

Index

- affine combination, 1, 3, 10
- B-spline matrix, 47
 - differentiation, 64
- B-splines, 21, 26
 - algorithms for differentiation, 66
 - B-spline matrix and dual polynomials, 58
 - basic properties, 40
 - basis for piecewise polynomials, 71
 - Bernstein polynomials, 39
 - cardinal, 39
 - coefficients, 41
 - commutation of B-spline matrices, 58, 64
 - complexity of algebraic form, 45
 - continuity, 69
 - $d + 1$ -extended knot vector, 62
 - $d + 1$ -regular knot vector, 62
 - definition, 35
 - definition of derivative, 63
 - dependence on knots, 37
 - derivative, 65
 - alternative recurrence relation, 65
 - recurrence relation, 65
 - derivative of any order, 65
 - detailed algorithms, 50, 51
 - detailed version of R-algorithm, 51
 - determining μ , 54
 - differentiation, 64
 - algorithms, 66
 - DL algorithm, 66
 - DR algorithm, 66
 - explicit form of DL algorithm, 66
 - explicit form of DR algorithm, 68
 - freedom in choice of matrix, 65
 - left algorithm, 66
 - right algorithm, 66
 - division by zero convention, 35
 - dual polynomial, 57
 - evaluation from the left, 49
 - explicit form, 47
 - explicit form in quadratic case, 38
 - explicit form of recurrence relation, 36
 - explicit notation, 37
 - extending the knot vector, 54
 - first derivative, 64, 65
 - formular for jump in a derivative, 69
 - knot averages, 43
 - linear, 36
 - linear combination, 41
 - linear independence, 41, 71
 - $d + 1$ -extended knot vector, 62
 - local, 61
 - near ends of knot vector, 71
 - short knot vectors, 71
 - local knots, 40
 - local linear independence, 61
 - local support, 40
 - Marsden's identity, 59
 - on one knot interval, 59
 - Matlab algorithm, 51, 54
 - matrix representation, 45, 63, 64
 - cubic case, 46
 - differentiation, 63
 - general degree, 47
 - linear case, 45
 - quadratic case, 45
 - piecewise polynomial, 40
 - polynomial pieces, 37
 - positivity within support, 40
 - quadratic, 37
 - recurrence relation, 27, 35
 - for jumps, 68
 - for uniform knots, 39
 - repeated application of B-spline matrices, 58

- representation of power basis, 60
- right algorithm, 49
- second derivative, 65
- smoothness, 68
 - cubic case, 38
 - linear case, 36
 - quadratic case, 37, 63
- special values, 40, 52
- translation invariance, 38
- triangular algorithm, 66
 - complexity, 72
- triangular algorithms, 50
- trivially zero, 36
- uniform knots, 39
- vector algorithms, 51
- vector version of R-algorithm, 51
- Bézier curve, 12, 13, 40
 - basis, 13–15
 - Bernstein basis, 13, 26
 - Casteljau algorithm, 15
 - complexity, 15
 - composite, 17
 - control points, 13, 15
 - control polygon, 13, 15
 - cubic, 14, 15
 - end conditions, 13
 - evaluation, 15
 - evaluation algorithm, 17
 - general degree, 17
 - general interval, 17
 - on general interval, 17
 - partition of unity, 14
 - problems with high degree, 17
- Pierre Bézier, 12
- Bernstein basis, 13–15, 26
 - partition of unity, 14, 15
- Bernstein polynomials, 39
 - basic properties, 52
- Casteljau algorithm, 15
- Paul de Casteljau, 15
- Chebyshev polynomial, cubic, 43
- Citroën, 15
- combination
 - affine, 1, 3, 10
 - convex, 1–3, 6, 8, 9, 11, 12, 14, 15, 17, 20, 22–24, 29–31
- commutation of B-spline matrices, 58, 64
- complexity of triangular algorithms, 72
- composite Bézier curve
 - continuity, 18
 - smoothness, 18
- control points, 13, 15, 18, 20
- control polygon, 13, 15, 20
- convention for division by zero, 26
- convex hull, 1–5, 11, 12, 14, 15, 29–31
 - of n points, 3
- convex set, 3, 30, 31
- C^r continuity, 62
- Curry-Schoenberg theorem, 71
- curve
 - Bézier, 12, 13
 - definition, 6
 - interpolating polynomial, 6
 - spline, 12, 18
 - travelling along, 6, 8
- detailed spline evaluation algorithms, 50, 51
- differentiation of matrix product, 63, 72
- dimension of space of piecewise polynomials, 70
- dual polynomial of B-spline, 57
- elementary symmetric polynomials, 61
- floating point, 1
- function, 5
 - jump, 62
 - left derivative, 63
 - one-sided derivative, 63
 - piecewise continuous, 62
 - piecewise C^r , 63
 - piecewise smooth, 63
 - right derivative, 63
 - vector valued, 6
- hat function, 36
- interpolation
 - complexity, 11
 - convex combinations, 11
 - cubic, 8

