analog-to-digital converter (ADC) performance, 42–45
in stem cell culture monitoring systems, 313–314
aneuploidy, in cancer cells, 358
antenna(s)
array, for radio frequency circuit, 100–101, 103
design challenges, 123
for health-care sensors, 94, 97
in implantable medical electronic systems, 123
antialiasing filter, in recording microsystem, 86–87
antibodies, as biofunctionalized sensing layer, 219, 220
antisense oligonucleotides, and controlling gene expression, 412
AP. See extracellular action potential (AP)
APD. See avalanche photodiode
APMU. See analog power management unit
apoptosis, 356, 440–441
APTES. See aminopropyltriethoxysilane arithmetic mean, as method of calculating average sensitivity between data records, 18–22, 19, 21
artificial neuron networks, 201, 202
ASK. See amplitude shift keying
autocorrelation algorithm, in health care sensor, 104–108, 107, 110–112, 111
automated measurement methods, in microfluidics, 275
avalanche photodiode (APD), in optical flow cytometry, 245, 246–247
avidin, detection of in phosphate buffered saline solution, 483–484, 484
BAC. See bacterial artificial chromosome
BAC-BSA. See biotinamidocaproyl-labeled bovine serum albumin
bacteria, growth monitoring, 219, 221
bacterial artificial chromosome (BAC), as genetic vectors, 413–414, 414
bacterial flagellar motor, comparison with F$_{1}$-ATPase, 383
bacteriophage, and E. coli, 414, 415
bandgap reference voltage generator, for wireless endoscopy capsule, 136, 136
baseband communication processing, architecture, 149, 149
behavioral model, of the ear, 203
BiCMOS processes, 0.25-µm, 196–197
bidirectional communication, in implanted circuits, 86
biochemical noise, 174
bio-CMOS hybrid platforms
and cell sizes, 444
components, 439
corrosion, 441–442
requirements, 436, 438–439
relevant technologies, 438
resolution, 444
biocompatibility, in CMOS devices, 441–442, 442
bioelectronic interface, and cell viability, 440–441
biological components, in integrated systems, 328
biological phenomena, in microcirculation research, 271–272
bioreactor, for stem cell culture monitoring, 317, 318
biosensors
biocompatibility, 317–318
capacitive affinity, 218–222, 219
capturing, 168–173, 169
controlling gain, 310–311
for monitoring stem cell culture parameters, 302
noise in, 176–178, 175
quantitative analysis, 167
using nuclear magnetic resonance, 458
using proteins, 222
using radio frequencies, 457–458, 458
biosignals
acquisition, 125–126
generation, 166
biotinamidocaproyl-labeled bovine serum albumin (BAC-BSA), as receptor layer, 361
bistability, 334–335
BMI. See brain-machine interface
bone implantable stress sensor, 207–208
brain-machine interface (BMI), 45
data compression, 125–126
data transfer, 45–47
drivers, 122
Brownian motion, in nuclear magnetic resonance, 462–463, 463
bulk micromachining
for biomedical applications, 201–204
manufacturing, 196, 196–199
Butterworth filter, in recording microsystems, 87–88, 88

cancer cells, chromosomes in, 358
capacitive sensors
for biological applications, 217, 217–222, 219
capacitive integrator technique, 223–225, 224
comparison with LoC and MEMS-based sensors, 222–223, 223
components, 216–229
implementation, 223–225
performance, 216
capillary network map, 286, 287, 288, 289
cardiac pacemaker, 76–77, 77, 122
CBCM. See core-charge-based capacitance measurement
CD. See compact disc
cell culture, in situ measurement, 302
cell phone technology, use, 240, 251–252

cells
analyzing behavior, 301, 391
communication between, 328–329
electroporation in, 421, 423
genetic manipulation, 411
growth and harvesting for integration with microchannel devices, 387–388
homeostasis in gene-injection platforms, 443
incorporation in CMOS architectures, 439
measuring activity, 219, 220
patterning with microsieve, 400, 400–403
respiration as indicator of cell health, 357
schematic, 281
sizes, 444
statistical image libraries for characterization, 252–253
transfection of using microcavitation, 433–434
cell seeding, of microwell array chips, 368
