

Index

- absolute threshold, 318
- acceleration, 186
- accelerometer, 38, 216
- accommodation, 98–99, 105, 132, 305
- acoustic shadow, 284
- acoustic wayfinding, 283
- active feature, 228
- adaptation, 51, 126, 293, 294, 298, 302, 305
- adaptive psychophysical methods, 319
- additive mixtures, 148
- air sickness, 303
- aliasing, 122, 143, 165, 177, 300, 307
- Allegory of the Cave, 3
- alternative hypothesis, 314
- amacrine cells, 114
- ambient shading, 159
- amygdala, 327, 329
- analysis of variance, 317
- Angry Birds, 24, 26
- angular acceleration, 189
- angular velocity, 37, 188
- animation, 22
- anime, 22
- ANOVA design, 317
- anterior canal, 190
- anthropomorphic, 330
- aperture, 103
- aperture problem, 139, 140
- apparent motion, 304
- applied statistics, 313
- aqueous humor, 108
- AR/VR, 5
- aspect graph, 177
- aspect ratio, 62
- aspheric lens, 94
- Assassin’s Creed, 24, 26
- astigmatism, 94, 99
- atmospheric cue, 133, 134
- attenuation, 272
- auditory illusions, 280
- auditory parallax, 284
- augmented reality, 5, 17–19
- avatar, 30, 263
- average treatment effect, 315
- axis-aligned bounding box, 202
- axons, 48
- azimuth, 282
- backface culling, 167
- backlight, 105
- backward vection, 207
- backwards brain bicycle, 246
- ball and shadow illusion, 134
- Ball, John, 21
- bandwidth, 262
- barrel distortion, 94, 169
- barycentric coordinates, 163, 329
- basilar membrane, 277
- basin of attraction, 260
- Bayes’ rule, 150, 152
- BCI, 335
- beam tracing, 174
- behavioral science, 312
- Bessel’s correction, 314
- beta movement, 140, 142
- Bhimbetka rock shelters, 21
- bidirectional reflectance distribution function, 159, 160
- bidirectional scattering distribution function, 289
- binaural cue, 283
- binocular disparity, 134
- bipolar cells, 113
- Birdly, 2, 19, 324
- bistable perception, 153
- bitter taste, 329
- blind spot, 110, 112
- Blinn–Phong shading, 158–159

INDEX

- blob detection, 231
- blocking (experimental design), 317
- BMI, 335
- body frame, 236
- body schema, 338
- body senses, 320
- body transfer illusion, 324
- boundary conditions, 290
- bounding box, 162
- brain in a vat, 4, 339
- brain-machine interfaces, 335–339
- BRDF, 159, 160
- Breakout, 248
- BSDF, 289
- buffering (video), 174
- bump mapping, 164
- bundle adjustment, 230
- CAD, 269
- calibration error, 212
- camera frame, 230
- camera obscura, 100
- cameras, 100–103, 230–232
 - global shutter, 102
 - rolling shutter, 102
- canonical head motions, 296
- canonical view transform, 77–78
- canonical view volume, 169
- car sickness, 303
- cartoons, 22
- cathode ray tube, 103
- causal filter, 286
- CAVE, 26, 28
- CCD, 101
- centripetal acceleration, 189
- cerebellum, 246
- cerebral cortex, 47
- Charge-Coupled Device, 101
- Chebyshev–Grübler–Kutzbach criterion, 237
- checker shadow illusion, 47, 149
- chemical senses, 47, 327
- chemoreceptors, 47, 327
- chromatic aberration, 92, 171
- chromatic adaptation, 148
- CIE color standard, 148
- cilia, 191
- ciliary muscles, 108
- cinema, 9–11
- Cinerama, 27
- circular vection, 208
- closed-loop, 5, 247
- Clouds Over Sidra*, 14
- CMOS active-pixel image sensor, 101
- cochlea, 190, 277
- cochlear, 339
- cognitive bias, 153
- coherent light, 85
- coherent model, 58, 201
- Cohl, Emile, 24
- collision detection, 44, 200–204
- color constancy, 148
- color space, 146
- coma (optics), 94
- complementary filter, 215
- computational geometry, 157
- computer-aided design, 269
- cone of confusion, 284
- cones, 108
- configuration space, 32
- confounding variable, 318
- control group, 314
- control systems, 199, 247
- control variable, 317
- convergence, 119
- convex hull, 202
- Coriolis forces, 216
- cornea, 97, 107
- corneal reflection, 235
- critical band masking, 281
- CRT, 103
- cue, 129
- cupula, 192
- cybersickness, 304
- cycles per degree, 123
- cyclopean viewpoint, 77, 223, 297
- cylindrical joint, 236
- dB, 272
- decibels, 272
- declination angle, 221
- degrees of freedom, 32, 64, 195
- Denavit–Hartenberg parameters, 237
- dendrites, 48
- dependent variable, 313
- depth buffer, 161
- depth cameras, 39
- depth cues, 129–135
 - monocular, 129–133, 137–138
 - stereo, 134–135
- depth cycles, 161, 162
- dermis, 321
- deurbanization, 12
- diffraction, 274
- diffuse reflection, 84, 157
- digital cameras, 100
- digital heritage, 16
- digital light processing, 168
- digital lollipop, 329