- general degree, 9
 - Neville-Aitken algorithm, 10
 - Newton form, 11
 - parametrization, 11
 - problems, 11
 - quadratic, 7
- jump in a function, 62
- knot averages, 43
- knot sequence, 35
- knot vector, 18, 35
 - $d + 1$ -extended, 62
 - $d + 1$ -regular, 43, 62
- knots, 18
- left algorithm, 49
- linear independence, 61
- linear interpolation, 58
- Matlab algorithm, 51, 54
- multiple knots, 36
- numerical stability, 1, 2, 24, 29
- parametric curve, 5
- parametric representation, 5
- parametric spline curve, 45
- parametrization, 11
- piecewise polynomials, 70, 72
 - truncated power basis, 71, 72
- proof by induction, 27, 31, 32, 37–40, 52, 53, 69, 70
- Renault, 12
- right algorithm, 49
- round-off error, 1, 11, 17, 29
- S in Times Roman font, 19
- smoothness, 25
- speed, 6
- spline curve, 12, 18, 44
 - control points, 18, 20, 23, 24, 45
 - control polygon, 20, 24, 45
 - controlling smoothness, 25
 - cubic, 22
 - definition, 44
 - division by zero, 23, 26
 - elaborate notation, 22
 - end conditions, 21
 - explicit form, 24, 26
 - expressed in terms of B-splines, 28
 - finding B-splines, 27
 - general degree, 23
 - interpolating at d -tuple knot, 44
 - knot vector, 18
 - knots, 18
 - linear, 18
 - Marsden's identity, 59
 - on one knot interval, 59
 - multiple knots, 25, 26
 - notation, 22
 - on one knot interval, 44
 - parametric, 45
 - quadratic, 20, 21
 - redundancy of end knots, 28
 - repeated averaging, 24
 - right algorithm, 49
 - smoothness, 21, 25
 - special case of Bézier curve, 20
 - triangular algorithm, 23, 24
 - undoing convex combinations, 27, 28
 - unwrapping, 27, 28
- spline function, 41
 - algorithms for evaluation, 48
 - B-spline matrix and dual polynomials, 58
 - basic properties, 43
 - commutation of B-spline matrices, 58
 - control points, 43
 - control polygon, 43
 - $d + 1$ -extended knot vector, 62
 - $d + 1$ -regular knot vector, 62
 - definition at right end of knot vector, 42
 - detailed algorithms, 50, 51
 - determining μ , 54
 - differentiation, 66
 - DL algorithm, 66
 - DR algorithm, 66
 - explicit form of DL algorithm, 66
 - explicit form of DR algorithm, 68
 - left algorithm, 66
 - right algorithm, 66
 - evaluation from the right, 49
 - extending the knot vector, 54

- generalizing algorithms to spline curves, 45
- generating one polynomial piece on all of \mathbb{R} , 47
- interpolating at d -tuple knot, 43
- left algorithm, 49
- linear, 41
- Matlab algorithm, 51, 54
- matrix representation, 47
- repeated application of B-spline matrices, 58
- representation of power basis, 60
- smoothness at multiple knot, 44
- triangular algorithm
 - complexity, 72
- triangular algorithms, 50
- vector algorithms, 51, 54
- vector version of L-algorithm, 54
- spline space, 41
- spline vector function, 45

- tangent vector, 6, 7
- triangular algorithm, 10, 17, 23
- triangular algorithms, 50
- truncated power basis, 71, 72

- variation diminishing spline approximation, 29, 42
- velocity, 6

- weighted averages, 2
- wiggles, 11