

Index

A

- Action Potential-clamp (AP-clamp) technique, 44
 - advantage of, 34
 - ^{self}AP-clamp technique, 32–34, 37
 - cardiac myocytes, Ca²⁺ dynamics in, 35
 - channel inhibitors, 42–43
 - digitized AP, 35
 - drug effects, 40
 - Dynamic Clamp technique, 35, 36
 - epicardial vs. endocardial cells, 39
 - mapping, 39
 - modified/reconstructed AP, 36
 - pathological conditions, complex effects of, 39–40
 - prerecorded AP, 34
 - sequential dissection/Onion-Peeling method (see Onion-Peeling method)
 - specific blocker and current subtraction method, 35
 - technical requirements
 - cell quality and pipette solutions, 40–41
 - instrumentation, 42
 - patch pipette and whole-cell seal configuration, 41–42
 - transmural differences, 39
 - two-electrode technique, 34–35
 - typical/standardized AP, 35–36
 - vs. voltage-clamp experiments, 34
- Action potential duration (APD), 90–92, 105
- Agard, D.A., 67, 71
- Anomalous scattering, 66, 68–70
- AP-clamp technique See Action Potential-clamp (AP-clamp) technique

B

- Bányász, T., 31–45
- Barstow, T.J., 112
- Bastian, J., 34
- Bendahan, D., 109–115
- Bifurcation diagram, 90
- Brooks, G.A., 115

C

- Cardiac Arrhythmia Suppression (CAST) Trial, 82
- Cardiac cells and tissue
 - action potential and transmembrane currents, 82–83

- APD restitution and alternans, 90–92
- cell membrane and channel gating, 83–85
- gap junctions, 92
- parallel computing
 - CUDA, 97–105
 - OpenMP, 96–97
- reaction–diffusion equation, 92
- single cell simulation
 - Echebarria and Karma model, 87, 88
 - fast Na current, 86
 - generic K current, 87
 - L-type Ca current, 86
 - membrane potential and gating variables, 85, 86, 90
 - ODE, Euler method, 87–90
 - tissue model parameters, 87, 88
- tissue simulation
 - one-dimensional (1D) cable, 92–93
 - SDA, 94
 - two-dimensional tissue, 94–95
 - ventricular tachycardia and fibrillation, 95, 96
- Chan, J., 1–29
- Channel inhibitors, 42–43
- Chatel, B., 109–115
- Chen, C.-Y., 49–63
- Chen-Izu, Y., 1–29, 31–45
- Chung, Y., 115
- Computer simulations and nonlinear dynamics
 - APD restitution and alternans, 90–92
 - cardiac action potential, 82–83
 - cardiac tissue, 92
 - cell membrane and channel gating, 83–85
 - parallel computing
 - CUDA, 97–105
 - OpenMP, 96–97
 - single cell simulation
 - Echebarria and Karma model, 87, 88
 - fast Na current, 86
 - generic K current, 87
 - L-type Ca current, 86
 - membrane potential and gating variables, 85, 86, 90
 - ODE, Euler method, 87–90
 - tissue model parameters, 87, 88