INDEX

- diplopia, 134
- Dirichlet boundary conditions, 290
- display, 33
 - aural, 34, 285
 - general concept, 33
 - light-field, 105
 - pass-through, 19
 - resolution, 122–204
 - retina, 123
 - see-through, 19
 - varifocal, 105
- distinguishability, 227
- distortion correction, 168–171
- distortion shading, 170
- divergence, 120
- DLP, 168
- Donkey Kong, 24
- Doom, 24, 26
- Doppler effect, 273, 284
- double buffering, 176
- doubly connected edge list, 57
- dress color illusion, 145
- drift correction, 215–216, 219–222
- drift error, 38, 213
- duplex theory, 323
- dynamic world, 173
- dynamical system, 197

- ear canal, 277
- eardrum, 277
- ECG, 309
- echo threshold, 280
- echolocation, 283
- ecological validity, 312
- education, 13–16, 268
- EEG, 337
- efferece copies, 49, 133, 247
- EGG, 309
- Einstein equivalence principle, 191, 193, 220
- electrocardiogram, 309
- electroencephalogram, 337
- electrogastrogram, 309
- electrooculogram, 310
- electrooculography, 235
- elevation, 282
- EM algorithm, 243
- emitter-detector pair, 225, 310
- empathy, 12
- end-bulbs of Krause, 322
- end-effector, 330
- EOG, 235, 310
- epidermis, 321
- estimation-maximization algorithm, 243
- etiology, 307

- evil demon, 4
- experimental design, 53, 311–319
- exponential smoothing, 287
- exponentially weighted moving average, 287
- extended reality, 5
- eye, 96–100, 107–111
 - lens, 97, 108
 - movements, 116–121, 127–128
- eye box, 105
- eye chart, 124
- eye tracking, 211
- eye-closing trick, 296
- eyestrain, 305

- f-stop, 103
- Fantasmagorie, 24
- far-field approximation, 292
- farsightedness, 99, 169
- Fast Fourier Transform, 287
- features, 227
- feedback, 247
- FFT, 287
- field of view, 41, 99, 125, 126, 137, 167, 168, 180, 181, 204, 205, 208, 254, 258, 302, 334
- filter, 286
- filtering, 213
- filters, 285
- finite impulse, 287
- finite impulse response, 287, 288
- FIR, 287
- FIR filter, 287
- first-person shooter, 6, 9, 24, 51, 204
- first-person view, 330
- fish-eyed lens, 94, 181
- Fitts' law, 249
- Fitts's law, 261
- fixation, 119
- flat-panel displays, 104
- flavor, 329
- flicker, 142, 299
- flicker fusion threshold, 143
- flight simulation, 13
- fMRI, 336
- fNIRS, 339
- focal depth, 90
- focal length, 90
- focal plane, 90
- focal point, 90
- focal ratio, 103
- forced fusion, 308
- forcing function, 290
- forward vection, 207
- four-bar mechanism, 239
- Fourier analysis, 274, 275, 285, 287–288