cell shearing, 388–389
cell tethering, 384
using dip-pen technology, 402
efficiency, 388, 391–392
in fluid dynamics simulation, 385
using microsieves, 400–403, 401, 402
preferential location of in microchannels, 398–399
rotation rate distribution, 393
substrates for, 389, 399

cellular neural network (CNN)
dynamics, 281–282
in Eye-RIS Vision System, 282–283
in image processing analysis, 276–277, 280
use of in microhemodynamics, 278, 290
model, 281
CFD. See computational fluid dynamics
charge-based capacitance measurement technique, for capacitive sensors, 225
charging current, measuring, 227–228
clock controller, for implantable medical electronics systems, 128
clock management architecture, low-power design in wireless endoscopy capsule, 140–142, 141
CMOS-based gene injection systems, 440–449, 448
disadvantages, 448–449
future applications, 440
integration of functions, 447–448
requirements, 447–449
CMOS image sensor, for wireless endoscopy capsule, 143–144
CMOS imaging systems, and mechanical injection of genetic material, 426–427
CMOS processes, 193–195, 194–195, 196
acceptance, 210–211
effect of variations on circuit performance, 137
biocompatible surfaces in, 441–442, 442
for biomedical applications, 199–201
three-dimensional, 211
universities using, 193–195, 194, 195
CMOS technologies, for gene injection, 415–416, 419
CNN. See cellular neural networks
cochlear implant, 77–78, 78, 122
compact disc (CD), as chemical interface
system, 331–332, 334
complementary DNA, detection, 361–362
computational fluid dynamics (CFD)
techniques, 167
confidence intervals, for data-reduction
algorithms, 26–29, 28
conformational changes in proteins,
detection, 219, 222
control signals, in implanted circuits, 47
cooperation, between service
organizations, 210
core-charge-based capacitance
measurement (CBCM), 225–229, 226, 228
corrosion, in bioelectronic interfaces,
441–442
Cotinis texana
as cyborg beetle, 337, 339–341, 340
elevation control, 346, 346
flight data for, 343
turning control, 349, 349
Couette flow, in micropump, 381
Coulter counter principle, for cell
counting, 247
cross talk, in microelectrode arrays, 446
crossover switches, for switching
amperometric sensors, 312, 312–313
current-differential method, for
implementing charge-based
capacitance measurement structures,
229
current-mode microstimulator, 85
cyborg beetles
remote control, 341–345
tetherless control, 339, 340
cytokine, as cancer indicator, 358
damping, in nuclear magnetic resonance,
460–462, 461
Darlington pairs, in microscale
electroporation architectures, 423
data acquisition system, for monitoring
stem cell culture parameters, 303
data compression algorithm, for
implantable medical electronics
systems, 125–126
data reduction, using signal processing
algorithms, 7–10
data reduction algorithms
cost, 15, 17
feature detection by, 13
performance, 15–25, 23, 24, 26–29, 28
sensitivity, 24–25, 28
statistical validation, 25–29, 30
subject-dependent tuning, 22
testing, 18, 20, 30
trade-offs, 15–16, 17
data transmission, in brain-machine
interfaces, 45–47
DBS. See deep brain stimulation
DC bias, in extracellular recordings, 38
DDA. See differential difference amplifier
deep brain stimulation (DBS), 79–80, 80
dielectrophoresis (DP),
methods of controlling high-velocity
projectiles, 431
in microcytometer systems, 246
differential difference amplifier (DDA), in
programmable gain preamplifier, 86, 86
differential matching network, for low-
noise amplifiers, 476–479, 477
differential nonlinearity (DNL), of analog-
to-digital converters, 313
diffraction images, holographic, 262
diffraction signatures, in LUCAS images,
250, 251, 253–258, 254, 255
diffusive spreading, in biosensor platforms,
167–168
Markov chain model, 168, 170, 172, 172,
182
random walk model, 168, 170
digital chip characteristics, in wireless
endoscopy capsule, 152, 152
digital integrated circuits
architecture, 124–125, 125, 139
design considerations, 124–129
in wireless endoscopy capsule, 154
