# Index

adversarial, 18
  action, 16
adversary, 26, 30
  deception, 26
agents, 16
algorithm
  Bolza form, 119
  Bryson's gradient, 118
  data processing, 106
  Euler's method, 118
  Mayer form, 118, 119
allocation, 7, 15
arbitration, 24
area coverage rate, 104, 106
assignment, 8, 11, 12, 28, 37, 46, 54, 58, 61, 65–67, 70, 74, 76, 78–80, 83, 84, 90, 96, 136
  multiple, 12, 53
asynchronous, 13, 45, 95
ATR, *see* automatic target recognition
auction, 26, 28, 30
  combinatorial, 20
  distributed iterative, 137
  iterative, 22, 137
  Jacobi, 20
  parallel, 20, 21
automatic target recognition, 25, 30, 39, 42, 44, 133, 134
autonomous, 3, 4, 6, 13, 17
autopilot, 141, 147
  cross-track following, 143–144
  path following, 144–146
  waypoint following, 143

bandwidth, 24, 100
battle space, 104, 106
  circular, 104, 105
  linear-symmetric, 104, 105
  randomly shaped, 104
  scenario, 104
Bayesian networks, 22, 26
behavior
  adversarial, 19
  noncooperative, 18
  predatory, 19
behavioral model, 26
biological analogies, 21
biomimetics, 21

C++, 125
capacitated transshipment assignment problem, 20, 26, 28, 30, 39–43, 45, 46, 50, 69, 83, 89, 136
  distributed iterative, 137
  iterative, 22, 46–48, 89, 90, 137
  memory, 48, 49, 53
churning, 19, 22, 24, 48, 49, 53
clutter, 15
CMTE, *see* cooperative moving target engagement
coalition, 16, 18
collateral damage, 106
collusion, 18
communication, 6, 8, 12, 13, 21, 23, 28, 91, 93, 95–97
  constraint, 91, 100
  delay, 21, 24, 25, 30, 89, 135
  information state, 135
  intervehicle, 125, 135
  simulation, 127
  simulation truth, 135
competition, 16
complexity, 8, 12, 13, 21, 60, 63, 69, 71, 75, 76, 80, 83, 86, 87, 93, 96



Copyright © by SIAM.
Unauthorized reproduction of this article is prohibited.

2008/10/17
page 160



conflict, 17
conflict of interest, 16–19
confusion matrix, 105
  binary, 106
consensus, 20, 21, 24, 26
  Paxos, 20, 21
constraint, 10, 46, 53, 54, 56–58, 75–79, 81, 83, 86, 87
  communication, 91, 100
  coupling, 8, 13, 39, 41, 49
  satisfaction, 20, 21, 26, 28
  timing, 9, 12, 46, 49, 55, 58, 59, 69, 70, 73, 74, 77, 79, 81
contract nets, 24, 26
control, 2, 92, 94
  allocation, 132
  autonomous, 4
  centralized, 8, 13, 20, 21, 28, 30
  cooperative, 1, 7–13, 30, 37, 42, 47, 50, 53, 76, 91
    stochastic, 25
  decentralized, 8, 13, 21, 24, 28, 30
  dynamic inversion, 132
  hierarchical, 8, 20
  noncooperative, 24
  predictive, 21
  rate, 132
  trajectory, 2
cooperation, 6, 8, 9, 12, 13, 15, 28, 37, 39, 47, 87, 89, 100, 104
  value, 19
cooperative behavior, 16
cooperative moving target engagement, 8, 73, 80
coordination, 4, 28, 91, 100
  implicit, 46
cost functional, 113
CTAP, *see* capacitated transshipment assignment problem

database, 90, 91, 95
decentralization, 21
deception, 19, 30
decision
  cycling, *see* churning
  maker, 20
  tree, 60
decomposition, 8, 22, 26
delay
  classification, 25
  communication, 25, 135
  link, 23
  operator, 25
  processing delay, 135
disinformation, 18
distributed, 8, 15, 46
Doppler, 9, 73
Dubins, 71, 92, 141
  algorithm, 149
  car, 43, 48, 50, 77, 92

