

Index

Numbers

- 2D objects, 45
- 2D transformations, 103
- 3D objects, 77
- 3D transformations, 123
- 3D view, 3

A

- Affine transformation, 103
 - most general in 2D, 111
 - most general in 3D, 135
- Arrays
 - column arrays, 16
 - row arrays, 16
- Associativity, 16
- Asymptotes, 62
- Axonometric view, 4

B

- Backward substitution, 36
- Bevel gears, 152
- Bisector plane, 131
- Boolean operations, 94
- Bounded solids
 - properties, 94

C

- CAD, *see* computer-aided design
- CAE, *see* computer-aided engineering
- Capitol Building, 53
- Cartesian coordinate system, 4
- Circle, 51
 - center, 51

- implicit representation, 51
- parametric equation, 52
- Cofactor expansion, 21
- Column array, 14
- Commutativity, 16
- Compliant mechanism, 50
- Computer-aided design, 2
- Computer-aided engineering, 4
- Cones, 87
 - apex, 87
 - axis, 87
 - oblique, 87
 - right, 87
 - vertex, 87
- Conics, 50
 - discriminant, 63
- Convex, *see* convexity
- Convexity, 49
- Coordinates
 - 2D coordinates system, 4
 - 3D coordinates system, 4
 - absolute, 10
 - Cartesian coordinates, 4
 - cylindrical, 8
 - cylindrical coordinates, 8
 - homogenous coordinates, 11
 - polar, 7
 - polar coordinates, 7
 - relative, 10
 - spherical, 9
 - spherical coordinates, 9
 - world, 10
- Coordinate space
 - homogenous coordinates, 123
- Cross product, *see* vectors, vector product

Cross-product matrix, 31
 Curvature, 69
 Curves
 control points, 68
 free-form, 67
 spline curve, 68
 Cyclic permutation, 28, 31
 Cylinder
 directrix, 85
 generatrix, 85

D

Design specifications, 1
 Determinants
 computation, 28
 definition, 25, 27
 Difference, 94
 operator, 95
 Direction cosines, 15
 Directrix, 84, 87
 Discriminant, *see* conics, discriminant
 Distance
 between two lines, 82
 point to line, 81
 point to plane, 80
 Distributivity, 16
 Dot product, *see* vectors, scalar product

E

Ellipse, 52
 definition, 52
 implicit representation, 54
 major/minor axes, 53
 reflective property, 53
 Embody, 1
 Euclidean vector norm, *see* vectors, magnitude
 External product, 34
 Extrusion, 85
 conic, 151
 extrusion matrix, 146

F

Factorial, 29
 Floating-point number, 29
 Floating-point operations, *see* flops
 Flops, 25, 28
 Free-form surfaces, 153
 Free-hand sketch, 1
 Frustum, 87
 Functional requirements, 1

G

Generators, 45
 Generatrix, 84, 87
 Geometric model, 4
 Geometry
 projective geometry, 11
 Gestalt, 38
 Greenwich meridian, 9

H

Homogeneous-transformation matrix, 30, 37
 inverse, 37
 Homogenous coordinates, *see* coordinate space
 Hyperbolic functions, 62

I

Image of a point, 111, 135
 Implicit equation, 78
 Inequalities, 17
 Cauchy–Schwartz inequality, 17
 Triangle inequality, 17
 Infinity, 11
 Intersection, 94
 operator, 94

J

Jacobian matrix, 42

K

Kronecker delta, 18

L

Lamé curves, 64
 curvature, 69
 parametric representation, 64
 Left-hand rule, 7
 Linear combinations, 27
 Line of sight, 11
 Lines, 46
 equation, 79
 Locus, 51

M

Math behind the CAD, 2
 Matrices, 17
 adjoint, 35

- block, 30
- block-partitioned matrices, 30
- cofactor, 27
- column matrix, 18
- definition, 17
- diagonal matrix, 18
- identity matrix, 18, 37
- inverse, 35
- inverse of block matrices, 36
- inversion, 35
- lower triangular matrix, 19, 36
- LU-decomposition, 29, 35
- matrix addition, 19
- matrix equality, 19
- matrix product, 20
- minor, 27
- non-singular, 35
- partitioned matrix, 25
- properties, 19
- row matrix, 17
- scalar multiplication, 20
- singular, 25, 35
- skew-symmetric matrix, 19
- special matrices, 17
- square matrix, 17
- symmetric matrix, 19
- transpose matrix, 20
- upper triangular matrix, 19, 35
- zero matrix, 18, 37
- Matrix partition, 26
- Monolithic mechanism, 50
- Mormon Tabernacle, 53
- Multiview, 7

N

- Nappes, 56
- N-gons, 49
- Norm, 13

O

- OLCF-4, 29
- Orthogonal matrix, 21

P

- Parabola, 56
- Parallelepiped, 7
- Planar contour
 - centroid, 93
- Planes
 - as a surface, 83
- Point, 45, 77

- Points, lines, and planes in space, 77

- Polygon, 49

- Polyhedra, 83

- regular, 90

- Prisms, 92

- oblique, 92

- right, 92

- truncated, 92

- Product

- box product, 26

- mixed product, 26

- triple product, 26

- Pyramids, 92

- oblique, 93

- right, 93

- truncated, 93

- vertex, 92

- Pythagorean theorem, 14

R

- Recursively, 36

- Recursive solution, 35

- Reflection

- 2D, 108

- 3D, 134

- Reflective property

- parabola, 56

- Right-hand rule, 7

- Robots

- mobile robot, 40

- planar, three-axis robot, 42

- Rotation

- 2D, 107

- 3D, 125

S

- Scaling

- 2D, 104

- 3D, 123

- Sets, 13

- Shear, 118

- Single-valued arctan function, 7

- Solids, 85

- Specs, *see* design specifications

- Spherical cams, 152

- Spline, *see* curves, spline curve

- Surface of revolution, 143

- Surface patches, *see* free-form surfaces

- Surfaces, 83

- quadrics, 83, 84

- ruled, 84

warped, 85
Sweeping, 146

T

Transformations
 affine transformations, 13
 homogeneous transformation, 30, 103, 123
Translation
 2D, 106
 3D, 125
Transposition, 16
Triangular system of equations, 35
Twist, 42

U

Union, 94
 operator, 94
Unit magnitude, 79

V

Vector product
 2D form, 21
 double vector product, 32
 geometric interpretation, 21
 properties, 21
 triple vector product, 32
Vectors, 13
 addition properties, 16
 magnitude, 14
 notation, 13
 position vector, 45
 scalar multiplication, 15, 16
 scalar product, 16
 signed magnitude, 23
 unit vector, 14
 vector addition, 15
 vector product, 20

W

Whispering galleries, 53