Index

\( L_1 \) design system, 25
\( L_1 \) filter design, 26, 111, 189
\( L_1 \) adaptive augmentation, 243, 259

Adaptation law modifications
\( \sigma \)-modification, 2, 248
\( e \)-modification, 2, 248
projection operator, 248

Adaptation sampling time, 162

AirSTAR
GTM, 159, 254
Mobile Operations Station, xix
piloted evaluations, 254
T1 research aircraft, xix
T2 research aircraft, xix

Applications
AirSTAR, 159, 254
crew launch vehicle, 192, 259
flexible aircraft, 259
nuclear power plant, 260
rotorcraft, 259
SIG Rascal, 243
smart materials, 260
vision-based control, 259
well drilling, 260
X-29, 259
X-48B, 159, 259

Backstepping, xii, 2, 121
Barbalat’s lemma, 275
Base sampling time, 252, 253
Bursting, 77

Certainty equivalence, 2
Control reconfiguration, 242
Control signal saturation, 261
Controllability
strong, 286
uniform, 286

Convex
function, 291
set, 291

Crossover frequency
gain, 9
phase, 76

Decentralized control, 261
Disturbance rejection, 33

Event triggering, 261

Fault detection and isolation, 246
Feedforward prefilter, 145, 161
Final Value Theorem, 23
Flight control systems, 241
Flight envelope, 241, 254

Function
\( \mathcal{K}_\mathcal{L} \) class, 276
\( \mathcal{K} \) class, 276
\( \mathcal{K}_\infty \) class, 276
Dirac-delta, 267
Lyapunov, 273
positive definite, 272
truncated, 266

Gain scheduling, 3, 4, 211, 242, 260
Gap metric, 260
Guidance system, 242

Handling qualities, 254
Cooper–Harper rating, 254, 255
High-fidelity simulator, 255
High-gain feedback, 2, 3, 26, 260

Impulse response, 268
matrix, 268
Input quantization, 261
Invariant set
    positively, 82, 97
Limit cycle, 91
Linear matrix inequality, 112, 295
Locked-in-place failure, 245
Loss of control, 242, 259
Lyapunov equation, 265
Margin
    gain, 9, 59
    phase, 9
    time-delay, 11, 51
Matching conditions, 140, 159
Matrix
    Hurwitz, 265
    positive definite, 265
    state transition, 268
    transfer, 268
MIL-Standard requirements, 254
Model Reference Adaptive Control
    direct, 1, 4
    indirect, 1
    neural-network based, 89
    state-predictor based, 6
Model-following control, 8
Naval Postgraduate School
    flight tests, xviii, 243
    hardware-in-the-loop, 243
    SIG Rascal 110, xviii
Noise sensitivity, 33
Norm, 263
    ∗-norm, 114, 296
    ℒ1-norm for LTI systems, 277
    ℒ1-norm for LTV systems, 280
    function, 266
    induced matrix, 264
    truncated, 266
    vector, 263
Nyquist criterion, 8
Optimization problem
    constrained, 112
    convex, 114
    generalized eigenvalue, 115, 295
    nonconvex, 112
Parameter drift, 2, 76, 77
Path-following control, 243
Performance optimization, 112, 114
Persistency of excitation, 1, 3, 242,
    260
Piecewise-constant adaptation law, 163,
    192, 198
Pilot-induced oscillations, 255
Pitch break, 257
Polytopic uncertain system, 297, 298
Projection operator, 18, 292
Recursive design methods, 121, 140
Reference system
    LTI, 17
    LTV, 211
    non-SPR, 192
    strictly positive real, 179
Robust Multiple-Model Adaptive Control, 207
Rohrs’ example, 1, 76
    in flight, 247
Scaled response, 260
Self-oscillating adaptive controller, xi
Self-tuning regulator, xi
Semi-linear system, 84, 99, 125, 147
Space
    ℒ-space, 266
    extended ℒ-space, 266
Stability
    asymptotic, 272, 273
    BIBO, 276
    uniform, 280
    BIBS, 277
    exponential, 273
    Lyapunov, 272, 273
    uniform, 273
State predictor, 6
    modification, 22, 172, 207
Stochastic optimization, 113
    adaptive random search, 113
    meta-control methodologies, 114
    particle swarm optimization, 113
    randomized algorithms, 113
Strict-feedback system, 3, 121
Supervisory control, 2
Index

<table>
<thead>
<tr>
<th>Task execution time, 252</th>
<th>Trajectory initialization error, 44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission zeros, 142, 160</td>
<td>Two-cart benchmark problem, 207</td>
</tr>
</tbody>
</table>

Uncertainties
- actuator, 68, 94, 223
- internal dynamics, 94
- matched, 17
- system input gain, 35, 121, 142, 160
- unmatched, 121

Uniform performance, 14, 24
- scaled response, 19, 24, 29
- transient specification, 25

Verification and Validation, 241, 260

Wing rock, 90

X-15, 1