INDEX

- Fourier transform, 275, 287
- fovea, 108, 110
- foveated rendering, 125
- FPV, 330
- frame rate, 143, 178, 204
- Franssen effect, 280
- free nerve ending, 321, 327
- frequency domain, 287
- Fresnel lens, 168
- function space, 145
- functional magnetic resonance imaging, 336
- functional near-infrared spectroscopy, 339
- fundamental frequency, 275
- galvanic skin response, 310, 335
- galvanic vestibular stimulation, 190
- game engines, 194
- gamma correction, 149
- ganglion cell layer, 112
- ganglion cells, 112, 339
- Gaussian distribution, 314
- gender swap, 15
- geometric models, 55–59
 - data structures, 56–58
- gimbal lock, 69
- glabrous skin, 322
- global scanout, 126, 176
- global shutter, 102, 126, 231
- goggles and gloves, 27, 261
- Golgi tendon organ, 322
- gorilla arms, 8, 258, 259, 301
- GPS, 226
- gravity, 220, 224
- Gravity* (movie), 23
- grid cells, 3
- GSR, 310
- guillotine simulator, 20
- gustation, 326
- gustatory cortex, 329
- gustatory interfaces, 329
- gyroscope, 37, 212
- hair cells, 191
- hair follicle receptor, 322
- half-edge data structure, 57
- Hamilton, William Rowan, 70
- hand-eye coordination, 247
- handheld receiver, 262
- haptic exploration, 323
- haptic suit, 325
- hard iron, 222
- Hartman, Gilbert, 4
- haunted swing illusion, 50, 204
- Hausdorff distance, 201
- head model, 223, 224, 292
- head tracking, 211
- head-mounted display, 28
- head-related transfer function, 291
- health and safety, 7–8
- Heilig, Morton, 27
- Helmholtz wave equation, 290
- Henning’s tetrahedron, 329
- hierarchical processing, 48
- higher-order harmonics, 275
- homogeneous transformation matrix, 66–68
- horizontal cells, 113
- horopter, 134, 135
- Horse in Motion, 22
- HRTF, 291
- HSV, 146
- hue (HSV), 146
- human factors, 293
- human–computer interaction, 293, 311
- human–robot interaction, 334
- humanoid robots, 330, 331
- hyperopia, 99
- ILD, 283
- image blur, 133, 134
- image stabilization, 119
- image stitching, 180
- image-order rendering, 156
- impedance, 277
- impressionist, 21
- inbetweening, 179
- inclination angle, 221
- incremental distance computation, 201
- independent variable, 313
- inertial measurement unit, 37, 38, 212
- information spaces, 244
- infrared, 85
- inner nuclear layer, 112
- institutional review board, 313
- interaction, 5, 245–270
- interaction mechanisms, 245
- interaural level difference, 283
- interaural time difference, 284
- interlacing, 143
- interposition, 133, 134
- interpupillary distance, 100, 301
- intrinsic parameters, 231
- inverse Fourier transform, 287
- inverse kinematics problem, 237
- inverse problem, 229, 306, 313
- inverted pendulum, 332
- IPD, 100, 292
- IRB, 313
- iris, 108
- irradiance, 160