dip-pen technology, for single-cell
tethering, 402, 402–403
direct gene manipulation, steps in, 407
disease diagnosis
through complete blood count,
242–243
and mutated cells, 356–357
DNA
   antisense and sense strands, 409
   in biological information flow, 408, 409
   and capacitive sensing electrodes, 218–220
   composition, 408
   hydrogen bonding, 218
DNA microarrays, image processing, 283, 285
DNL. See differential nonlinearity
Doppler imaging, of microflow, 275, 276
DP. See dielectrophoresis
DR. See dynamic range
droplet formation, in microflow, 273, 275
dual-slit methodology
   - flow monitoring system using, 275, 277–278
   - for in vivo experimentation, 279
   - optical windows for, 278
dynamic capacitance, measurement, 225–229
dynamic range (DR)
calculation, 181
   - figure of merit for biosensors, 177
echo signals, in nuclear magnetic resonance systems, 462, 465, 482–483, 483, 484
efficiency, of analog-to-digital converters, 43–44
   - electrochemical cell, equivalent circuit for, 420
electrodes, See also neural electrodes
   - in electroporation chamber, 420–421
   - impedance model, 38
   - electroporation
      - chambers, 420
      - irreversible, 421
      - method of gene injection, 416, 416–417, 446
      - on microscale, 419–425
      - reversible, 421–422, 422
e-Mosquito cell, 205–206, 206, 231–233
epilepsy, 33
Escherichia coli, 332
   - and biofuels, 328
   - flagellar motors in, 384, 384–385
   - life expectancy, 392–394
and ultraviolet (UV) exposure, 397–398
   - excitation frequency. See Larmor frequency
exons, 409
   - exponential amplifier, for potentiometric biosensors, 307–308
extracellular action potential (AP), 34, 35–36, 36, 65
   - amplitude, 42
   - analog-to-digital-conversion, 42–45
extracellular recordings
   - amplification, 48–59
   - filtering, 48–52
   - noise in, 36, 64
Eye-RIS Vision System, 282
false detection rate, of data-reduction algorithms, 16, 29
F1-ATPase, as molecular motor, 383, 383–385
FCD, functional capillarity density. See functional capillaries
FE modeling. See finite element modeling
FET. See field-effect transistor
FIA. See flow injection analysis
field-effect transistor (FET), as biosensor, 438
field inhomogeneity, in nuclear magnetic resonance, 461–462
field-programmable gate array (FPGA), testing system for wireless endoscopy capsule, 150–153, 151
figure of merit (FOM),
   - for analog-to-digital converters, 43–44, 44
   - for biosensors, 177
filters
   - architecture, in implanted circuits, 49–52, 50
   - design, optimization, 56–59
   - for extracellular recordings, 37, 38, 48–52
finite element modeling (FE), of sensor structure, 204–205, 205
flagellar filament binding, on various materials, 398–399, 399
flagellar motors, integration with microchannel devices, 386–389
flicker noise, in amplifiers, 52–54
flight initiation and cessation, control, 339, 341, 342
floating capacitor technique, for capacitive sensors, 224, 225
flow channel, miniaturization, 245–246
flow characterization, using polymeric devices, 294, 295
flow cytometry
detectors for, 246–247
for diagnosis of infectious diseases, 241
electrical and optical approaches for, 244–249
using impedance spectroscopy, 248
system for, 244, 246
flow injection analysis (FIA), for in situ measurement of cell cultures, 302
flow rate, in electrical flow cytometry, 248
fluid dynamics simulations, for microviscous pump, 385, 386
FNS. See functional neuromuscular stimulation
Fokker-Planck (FP) equation, 168, 173, 173, 183
FOM. See figure of merit
forward-scattered light, detection of in flow cytometry, 245
FP. See Fokker-Planck (FP) equation
FPGA. See field-programmable gate array functional capillaries, 286–288, 287
functional neuromuscular stimulation (FNS), 79, 79
gene chips, 436–440
CMOS technology in, 436–437
desired features, 438–439
incorporation of living cells in, 439
gene delivery
using bacteriophages, 415
using microneedles, 430
vectors, 413–414
using viruses, 414
gene expression
controlling with antisense oligonucleotides, 412
