

Index

A

Abstract sound, 133
Accelerometer, 75
Accommodation, 100, 119
Active mechanics, 147
Additive technique, 134
Admittance control, 183
Ambisonics, 136
Auditory localization, 149
Auditory masking, 156
Augmented reality, 5, 9, 195
Auralization, 132, 137
Avatar, 219

B

Bidirectional, 161, 186
Bidirectional communication, 176
Binaural audition, 149
Binaural listening, 145
Body motion, 50
Boundary representation, 103
Boundary surface, 172
Bounding box
 axis aligned, 48
 oriented, 48
Bounding sphere, 48

C

Camera, 59
CAVE, 6, 125
Center of mass, 38
Clipping, 109
Coincident microphone, 158
Collision detection, 43, 162, 174

 between a block and a particle, 44
 between a block and a sphere, 47
 between a sphere and a particle, 44
 between complex bodies, 48
 between two blocks, 46
 between two spheres, 45

Communication, 205
Computer game, 214
Computer graphics, 102
Constructive solid geometry, 106, 172
Contact
 multipoint, 178
 single-point, 178
 two-point, 178

Content, 2
Convergence, 100, 119
Cooperation, 210
Coupling
 electromagnetic, 72
Crosstalk, 136
Cue
 kinaesthetic, 192
 kinesthetic, 176
 tactile, 176, 192

D

Degree of freedom, 18
Depth buffer, 110
Depth cues, 99
 monoscopic, 99
 stereoscopic, 100
Design, 202
Diffuse sound fields, 144
Direct user control, 206

Displacement, 23
 Display, 14, 161
 admittance, 186
 autostereoscopic, 126
 handheld, 200
 haptic, 161, 171, 176, 186
 head-mounted, 5, 87, 122, 199
 impedance, 186
 kinesthetic, 186
 liquid crystal, 116
 multiple screens, 125
 plasma, 117
 projector, 117
 properties, 115
 retinal projector, 123
 stereoscopic, 117
 tactile, 172, 176, 189
 vestibular, 189
 visual, 115, 198
 volumetric, 127
 Doppler effect, 155
 Dynamics
 haptic display, 188
 mass particle, 36
 rigid body, 37

E

Echo, 133
 Education, 221
 Environment reconstruction, 198
 Environment topology, 2
 Environmental coherency, 211
 Equal-loudness contours, 147
 Equations of motion, 36
 Euler angles, 26
 Exposure therapy, 10
 Eye, 89
 eye, 97

F

Feedback, 207
 sensory, 4
 Feedback loop, 10
 Filtering, 134
 Force display, 172
 Force plate, 86
 Force vector field, 172
 Force/torque sensor, 162
 Free field, 144
 Frequency modulation, 134

G

Games, 201
 Gesture, 87
 Golgi tendon organ, 167
 Gyroscope, 77

H

Haptic, 161
 Haptic channels, 192
 Haptic image, 162
 Haptic interaction, 161, 170
 Haptic interaction point, 175, 178
 Haptic interface, 162, 176, 178, 186
 Head-related impulse response, 135
 Head-related transfer function, 135
 Headphone, 135
 Headphone equalization, 135
 History
 virtual reality, 5
 Hologram, 128

I

Illumination, 110
 global, 112
 without light sources, 111
 illumination
 local, 111
 Image
 raster, 102
 vector, 102
 Immersion, 192
 Impedance
 biomechanical, 171
 Impedance control, 183
 Implicit surface, 104
 Inertial measurement unit, 79
 Information
 kinesthetic, 164
 tactile, 164
 Infrasound, 138
 Inner ear, 147
 Inside-the-head-localization, 135
 Intensity spectrum level, 143
 Interaction, 53, 176, 183, 205, 210
 man-machine, 176
 Interaction force, 84
 Interactive configuration, 222
 Interactivity, 4
 Interaural level difference, 154
 Interaural time difference, 154
 Interface, 93

Intermediary, 2
Intermediate plane, 172

K

Kalman filter, 82
Kinematics
 haptic display, 187
Kinesthetic senses, 161

L

Linear distortion, 157
Localization, 137
Locomotion, 210
Loudness, 147
Loudspeaker, 135