INDEX

- ITD, 284
- iterative optimization, 237
- jaggies, 122
- jerk, 187
- JND, 280
- joint, 196, 236
- joint receptor, 322
- judder, 144
- just noticeable difference, 53, 280, 318
- Kalman filter, 234
- Kant, Immanuel, 4
- kinematic singularities, 68–70, 237
- kinematics, 235–237
 - inverse, 237
- kinesthesia, 321
- kinocilium, 191
- Kleinfinger–Khalil parameters, 237
- knee-jerk reflex, 322
- La Ciotat, 23
- Lambertian shading, 157–158
- land sickness, 305
- Lanier, Jaron, 4, 27
- latency, 171–179, 204
 - perception of, 298–299
 - zero effective, 176
- lateral canal, 190
- lateral geniculate nucleus, 114
- lateral inhibition, 114, 279, 322
- lateral vection, 206
- Latin square, 317
- LCD, 104
- LCoS, 105
- lens flare, 95
- lenses, 87–96
 - aberrations, 92–96
 - concave, 92
 - convex, 89–92
- LGN, 114
- light field, 183
- light-field cameras, 183
- light-field displays, 105
- lighthouse tracking, 229, 232
- lightness constancy, 149
- linear filter, 286
- linear least-squares, 214
- linear transformations, 61
- linear vection, 208
- liquid crystal display, 104
- liquid crystal on silicon, 105
- localization, 241, 282
- locomotion, 43, 194, 250–258
- longitudinal wave, 271
- look-at, 74–75
- low persistence, 144
- lower pairs, 239
- Luckey, Palmer, 8
- Lucky’s Tale, 9
- Möller–Trumbore intersection algorithm, 157
- MAA, 282, 283
- magic lantern, 103
- magnetometer, 38
- magnification, 99
- maladaptation syndrome, 303
- manipulation, 258–261
- map projection, 182
- mapping, 240–243, 248
- matched zone, 42, 194, 203, 211, 250
- Matrix, The*, 4
- McGurk effect, 153, 280, 324
- mean, 314
- Meissner’s corpuscle, 322
- Merkel’s disk, 322
- merry-go-round, 188, 212
- mesh (of triangles), 56
- mesh simplification, 173
- metamerism, 146
- method of adjustment, 299
- Mickey Mouse, 24
- microsaccades, 121, 127
- Milk, Chris, 14
- Minecraft, 24, 26
- minimum audible angle, 282, 283
- Minnesota scanner, 232
- mipmap, 165
- mixed reality, 5, 17–19
- MMORPGs, 29
- MOCAP, 229, 240
- monaural cue, 282
- Monet, Claude, 21
- monosodium glutamate, 328
- motion capture, 229, 240, 265, 331
- motion parallax, 177
- motion planning, 334
- motion sickness, 303
- motion-to-photons, 171
- motor cortex, 49
- motor imagery, 338
- motor programs, 245–250
- moviesphere, 180
- MSAA, 165
- MSG, 328
- MUDs, 29
- multibody dynamics, 235
- multibody kinematics, 196, 235
- multibody system, 235

INDEX

- multilateration, 226
- multiresolution shading, 170, 174
- multisample anti-aliasing, 165
- multistable perception, 152, 153
- muscle spindle, 322
- Muybridge, Eadweard, 22
- myopia, 99

- naked-eye display, 105
- nausea, 304
- nearsightedness, 99, 169
- Necker cube, 153
- negatively correlated, 316
- nerve ending, 321
- Neumann boundary conditions, 290
- neural impulse, 32, 111
- neuron, 48
- neuroplasticity, 247, 295, 335
- nocireceptors, 322
- nonlinear filter, 287
- nonrigid models, 197
- normal distribution, 314
- normal mapping, 164
- NTSC standard, 143
- nuisance variable, 313, 316–317
- null hypothesis, 314, 316
- Nuremberg code, 313
- Nyquist–Shannon sampling theorem, 286

- OBB, 202
- object-fixed camera, 231
- object-order rendering, 156
- occlusion culling, 167
- OFF bipolar, 113
- OLEDs, 105
- olfaction, 326
- olfactory receptor, 327
- omnidirectional treadmill, 256
- ON bipolar, 113
- open-loop, 5, 247
- OpenSimulator, 45
- optic disc, 108
- optic nerve, 108, 112
- optical axis, 89
- optical flow, 133, 139
- optical illusions, 46
- optokinetic drum, 304
- optokinetic reflex, 119
- organ of Corti, 277, 279
- orientation tuning, 116
- oriented bounding box, 202
- orthographic projection, 75–76
- otolith organs, 208
- otolith system, 190
- oval window, 277