modulation, 408–411, 412
gene injection
and cell homeostasis, 443
using CMOS technologies, 415–416
comparison of techniques, 418, 418–419
electroporation method, 416, 416–417
mechanical methods, 417, 417–418, 426–427
and molecule size, 412–413
using transfection, 412–414
gene manipulation
in bio-CMOS hybrid platforms, 436–437
direct, 407
in living cells, 411
genetic control mechanisms, in mammalian systems, 409–410, 410
 genetic engineering, focus, 411
genetic vectors, packaging sequence limitations for, 414
genome sequencing, of organisms, 408
GFP. See green fluorescent protein
glass, use of in microchannels, 389–390, 392
globalization, of service organizations, 211–212
glucose, in inkjet chemical interface system, 336, 338
glucose sensor, 305–306
gold, in capacitive sensing electrodes, 218
green fluorescent protein (GFP), in genetic manipulation, 411–412
half-toning, in chemical interface printer system, 334, 335
hamsters, in microfluidics research, 272, 272
Hanning window, 104
health-care sensors, 112–115, 115
heartbeat
measurements, 112–115, 114
signal processing algorithms for, 102–112
Helmholtz layer, 37–38
hemacytometers, 241, 244, 262–263, 263
high-velocity projectiles, 431–432
Hilbert transform, in radio frequency receiver path, 465–467
HIV/AIDS, testing patients with, 250
human vital signs, remote monitoring, 93
hydrated agar, printing, 334–336
hydrodynamic loading, of tethered cells, 394–396, 395
IC. See integrated circuit
illumination devices, for wireless endoscopy capsule, 134
image compression algorithm, 143–149
architecture, 144, 145–149
clock controller for, 147–148
JPEG-LS engine for, 146–147, 147
mode decision module for, 147
parallel pipelines in, 148, 149
performance, 144–145, 145
preprocessor for, 145–146, 146
two-tier data packer for, 148–149
image data compression, 143, 143–149
image processing, 283–284
imaging noise, in radio frequency receiver path, 465–467
IMED. See implantable systems
impedance, of neural electrodes, 37
impedance-based cytometers, 247–249
impedance matching, of low-noise amplifier, 468–469, 469
impedance spectroscopy, in cell detection and counting platform, 249
implantable medical electronic devices. See implantable systems
implantable systems. See also health-care sensors
baseband communication processing in, 126
cardiac pacemaker, 76–77, 77
cochlear implant, 77–78, 78
deep brain stimulation, 79–80, 80
external and implant units, 120–121
functional neuromuscular stimulation, 79, 79
in human body, 76
low-noise performance, 40
model 121
powering, 40, 47, 121
retinal prosthesis, 78, 78
system-state machine for, 127
induction profiles, of printed lactose, 334–336, 335, 337
inductive coupling, for powering implanted circuits, 47
inductive links, for power supply and back telemetry in implanted circuits, 40, 47
information transfer, in molecular biology, 408–409, 409
infrared (IR) transmissions
in brain-machine interfaces, 46
in implanted circuits, 59
inkjet technology, as chemical interface system, 331–332, 333–336
input-referred noise, of low-noise amplifier, 473–475
insect flight, remote control, 330–331, 337
insulin diffusion pump, 205–206
integrated circuit (IC)
design kits and CAD software for, 193
manufacturing processes, 190–192, 191, 192
technological operations required for, 190
integration, of neuron networks with integrated circuits, 200
interfaces
for biosignal acquisition, 125
between biological and electronic worlds, 3–5, 4, 29, 199–201
between brain and electronic circuits, 34
with image sensors, 142
between implantable medical electronic device and living tissue, 121–122
low-power design, 125
for potentiometric biosensors, 306–308
interface systems
battery requirements, 5
simplified model, 8
introns, 409
ion-selective electrode (ISE), in stem cell culture monitoring systems, 304, 318
ion-selective field-effect transistor (ISFET), 201
as biosensors, 438
ions in neurons, 34–35
iontophoresis, using microneedles, 430
IR. See infrared
ISE. See ion-selective electrode