M

Magnetometer, 78
Manipulation, 205, 208
Mass, 38
Matrix
 homogenous transformation, 19, 21, 23, 29
 rotation, 22, 38
Measurement
 force and torque, 84
Mechanical
 energy, 183
 power, 183
Meissner's corpuscles, 167
Merkel's discs, 167
Middle ear, 146
Mixed reality, 195
Modality
 aural, 2
 haptic, 2
 visual, 2
Model
 admittance, 180
 compliance, 179
 free space, 180
 impedance, 180
 object stiffness, 181
 polygonal, 173
 spring-damper, 181
 stiffness, 179
Modeling
 computational, 134
 graphical, 219
 physical, 133
 ray-based, 134
 scale, 134

 solid, 107
 statistical, 134
 visual, 103
 wave-based, 134
Moment of inertia, 39
Momentum
 angular, 39–41
 linear, 39, 40
Motor system, human, 170
Multiplexing
 spatial and temporal, 123
Muscle spindle, 166

N

Navigation, 205, 208
Newtonian physics, 35
Nonlinear distortion, 157

O

Object, 2
Orientation, 19, 23
Outer ear, 145

P

Pacinian corpuscles, 167
Painter's algorithm, 110
Parallax, 118
Parametric surface, 104
Passive haptic feedback, 172
Path planning, 208
Path tracking, 210
Perception, 14
 color, 98
 depth, 99
 haptic, 163
 kinesthetic, 166
 light, 97
 tactile, 167
 vestibular, 169
Perspective, 4
Perspective transformation, 32
Phon, 147
Physical control, 206
Physical input, 93
 controls, 93
 platform, 94
 props, 94
Pinna notches, 154
Pixel conversion, 113
Polygon, 103, 106
Pose, 19, 23

Position, 19, 23
 Position awareness, 209
 Postprocessing, 133
 Presence, 2
 Pressure spectrum level, 143
 Projection, 108
 parallel, 108
 perspective, 108
 Proprioception
 extended physiological, 163
 Psychophysiological state, 10
 Pure stereo, 136

Q

Quaternion, 28, 38

R

Radiosity, 113
 Ray casting, 110
 Ray tracing, 112, 114
 Reaction force, 44, 174
 Receptor
 tactile, 167
 Rehabilitation, 9
 Rendering, 11, 13, 107
 haptic, 176
 kinesthetic, 177
 temperature, 177
 texture, 177
 Representation
 haptic, 171
 Resolution
 spatial, 193
 temporal, 193
 Reverberation time, 145
 RGB model, 99
 Room acoustics, 144
 Rotation, 19, 21, 23
 Ruffini corpuscles, 167

S

Sabine's equation, 145
 Safety, 193
 Sampling, 133
 Scene graph, 107, 216, 218, 220
 Selection, 208
 Senses
 tactile, 161
 Sensor, 196
 calibration, 85
 force and torque, 85

Shading effect, 152
 Shared experience, 210
 Simulation, 1
 Simulator
 driving, 7
 flight, 7
 surgery, 8, 202
 Singularity, 187
 Sinusoidal sound, 134
 Sone, 148
 Sonification, 131
 Sound, 138
 energy density, 142
 intensity, 142, 143
 power level, 143
 pressure level, 143
 rendering, 132
 speed of, 140
 synthesis, 133
 Specific acoustic impedance, 143
 Spectral method, 133
 Speech recognition, 94
 Spline, 105
 Stereophonic reproduction, 135
 Stimulus
 kinesthetic, 186
 tactile, 186
 Subtractive technique, 134
 Surface
 implicit, 173
 parametric, 173
 Surface contact point, 175

T

Teleoperation, 8
 Teleoperation system, 162
 Telepresence, 5, 8
 Time difference, 150
 Towrope method, 210
 Tracking, 53
 electromagnetic, 70
 eye, 90
 hand, 88
 head, 87, 121
 inertial, 74
 legs, 93
 motion, 87
 optical, 59
 passive, 53
 pose, 55
 radiofrequency, 70
 requirements, 54

- trunk, 93
- ultrasonic, 57
- videometric, 69

Training, 217

Transaural, 136

Transformation, 108

Translation, 18, 20, 23

Travel, 208

Triangulation, 68

U

User interface, 10, 201

- elements, 2

V

Ventriloquism, 137

Viewpoint, 121, 207

Virtual acoustic environment, 132

Virtual control, 206

Virtual environment, 162

- design, 1

Virtual fixtures, 207

Virtual reality, 1

Virtual tunnel, 210

Visibility, 109

Visual modality, 97

Volumetric representations, 172

W

Wave equation, 141

Wave field synthesis, 136