- P300, 338
- Pacinian corpuscle, 321
- Painter’s algorithm, 161
- PAL standard, 143
- pallor, 305
- panoramas, 179–183, 242
- parallax, 133, 206, 297
 - auditory, 284
- parallel wavefronts, 83
- partial differential equations, 197
- pass-through display, 19
- passive feature, 228
- PDEs, 197
- Pearson correlation coefficient, 316
- Pearson’s r , 316
- penetration depth, 201
- perceived visual angle, 131
- perception
 - auditory, 280–285
 - gustatory, 329
 - of color, 145–149
 - of depth, 129–138
 - of motion, 138–145
 - of scale, 129, 135–136
 - olfactory, 327
 - somatosensory, 323
- perception engineering, 5
- perception of stationarity, 27, 51, 126, 138, 143, 144, 171, 250, 292, 298, 305, 310
- perception-based criteria, 7
- perceptual learning, 154, 294, 335
- perceptual training, 51, 294–299
- perilymph, 277
- peripheral vision, 110
- persistence of vision, 140
- perspective n point problem, 229
- perspective projection, 76–77
- Persson, Markus, 26
- Petzval surface, 94
- phase, 274
- phase space, 199
- phi phenomenon, 140, 142
- photodiode, 229
- photopic vision, 110
- photoplethysmogram, 310
- photoreceptors, 96, 108–112, 126, 129, 144, 146
- physics engine, 194
- pincushion distortion, 94, 168, 169
- pinhole, 100
- pinna, 276
- pitch (sound), 273, 281
- pitch rotation, 65
- pitch vection, 206
- place cells, 2, 3

INDEX

- placebo, 314
- planar joint, 236
- Plato, 3
- PLATO system, 29
- plenoptic cameras, 183
- PnP problem, 229, 237
- point cloud, 242, 243
- Point Cloud Library, 243
- poison hypothesis, 308
- Pokemon Go, 18
- polygon soup, 58
- Pong, 24, 26
- Ponzo illusion, 47
- Portal 2, 9
- pose, 224
- positively correlated, 316
- post-rendering image warp, 177–179
- posterior canal, 190
- postural disequilibrium, 305
- power law of practice, 270
- PPG, 310
- PPI, 123
- precedence effect, 280, 283
- premotor cortex, 246
- presbyopia, 99
- presence, 1
- primary auditory cortex, 280
- primary motor cortex, 246, 338
- primary olfactory cortex, 327
- primary somatosensory cortex, 322
- primary visual cortex, 114
- prior distribution, 151
- prism, 88
- prismatic joint, 236
- probability of detection, 52
- probability theory, 150, 313
- proprioception, 49, 140, 247, 320
- prosopagnosia, 46
- Proteus effect, 263
- pseudoscopic vision, 296
- pseudounipolar, 321
- psychoacoustics, 280
- psychometric function, 52
- psychophysics, 51–53, 280, 318–319, 323
- pulse oximeter, 310
- pupil, 103, 108
- pure tone, 274
- Purkinje images, 235
- QR code, 228
- quaternions, 70–72, 218, 219, 222, 237
- r*-value, 316
- rabbit duck illusion, 153
- radiance, 160
- randomized design, 317
- rapid eye movements, 118
- rarefaction, 271
- raster scan, 126
- rasterization, 161–168
- ratio principle, 149
- ray casting, 156, 157, 257
- ray tracing, 156–157
- reading glasses, 99
- receptive field, 112
- receptor, 32, 46
- redirected walking, 251
- reflection, 273
- refraction, 274
- refractive index, 88
- registration, 215
- Reichardt detector, 138
- remapping, 250
- respiration, 335
- retina, 96, 108
 - image size, 131
- retina display, 123
- retinal image size, 131
- retinal image slip, 127
- retinal implants, 339
- retroreflective markers, 229
- reverberation, 280
- revolute joint, 236
- rigid body transform, 67
- robotic avatar, 334
- robotic mapping, 241
- robotics, 329–335
- rods, 108
- roll rotation, 65
- roll vection, 206
- rolling scanout, 126, 174
- rolling shutter, 102, 126, 231
- rotations
 - 2D, 63–64
 - 3D, 64–66
 - axis-angle representations, 68, 72
 - two-to-one problem, 70
- round window, 277
- rubber hand illusion, 324, 325
- Ruffini’s corpuscle, 321
- Runge–Kutta integration, 198
- saccadic masking, 119
- saccule, 190
- sagittal plane, 190
- salty taste, 329
- sampling frequency, 285
- sampling rate, 197, 213, 285
- saturation (HSV), 146