ISFET. See ion-selective field-effect transistor
lab-on-chip (LoC) capacitive sensors, compared to MEMS-based capacitive sensors, 222–223
lab-on-chip (LoC) devices, for microfluidics systems, 272–274
lac operon, 332, 333
lactose ink, in chemical interface system, 333, 334–335, 335, 336, 338
Lange coupler, in radio frequency circuit, 100, 102
Larmor frequency, in nuclear magnetic resonance, 459–460, 467, 467
LDO. See low-dropout regulator
lead-zirconate-titanate (PZT), incorporated in CMOS processes, 435–436
leakage currents, in multichannel measurement systems, 312
Lebouiz process, for fabricating microneedles, 429
lens-free cytometry, 249–264
lensless ultrawide field-of-view cell monitoring array platform based on shadow imaging (LUCAS), 249–264, 251
advantages, 250–251
and cell phones, 251–252
characterization algorithm, 255
demonstration, 252
images from, 259–260, 262
noise reduction in, 260
statistical image libraries for, 252–253
spatial coherence of illumination sources for, 261
in telemedicine applications, 250
LFP. See local field potential
life expectancy, of cells in a microchannel, 392–394
light sources, effect on LUCAS signatures, 253–256, 254
for optical flow cytometry, 244–245
spatial coherence, 261
LNA. See low-noise amplifier
LoC. See lab-on-chip
local field potential (LFP), 39
local oscillator, in radio frequency transmitter path, 465, 467–468
Lorentz force, and magnetofection, 432
low clock controller, state machine for, 141
low-dropout regulator (LDO), design of for wireless endoscopy capsule, 133–134, 134
low-noise amplifier comparison of types, 475–476
design, 473–475
with inductive source degeneration, 475, 475–476
noise spectra, 63
performance, 64
in radio frequency circuits, 98, 100, 468–479
schematic, 474, 480
transfer functions, 62
low-power amplifier, performance, 64
low-power systems, design strategies for, 138
LUCAS. See lensless ultrawide field-of-view cell monitoring array platform based on shadow imaging
M/NA V. See micro- and nano-air vehicle magnetofection
advantages and disadvantages, 432
for mechanical gene injection, 431–432
magnets, and miniaturization of nuclear magnetic resonance systems, 464–465
Manchester decoder, 83–84
Mann-Whitney U-test, and receiver-operator curves, 25–26, 27
manual injection, gene delivery method, 426
manufacturing infrastructures, for integrated circuits and microelectromechanical systems, 199
Markov chain model, 168, 170, 171, 172, 172, 182
Maxwell-Wagner polarization, 421
MCI. See miniature cell incubator
MEA. See microelectrode array
measurement interval, in stem cell culture monitoring systems, 306
mechanical gene injection, using magnetofection, 431–432
mechanical index, definition, 434
Mecynorrhina torquata as cyborg beetle, 337, 340, 241–245
elevation control 347, 347, 348, 348
tethered control, 341–345, 344, 349
turning control, 350
MEMS. See microelectromechanical system
mercaptopropyltrimethoxysilane (MPTMS), as receptor layer, 361
messenger RNA (mRNA), 409–410
Michigan probe, 37
micro- and nano-air vehicle (M/NA V), insects mimicking, 330–331
microbiological binding systems, and flagellar filament adhesion force, 396–397
mixers, 98–100, 101, 480, 481
mixing process, in microfluidics systems, 273
mobile health-care device, 95
as application of mobile technology, 93
design considerations, 96
mobile sidewall, in micropump, 381–382
molecular motors, 383, 383–385
Monte Carlo simulation, of binding process, 182–183, 183
morphogens, 328, 329
motility buffer, and cell life expectancy, 393
MPTMS. See mercaptopropyltrimethoxysilane
mRNA. See messenger RNA
MS. See multiple sclerosis
multianalyte sensor, and multichannel measurement, 313
multicellular organisms, communication in, 328, 329
multicellular systems, spatiotemporal control, 331
multiple sclerosis (MS), 33
multiple-phase flow, in microfluidics systems, 273
multiproject chip and wafer techniques, 190
multi user MEMS processes (MUMPS), in biomedical applications, 196, 204–206