ECAV, *see* electronic combat aerial vehicle
effectiveness, 104
  measures, 106
EFS, *see* embedded flight software
electronic combat aerial vehicle, 10
embedded flight software, 125, 128
emergent behavior, 21
engagement geometry, 106
equilibrium point
  Nash, 18
  Pareto, 18
error
  classification, 25
  operator, 25
estimation, 9, 12, 13, 21, 30, 75, 89, 91, 93, 95–97, 100
expected future value, 104

feasibility, 22, 30
filter
  information, 93–95
  Kalman, 93

GA, *see* genetic algorithm
game
  Nash, 19
  non zero sum, 18
  Pareto, 19
  prisoners' dilemma, 19
  theory, 22, 26

Copyright © by SIAM.
Unauthorized reproduction of this article is prohibited.

2008/10/17
page 161



zero sum, 18
generalized mathematical framework, 104
genetic algorithm, 22, 53, 63, 65–67, 69, 71, 83, 87
crossover, 66, 84
elitism, 66, 85
mutation, 65, 66, 85
operators, 64, 65, 84
global information, 21
Global Positioning System, 9, 73–75
GMTI, *see* ground moving target indication
GNC, *see* guidance navigation and control
GPS, *see* Global Positioning System
ground moving target indication, 9, 73, 74, 87
guidance, *see* path guidance
navigation and control, 141

Hamiltonian, 114
hierarchical decomposition, 21

incentive games, 21
independent agent, 17
information, 3, 6–8, 38, 39, 41, 46, 54, 91, 94, 95, 100
communicated, 90, 93, 95, 97
distributed, 24
false, 13, 24
flow, 89
global, 8
imperfect, 12
limited, 24
matrix, 93
partial, 21, 24
pattern, 16
set, 89, 91
shared, 24
state, 24
theory, 22
warfare, 30
intelligence, surveillance, and reconnaissance, 9, 12
ISR, *see* intelligence, surveillance, and reconnaissance
iterative network flow, *see* capacitated transshipment assignment problem, iterative

job shop scheduling, 22, 24, 26
joint action, 18

LADAR, *see* laser detection and ranging
laser detection and ranging, 38, 39
level of discrimination, 105
load balancing, 24

manager
cooperation, 130
route, 130
sensor, 128
target, 130
weapons, 130
Markov decision processes, 22, 26
MAV, *see* micro aerial vehicle
measurement, 8, 89, 92–94
noise, 30
memory weight, 48–50
micro aerial vehicle, 10
MILP, *see* mixed integer linear programming
mission
objective, 127
search and destroy, 104, 106
tactics, 127
mixed integer linear programming, 20, 26, 28, 53–56, 58, 60, 66, 69, 71, 78, 79, 82, 86, 87
MultiUAV2, *see* MultiUAV simulation
MultiUAV simulation, 48, 61, 67, 91, 100, 125

negotiation, 17, 20, 21, 24
network flow, *see* capacitated transshipment assignment problem
noncooperation, 16
nonholonomic kinematic constraints, 147

objective
common, 21
function, 18, 24, 113
individual, 16

Copyright © by SIAM.
Unauthorized reproduction of this article is prohibited.

2008/10/17
page 162




private, 17
team, 16, 17
local, 17
team, 21
objectives
common, 16
operator, 1, 3, 10, 13, 25
cognition phenomenology, 25
error, 25
workload, 25
optimal
control, 113, 120
theory, 104
path, *see* path
strategy, 26
optimization
combinatorial, 60, 63, 77
multiobjective, 16
organizational structure, 16

partially observable Markov decision process, 26
path
elongation, 49
flyable, 70, 147, 148
guidance, 141, 143, 146, 147
cross-track following, 143, 144
path following, 143, 144, 146
waypoint following, 143
minmum length, 148, 149
optimal, 148, 149
optimization, 12
planning, 43, 71, 141, 142
minimum-time, 126
waypoint, 153, 156
wind, 155, 156
point-to-point, 142
smooth, 142
payoff function, 16
POMDP, *see* partially observable Markov decision process
Pontryagin maximum principle, 114
potential fields, 21
prisoners' dilemma, 19
probability
applied, 104
distribution, 104
circular-normal, 104, 105
false target, 104
normal, 105
Poisson, 25, 104, 105, 111
target, 104
uniform, 104, 105
elemental, 111
false target report, 105
number of attacks, 108
target report, 105
unconditional, 111
programming, *see* mixed integer linear programming
dynamic, 20, 26
stochastic, 26
linear, 20, 22
nonlinear, 20
stochastic dynamic , 22
propaganda, 18