INDEX

- scala tympani, 277
- scala vestibuli, 277
- scanout, 126
- scientific method, 311
- sclera, 107
- scotopic vision, 110
- screen-door effect, 122
- sea sickness, 303, 305
- Second Life, 45, 264
- see-through display, 19
- semicircular canals, 190
- sense organ, 32
- sensor, 32
- sensor fusion, 213
- sensor mapping, 212
- Sensorama, 25, 27, 327
- sensorimotor relationships, 247, 258
- sensory conflict theory, 307
- sensory cue, 129
- sensory system selectivity, 46
- shading, 156–171
- shading model, 157
- shadows depth cue, 133
- Shannon–Weaver model of communication, 261
- Shepard tone illusion, 280
- shutter, 102
- shutter speed, 102
- signal processing, 285
- simulator sickness, 8, 304
- simulator sickness questionnaire, 309
- simulators, 304
- simultaneous localization and mapping, 43, 241
- single-unit recording, 46, 337
- size constancy scaling, 131, 132
- size perception, 131
- SLAM, 43, 241
- Smell-O-Vision, 327
- smooth pursuit, 119, 121, 141, 297
- Snell’s law, 87–89, 91, 97
- Snellen eye chart, 123
- social robotics, 334
- social VR, 261–268
- soft iron, 222
- soft iron bias, 218
- somatosensory perception, 323
- somatosensory system, 320–323
- Sommerfield radiation condition, 290
- Sopite syndrome, 305
- sound propagation, 289–292
- sound ray, 272
- sour taste, 329
- South Park*, 24
- space sickness, 303
- spatial aliasing, 165, 166
- spatial cue, 323
- spatial opponency, 114, 323
- spectral color, 85
- spectral distribution function, 145
- spectral power distribution, 86, 145, 157
- spectral reflection function, 86, 157
- specular reflection, 84
- speed, 187
- spherical aberration, 94
- spherical joint, 236
- spinning dancer illusion, 153
- spiral aftereffect, 139
- sRGB, 149
- SSQ, 309
- SSVEP, 338
- staircase procedures, 319
- Star Wars*, 207
- Star Wars: The Clone Wars*, 24
- state transition equation, 198
- state vector, 197
- static world, 173
- steady state visually evoked potential, 338
- Steamboat Willie*, 24
- stencil buffer, 167, 174
- step size, 197
- stereo displays, 137
- stereo rig, 133
- stereo vision, 243
- stereopsis, 25, 119
- stereoscope, 25, 27
- Stevens’ power law, 52, 318, 319
- stochastic approximation method, 319
- stochastic ray tracing, 291
- strafing, 253
- stroboscopic apparent motion, 21, 140–143, 304
- Student’s *t*-test, 315
- Student’s *t*-distribution, 314
- subjective constancy, 131
- sum of squares error, 214
- superior olive, 280
- supersampling, 165, 166
- supervised training, 295
- supplementary motor area, 246
- surrogate selves, 330
- surround-sound system, 34
- Sutherland, Ivan, 26
- sweet taste, 328
- synapse, 48
- synaptic pruning, 247
- syndrome, 303
- tangible user interface, 326