MUMPS. See multi user MEMS processes
µTAS. See micrototal analysis system
myosin, as molecular motor, 383–385
nanelectromechanical system (NEMS), and microfluidics, 379–380
nanowire sensor
advantages, 362
fabrication, 360, 360–361
operation, 358–360, 359
performance, 362
for single-cell analysis, 358–362
testing, 361–362
Navier-Stokes equation, in micropump, 381–382
necrosis, definition, 440
NEF. See noise efficiency factor
NEMS. See nanelectromechanical system
Nernst’s equation, 304
neural amplifier, 62, 63, 64
neural electrodes, for single-cell extracellular recordings, 35–38
neural recording system, 38, 39
characterization, 61–65
implementation, 59–61, 60, 62
integration, 59–61
power budget for, 39
neural signals, 34–35
neuromimetic application-specific integrated circuit, 202
neurons, 34–35
NF. See noise figure
NMR. See nuclear magnetic resonance
noise in extracellular recordings, 36, 37, 38
in LUCAS images, 259–260
noise efficiency factor (NEF), 40–42, 41, 55–56
noise figure (NF)
calculation, 181–182
figure of merit for biosensors, 177–178
of low-noise amplifier, 468–472
noise matching, in low-noise amplifiers, 468–473, 476–479
noise performance, of CMOS amplifiers, 40–42, 41
noise-power trade-offs, in amplifiers, 53
noise spectra, of low-noise amplifier, 63
noninvasive stimulus-response experiments, for single-cell analysis, 357
nonlinear distortion, in amplifiers, 56
nonspecific binding between biomolecules and non-target species, 166–167
interference in biosignals, 175–176
nuclear magnetic resonance
use of in biosensors, 457–458
review, 459, 459–461
system for, 458, 463, 463–465
transceiver for, 481–482
OCR. See oxygen consumption rate
online signal processing, and device miniaturization, 5–6
optical flow cytometry
  light sources for, 244–245
  on-chip systems for, 245–247, 249
organic solvents, detection, 219, 221–221
oscillator, for wireless endoscopy capsule, 136, 136–137
oxygen
  detection of in single-cell analysis, 363–364
  measurement of using miniature cell incubator, 365
  sensors for, 366–368
oxygen consumption rate (OCR), 363–364, 369–371, 370, 373–375, 375
PA. See power amplifier
packaging, of integrated circuits, 193
Parkinson’s disease, 33–34
particle imaging velocimetry (PIV)
  algorithms, 276
passivation layers
  as barrier to corrosion, 442
  in bio-CMOS hybrid platforms, 438
  in capacitive sensing electrodes, 217, 217
passive network, between coil and low-noise amplifier, 469–472, 471
PDMS. See polydimethylsiloxane
penetration force, for cells and tissue, 430–431, 431
PGA. See programmable gain amplifier
pH level, and rotation rate of tethered cells, 397
pH measurements, in single cells, 361
pH sensor, 304–305, 307
photomultiplier tube (PMT), in optical flow cytometry, 244, 245, 246–247
PIN photodiode, in optical flow cytometry, 246–247
PIV. See particle imaging velocimetry
PL. See polyelectrolyte layer
plant cell, transfection of using microcavitation, 434
plasmid, definition, 413
platinum porphyrin molecules, in oxygen sensors, 366
PMMA. See polymethyl-methacrylate
PMT. See photomultiplier tube
Poisson noise, in biosensor platforms, 177, 178
polarization, of signals in health care sensors, 94–95, 95, 96, 97
polydimethylsiloxane (PDMS)
  use of in microchannels, 389, 390–391
  for microsieve, 400–401
polyelectrolyte layer (PL), creating on CMOS substrate, 219, 221
polymethyl-methacrylate (PMMA), in nanowire sensor, 360
polysilicon microelectrodes, in electroporation, 442–443
pore formation and stability, for electroporation, 422–423
potentiometric sensors
  flexible gain stages for, 311
  interfacing to, 306–308
  for monitoring stem cell culture parameters, 304–305
  multiplexors in, 311–312
power amplifier (PA)
  in microstimulator system, 80
  in radio frequency transceiver, 468, 476–478
power consumption
  performance trade-offs, 128
  of wireless endoscopy capsule, 152
power management, in implantable medical electronic systems, 128–129
power matching, in low-noise amplifiers, 468, 476–479, 477