- Computer simulations and nonlinear dynamics (*cont.*)
 tissue simulation
 one-dimensional (1D) cable, 92–93
 SDA, 94
 two-dimensional tissue, 94–95
 ventricular tachycardia and fibrillation, 95, 96
- Compute Unified Device Architecture (CUDA)
 action potential, 100
 cardiac tissue code, 101
 cudaMalloc() function, 99
 deallocate memory, 101, 104–105
 GPU code, flowchart of, 98
 hardware diagram, 98, 99
 kernel code, 101, 103
 malloc() function, 98–99
 NVIDIA, 98
 ODE part, 103–104
 PDE part, 103, 104
 recoding data, 102
 stimulation arrays, 103
 Streaming Multiprocessors, 101
- Current clamp, 50, 56–57
 spiking response, 58
 whole-cell resistance and capacitance, 57–58
- Current subtraction method, 35
- D**
- Dahlen, R.W., 90
 Davis, M.L., 112
 Diastolic interval (DI), 90–91
 Dielectric noise, 55–56
 Doniach, S., 66
 Double Fourier transform
 electric field, diffraction pattern, 16–18
 letters ‘ABC’, diffraction pattern of, 20–21
 mirror image of object, 17–19
 Ronchi ruling and image, diffraction pattern of, 20
 silk cloth, diffraction pattern and image of, 21
 slide and eyepiece, distance between, 19, 20
- Double sucrose gap method, 34
 Dynamic Clamp technique, 35, 36
- E**
- Echebarria, B., 85
 Echebarria–Karma model
 initial conditions of, 88
 parameters of, 87
- Electrocardiogram (ECG), 90
 Euler method, 87–90, 93
- F**
- Fairclough, R.H., 65–78
 Fast-step perfusion system, 50
 Fourier transform (FT), 13, 15, 20, 67
 Fresnel, A.-J., 4, 5, 14
- G**
- Gouaux, E., 78
 Graphics processing unit (GPU), 97–101
- Gravity-fed perfusion system, 50
- H**
- Hamouda, A., 78
 Hegyi, B., 31–45
 Hemoglobin (Hb) and myoglobin (Mb)
 Millikan’s approach, 110
 NIRS signal
 blood free isolated heart, 113
 blood volume, 111
 combined ¹H-NMR and ³¹P-NMR, 113–114
 computer simulation, relative contribution, 113
 dissociation constants, 110
 HbO₂, MbO₂, DHb, and DMB, 110–111
 ¹H-NMR spectroscopy, 113
 during muscle contraction, 112
 predominant source, 111–112
 in resting muscles, 112
 second derivative approach, 112
 skeletal muscle, 111
 wavelength shift analysis, 112
- Hodgkin, A.L., 82
 Hooke, R., 2
 Huxley, A.F., 82
 Huygens, 4, 5
 Huygens–Fresnel principle, 4–5
 aperture and working distance, 9
 diffraction pattern, 5–8
 front aperture diameter, prediction of, 10–13
 maxima and central maximum, distance between, 8–9
 numerical aperture, 9, 10
- I**
- Image formation, wave theory, 25–29
 arbitrary distribution of scatterers
 electric field, 13–14
 Fourier transform, diffraction pattern, 13, 15
 rainbow glasses, diffraction pattern of, 15–17, 25
 two-point scatterers, 14
- demonstration apparatus
 alignment tip, 4
 diffraction grating and holder, 4
 laser and holder, 3
 objective/eyepiece and holder, 4
- double Fourier transform
 electric field, diffraction pattern, 16–18
 letters ‘ABC’, diffraction pattern of, 20–21
 mirror image of object, 17–19
 Ronchi ruling and image, diffraction
 pattern of, 20
 silk cloth, diffraction pattern and image of, 21
 slide and eyepiece, distance between, 19, 20
- Huygens–Fresnel principle, 4–5
 aperture and working distance, 9
 diffraction pattern, 5–8
 front aperture diameter, prediction of, 10–13
 maxima and central maximum, distance
 between, 8–9
 numerical aperture, 9, 10

