear function, 38
 STD, 373, 374, 381, 385
 Steady-state offset, 81
 Steel slitting line, 185
 Structural modelling, 380
 Structured text, 373, 378
 Sub-activity, 385, 390
 Sub-state, 374, 378, 394
 Successive design, 15
 Super-state, 374, 378, 381, 385

Switching point, 66
 Synchronisation, 373, 390
 System requirements, 12
 System specification, 9
 Systems engineering, 29

T

Target calculator, 82
 Technology, 6
 Temperature control, 157
 Temperature zones, 159
 Tension, 186
 Tension control, 188, 192, 200
 Tension control mode, 189
 Tension current, 201
 Tension mode, 203
 Tension sensor, 188
 Tent function, 44
 Theory/practice gap, 1
 Thermal mannequin, 259
 Three-water-tank system, 316
 Time delay, 143, 151, 294
 Titanium dioxide, 364, 382
 TITO controller, 292, 320
 Tools, 22
 Tracking controllers, 78
 Tracking inactive parameters, 52
 Tracking response, 307
 Tracking-error integration, 82
 Transfer function, 45
 Transient action, 375
 Transient state, 375, 386
 Transport delay, 67
 Tuning, 88
 Tuning rules, 132, 140

U

UML, 365, 374
 Uncoiler, 186
 Unmeasurable disturbance, 145, 151
 Usability, 18

V

Variable skin parameters, 282
 Vehicle, 105
 Velocity-based linearisation, 109, 110, 115,
 121
 Vibration, 224, 249

W

Wastewater treatment, 127, 129
 Waterfall life-cycle model, 8

Z

Ziegler–Nichols, 306