power modules, in implantable medical electronic systems, 123–124
power source
  for implantable medical electronics systems, 132–133, 133
  for implanted circuits, 47
  for neural recording systems, 40
power spectral density (PSD) algorithm, in health care sensor, 108–112, 109, 111
power supply rejection ratio (PSRR), in amplifiers, 55
preamplifier, in implanted circuits, 49–52, 51
printing system, for regulating cellular development, 331–332, 332
programmability, of microelectrode arrays, 447
programmable gain amplifier (PGA)
in biosensors, 309, 311
in recording microsystem, 86
in stem cell culture monitoring systems, 310–311
protein expression, 409
proteins, in high-specificity biosensors, 222
proton nuclear magnetic resonance, 462–463, 463
PSD. See power spectral density
pseudoresistors
in amplifiers, 65, 67
in implanted circuits, 56–59
PSRR, See power supply rejection ratio
PZT, See lead-zirconate-titanate material
radio frequency (RF) circuit, components, 97–101
radio frequency (RF) technology architecture, 96, 466
in health-care devices, 94–101, 96
random seeding process
of microwells, 368, 369
oxygen consumption measurements from, 369–371
random walk model, 168, 170
RBC. See red blood cell
Re. See Reynolds number
reactive ion etch (RIE), in nanowire sensor, 360
real-time signal processing, for stem cell culture measurement control, 315–316
received radar signal, from human subject, 104, 106, 107
receiver-operator curve (ROC), 17, 17, 20
and Mann-Whitney U-test, 25–26
receptor layers, 361
recording interface, between IMED and living tissue, 121
recording microsystem
amplitude shift keying modulator in, 87–89, 89
antialiasing filter in, 86–87
components, 86, 87–88, 88
rectifier, in radio frequency powering circuits, 80, 80–82, 81
red blood cell (RBC)
deformation, 271
density, 289–291
monitoring velocity, 277–278, 288–291
in optical flow cytometry, 245
relays, for switching amperometric sensors, 312
remote control, of beetles, 341–345
resistance, in amplifiers, 67, 67–68
resistance temperature detector (RTD), in stem cell culture monitoring systems, 314, 314–315
resonance noise matching, with infinite-impedance low-noise amplifier, 468–473
respiration measurements, 112–115, 114
signal processing algorithms for, 102–112
retinal prosthesis, 78, 78
Reynolds number (Re), in microfluidics systems, 273
RF. See radio frequency
RIE. See reactive ion etch
RNA, in biological information flow, 408, 409
ROC. See receiver-operator curve
rotation rate, of tethered cells, 393, 393–394, 394
RTD. See resistance temperature detector
Salmonella typhimurium, flagellar motors in, 384
SAM. See self-assembly monolayer
scaling, of biosensors, 182, 183–184, 184
selective binding, between biomolecules and target analytes, 165–167
selectivity, of data reduction algorithms, 16, 17
self-assembly monolayer (SAM) technique, 222
Sensicards, for UV protection, 208–209
sensitivity, of data reduction algorithms, 16
shearing force, in microchannel flow, 396
shot noise, in biosensor platforms, 177
side-scattered (SSC) light, detection of in flow cytometry, 245
signal processing algorithms
  characterization, 6
  comparison, 110–112, *II
  for human vital signs, 102–112
  objectives, 7–10
  testing, 10–13
  trade-offs in, 9
signal processing block, in health-care
  sensor, 101–102, *I, 105, 106
signal-to-interference-and-noise ratio
  (SINR), calculation, 181
signal-to-noise ratio (SNR)
  analysis and calculation, 178–182
  in biosensor platforms, 176–178
effect of scaling on, 182, 184–185, *I
  in LUCAS images, 253, 259–260
  in stem cell culture monitoring systems,
  310–311
silicon/neuron junction, 200
single-cell analysis
  data acquisition for, 358
  detection of complementary DNA in,
  361–362
  detection of streptavidin in, 362
  lab-on-chip for, 357
  oxygen consumption measurement, 363,
  369–371, *II
  pH measurements in, 361
single-cell analysis systems, materials for,
  372
single cell behavior, 355–356
single-cell trapping process