- numerical aperture, working distance, and resolution, 2
sharpness of image and resolution
 light wavelength, 21–23
 numerical aperture, frequency response, 22
 object size, 22–24
 working distance, 22, 23
- Individual cell electrophysiology (ICE), 37–39
- Ionic currents
 AP-clamp technique, 44
 advantage of, 34
 ^{self}AP-clamp technique, 32–34, 37
 cardiac myocytes, Ca²⁺ dynamics in, 35
 cell quality and pipette solutions, 40–41
 channel inhibitors, 42–43
 digitized AP, 35
 drug effects, 40
 Dynamic Clamp technique, 35, 36
 epicardial vs. endocardial cells, 39
 experimental protocol, 32–34
 instrumentation, 42
 mapping, 39
 modified/reconstructed AP, 36
 patch pipette and whole-cell seal configuration, 41–42
 pathological conditions, complex effects of, 39–40
 prerecorded AP, 34
 sequential dissection/Onion-Peeling method (*see* Onion-Peeling method)
 specific blocker and current subtraction method, 35
 transmural differences, 39
 two-electrode technique, 34–35
 typical/standardized AP, 35–36
 voltage-clamp technique, 32
- Izu, L.T., 1–29, 31–45
- J**
Jöbsis, F.F., 110
Johnson noise, 56
Jue, T., 109–115
- K**
Karma, A., 85
Klymkowsky, M.W., 71
- L**
Lee, T.E., 65–78
- M**
Magnetic resonance spectroscopy (MRS), 113
Mancini, D.M., 113
Maximal voluntary contraction (MVC), 114
Membrane diffraction, 77–78
 anomalous scattering, 66, 68–70
 Fourier transform, 67
 results of, 67, 68
 small-angle X-ray scattering, AChR-enriched membranes
 anomalous difference amplitudes, 71
 constrained iterative refinement, 71–72
 intensity and amplitude, 67, 70
 membrane system, 65, 70
 meridional data, 70
 resonant scattering, 70
 Tb³⁺ distribution solutions, 72–77
 Unwin 4 Å resolution model, 66, 72, 73
- Microscopy
 image formation, wave theory, 25–29
 arbitrary distribution of scatterers, 13–17
 double Fourier transform, 16–21
 Huygens–Fresnel principle, 4–13
 optics demonstration apparatus, 3–4
 sharpness of image and resolution, 21–24
 kinds of, 2
 van Leeuwenhoek's microscope, 2
- Millikan, G.A., 110
Mines, G.R., 96
- N**
Nakajima, S., 34
Near-infrared spectroscopy (NIRS), Mb and Hb signals
 blood free isolated heart, 113
 blood volume, 111
 combined ¹H-NMR and ³¹P-NMR, 113–114
 computer simulation, relative contribution, 113
 dissociation constants, 110
 HbO₂, MbO₂, DHb, and DMB, 110–111
 ¹H-NMR spectroscopy, 113
 during muscle contraction, 112
 as predominant source, 111–112
 in resting muscles, 112
 second derivative analysis, 112
 skeletal muscle, 111
 wavelength shift analysis, 112
- Neher, E., 50, 51, 61
Nioka, S., 113
Nolasco, J.B., 90
Nuclear magnetic resonance (NMR), 113–114
Numerical aperture (NA), 2, 9, 10, 22
Nyquist noise, 56
- O**
Onion-Peeling method
 cell quality and pipette solutions, 41
 channel inhibitors, Ca²⁺-sensitive currents, 43
 individual cell electrophysiology, 35, 37–39
 multiple ionic currents, recording of, 37, 38
 pathological conditions, complex effects of, 39–40
- OpenMP, 96–97
Operator splitting method, 92–93
Ordinary differential equations (ODEs), 87–90
- P**
Pacing cycle length (PCL), 85, 88, 90, 91
Patch clamp technique
 basic recording setup, 50

- Patch clamp technique (*cont.*)
 current clamp, 50, 56–57
 spiking response, 58
 whole-cell resistance and capacitance, 57–58
 in electrophysiology/neuroscience fields, 50
 noise
 extraneous electrical interference, 55
 intrinsic instrument noise, 55–56
 patch clamp configurations, 51–52
 seal resistance, 52–54, 62
 series resistance, 54–55, 62–63
 voltage clamp, 50
 glutamate receptors characteristics, 60–61
 postsynaptic current response, 59
 presynaptic release probability, 59
 single-channel recordings, 58–59
 voltage control, 61
 voltage-gated channel characteristics, 59–60
- Patch pipette, 41–42
 Perfusion system, 50
 Plano-convex glass, 2
- R**
 Richardson, R.S., 112
 Ross, M.J., 66, 71
- S**
 Sakmann, B., 50, 51, 61
 Sato, D., 81–106
 Seiyama, A., 111
 Series resistance, 54–55
 Small-angle X-ray scattering, AChR membranes
 anomalous difference amplitudes, 71
 intensity and amplitude, 67, 70
 membrane system, 65, 70
 Tb³⁺ distribution
 average, 73, 74
 in closed resting state, 73, 75, 76
 constrained iterative refinement, 71–72
 refined peak characteristics, 73, 77
 R-factor, 72, 73
 transmembrane domain, 73
 Unwin 4 Å resolution model, 66, 72, 73
 Spatially concordant alternans (SCA), 94
 Spatially discordant alternans (SDA), 94, 96
 Stroud, R.M., 66, 67, 71
 Survival With Oral d-Sotalol (SWORD) Trial, 82
- T**
 Thermal noise, 56
 Traube, L., 90
 Trautwein, W., 35
 Twain, M., 24
 Two-electrode technique, 34–35
- U**
 Unwin, N., 66, 72
- V**
 van Beek-Harmsen, B.J., 112
 van Leeuwenhoek, A., 2
 Ventricular fibrillation (VF), 95, 96
 Ventricular tachycardia (VT), 95, 96
 Voltage clamp, 50
 glutamate receptors characteristics, 60–61
 postsynaptic current response, 59
 presynaptic release probability, 59
 single-channel recordings, 58–59
 voltage control, 61
 voltage-gated channel characteristics, 59–60
 Voltage-clamp technique, 32, 34
 Voltage error, 54–55, 62–63
- W**
 Wave theory, image formation *See* Image formation,
 wave theory
 Weiss, J.N., 36
 Wilson, J.R., 111
- Z**
 Zero current, 34