INDEX

- taste buds, 328
- taste receptors, 328
- TDOA, 226, 284
- tearing, 174, 175
- tectorial membrane, 279
- tele-embodiment, 333
- teleconferencing, 267
- TeleGarden, 330
- teleoperation, 5, 332
- teleportation, 256
- telepresence, 5, 11–12, 331–334
- temporal cue, 323
- temporal drift error, 232
- texture gradient, 130
- texture mapping, 164, 179, 242, 264
- texture perception, 323
- thalamus, 114, 322
 - 3:2 pull down, 179
 - 3D glasses, 137
 - 3D mouse, 257
 - 3D scanner, 241
 - 3D triangle, 56
- tilt axis, 219, 220
- tilt error, 219
- time difference of arrival, 226, 284
- time of arrival, 225
- time of flight, 225
- time-invariant dynamical systems, 198
- TOA, 225
- tonotopically, 280
- topographic mapping, 49, 280, 322
- touch, 320
- transducer, 32
- transformed social interaction, 267
- transmission, 274
- transverse wave, 271
- tree sickness, 308
- trichromatic theory, 148, 157
- trilateration, 226
- Trip to the Moon*, 23
- triple buffering, 176
- Tron, 8
- tweening, 179
- two-point acuity test, 323
- 2001* (movie), 23

- Ultimate Display, 26
- ultraviolet, 85
- umami, 328
- uncanny valley, 7, 196, 264, 301
- uncorrelated, 316
- universal simulation principle, 6, 245, 250, 256, 258, 262, 301, 302
- unsupervised clustering, 317
- unsupervised learning, 317
- unsupervised training, 295
- utricle, 190

- value (HSV), 146
- variance, 314
- varifocal displays, 105
- vblank, 174
- vection, 50, 140, 154, 172, 204–209, 253–256, 285, 304
- vector field, 139, 205
- velocity, 185
- vergence, 119, 134
- vergence-accommodation mismatch, 105, 128, 299, 301, 302
- vertical blanking interval, 174
- vertical vection, 206
- vertigo, 194, 305
- vestibular organs, 47, 190, 303
- vestibular sense, 46, 50, 189
- vestibular system, 189–194
- vestibule, 190
- video game, 248, 253, 267
- video games, 8–9, 143
- video memory, 174
- video oculography, 235
- view volume culling, 166
- View-Master, 25, 27
- viewing frustum, 78
- viewing ray, 156
- viewing transformations, 73–81, 165
- viewport transform, 80
- Virtual Boy, 28
- virtual environments, 4
- virtual laser pointer, 257, 258
- virtual prototyping, 16, 269
- virtual reality (VR)
 - definition, 1–3
 - first use of term, 4
 - hardware, 31–41
 - history, 20–30
 - modern experiences, 8–19
 - software, 41–45
- virtual societies, 12
- Virtual World Generator (VWG), 33
- virtuality, 4
- visibility, 38, 227
- visibility complex, 177
- visibility computation, 156
- visibility constraints, 38
- visibility event, 177, 179
- visual acuity, 108, 123
- visual cortex, 114, 280
- visually induced apparent motion, 304

INDEX

- visually induced motion sickness, 303–304
- vitreous humor, 107
- VOG, 235
- VOR, 119–121, 138, 141, 143, 144, 190, 297
 - gain adaptation, 125
- VOR gain, 125
- VR sickness, 8, 302–311
- VR/AR, 5
- VR/AR/MR, 5
- Vredeman de Vries, Hans, 21
- vsync, 174
- VWG, 173

- wagon-wheel effect, 139
- walkie-talkie, 262
- waterfall illusion, 139
- waveguide, 105
- wayfinding, 257
- Weber’s law, 53

- Welch’s t-test, 315
- Wheatstone, Charles, 27
- white light, 148
- white noise, 288
- world in miniature, 257
- world-fixed camera, 230, 231

- XR, 5

- yaw correction, 221
- yaw rotation, 66
- yaw vection, 206
- Young–Helmholtz theory, 148

- z-buffer, 161
- z-transform, 288
- zero effective latency, 176, 299
- zipper effect, 143, 297
- zoetrope, 140, 141
- zoopraxiscope, 22