  oxygen consumption measurements
  from, 373–374
  for seeding microwell arrays, 371,
  371–372, *II
SINR. See signal-to-interference-and-noise
  ratio
SNR. See signal-to-noise ratio
SoC. See system-on-chip
spatial concentration profile, of ammonia,
  321, 320–321
spatiotemporal information
  acquisition, 320–321
  for regulating cellular development,
  331
specific binding, between biomolecules
  and target analytes, 165–167
specificity, of data reduction algorithms,
  16, 17
spike amplitude, as function of distance
  from cell, 35–36
SINR. See signal-to-interference-and-noise
  ratio
SSC. See side-scattered
statistical distribution, of responses from
  single cells, 356
stem cell culture
  bioprocess measurements, 301
  measurement system for, 318–319, *II
  media discharging, 310
  monitoring system for, 303, 303–304,
  311–317
  physiochemical parameters, 302
stem cells
  physiological activity, 301
  properties, 302
streptavidin, detection, 362
SU-8 photoresist
  in microwell arrays, 371, *II
  toxicity, 372–373, *III
successive approximation, 43, 44, 88
switch capacitor technique, for capacitive
  sensors, 223
switching, in radio frequency transceiver,
  479–481
synthetic biology, 327
synthetic multicellular machines, 329, *III
system architecture, of neural recording
  systems, 39–40
system errors, in stem cell culture
  monitoring systems, 315
system-on-chip (SoC), in biomedical
  applications, 75
technology access, 189–192
telemedicine, 239–240
temperature compensation, in stem
  cell culture monitoring systems,
  314–315
tethered cells
  hydrodynamic loading, 394–396, 395
  life expectancy, 392–394
  and pH level, 397
  rotation, 393, 395, 396
  and ultraviolet (UV) exposure, 397–398,
  398
tethered objects, for mechanical gene
  injection, 426
tetherless control, of beetles, 339, 340
throughput requirements, of analog-to-
digital converters, 43, 44–45
time constant technique, for capacitive
sensors, 224, 224
time/event-weighted average, method
of calculating average sensitivity
between data records, 18–22, 19, 21
time-weighted average, method of
calculating average sensitivity
between data records, 18–22, 19, 21
total sensitivity average, method of
calculating average sensitivity
between data records, 18–22, 19, 21
transduction mechanism, in biosensor
platforms, 174–175
transfection,
definition, 411
efficiency of for microscale
 electroporation, 420
 microcavitation method, 433–436
transfer functions, of low-noise amplifier,
62
transmembrane potential, of mammalian
cells, 421
transmitters, in brain-machine interfaces,
45–47, 46
turning control, of cyborg beetles, 349
ultraviolet (UV) exposure, and rotation of
tethered cells, 397–398, 398
ultrawide band (UWB) transmissions
in brain-machine interfaces, 45–46
in implanted circuits, 59
Utah array, 37
UV. See ultraviolet (UV) exposure
U-values, 26–27, 27
UWB. See ultrawide band
variable gain amplifier, schematic, 480
VCO. See voltage-controlled oscillator
verification system, for wireless endoscopy
capsule, 150–153
VGA. See variable gain amplifier
viruses, for gene delivery, 414
viscous pump, 381–383
using E. coli cells, 387
schematic, 382
Visio probe, for skin-care technology,
208
voltage-controlled oscillator, in radio
frequency circuit, 98, 99
voltage-differential method, for
implementing charge-based
capacitance measurement structures,
229
Wiener process, 171
wing oscillations, modulation, 339–345
wireless
health, use of cell phones in,
239–240
imaging system for wireless endoscopy,
206–207
pressure sensor, 206, 207
culture measurement control,
316, 317
sensor network (WSN) for stem cell
culture measurement control,
316, 317
transceivers in implantable medical
electronic systems, 123
transmission power in implantable
medical electronic systems, 124
wireless endoscopy
capsules, 130, 129–131, 131, 154,
207
comparison of systems, 153–155, 155
WSN. See wireless, sensor network
X-Gal pattern, 334–335, 335, 336, 337
YAC. See yeast artificial chromosome
genetic vectors, 413–414, 414