radar, 4, 9, 10, 73, 74
RCI, *see* redundant centralized implementation
real-time, 3, 12, 41, 46, 47, 50, 70, 71, 83
receding horizon, 28
receiver operating characteristic, 24
curve, 106, 111, 119, 120
redundant centralized decision approach, 23
redundant centralized implementation, 89, 136
relative benefits, 20, 137
resource allocation, *see* task assignment
robustness, 6–8
ROC, *see* receiver operating characteristic

SEAD, *see* suppression of enemy air defenses
search, 12, 26, 37, 39–47, 50, 54–56, 58, 61, 63, 65
branch and bound, 22
brute force, 22
graph theoretic, 20, 22
heuristic, 22


Copyright © by SIAM.
Unauthorized reproduction of this article is prohibited.

2008/10/17
page 163




stochastic, 20
Tabu, 22
trajectory, 126
self interest, 19
self organizing, 17
sensor, 6, 8–10, 39, 77
performance model, 105
threshold, 106
false, 111
footprint, 39, 44, 74, 80, 87, 106, 126, 133
mission, 133
performance, 105
sensor craft, 117
sequential events method, 106
set partition, 20
six-degree-of-freedom, 125, 132
6DOF, *see* six-degree-of-freedom
state estimation, 24
suboptimal, 21
subteams, 22
sufficient statistic, 24, 25
Suppression of Enemy Air Defenses, 76
synchronization, 91, 100

target, 131
false, 15, 104, 105, 108, 109, 111
false attack, 30, 120
multiple, 104
states, 46, 47, 127
threshold, 111
task, 12, 39, 42, 47, 48, 77, 80, 81, 86, 89, 100
allocation, 40, 44
iterative, 90
assignment, 9, 13, 17, 39–41, 43–48, 50, 53, 55, 56, 60, 69, 71, 73, 76–78, 81, 83, 86, 89, 91, 92
attack, 104, 126
classify, 104, 126
coupling, 8, 13, 16, 21, 22, 28, 30, 46
decoupling, 22
order, 22
precedence, 39, 41, 46, 49, 60, 79
search, 104, 126
tours, 37
verify, 104, 126
weightings, 42
team, 6–8, 10, 12, 13, 16, 28, 38, 40, 42, 43, 46, 48, 55, 67, 73, 75, 76, 80–83, 89, 92, 95, 96, 99
agent, 136
autonomy
complete, 25
management by exception, 25
management by permission, 25
mixed initiative, 25
collaboration, 17
cooperation, 17
coordination, 16, 17, 25
decision
asynchronous, 23, 24
synchronous, 23, 24
goal seeking, 17
interaction
collaborative, 16
cooperative, 16
coordinated, 16
member, 136
noncooperative behavior, 18
threat, 131
threshold
false target attack, 111
target attack, 111
time
dwell, 106
timing constraint, 22, 28
floating, 22
tour
sequence, 22
single task, 136
tree search, 60, 61, 63, 67, 69, 70

uncertainty, 13, 21, 39, 43, 75, 89, 92, 104
unstructured, 16
unicycle, 148
unstructured environment, 16
utility function, 17


Copyright © by SIAM.
Unauthorized reproduction of this article is prohibited.

2008/10/17
page 164



Variable Configuration Vehicle Simulation, 132
VCVS, *see* Variable Configuration Vehicle Simulation
vehicle
    model, 147–148
    routing, 26, 55

WASM , *see* wide-area search munition
wide-area search munition, 8, 37, 39, 42, 44, 46, 48, 53–56, 60, 61, 63, 65, 66, 73, 78, 83, 126

Copyright © by SIAM.
Unauthorized reproduction of this article is prohibited.