

Contents

Preface, xi

Author, xv

CHAPTER 1 ■ Interpolating Splines	1
1.1 INTRODUCTION	1
1.2 LINEAR SPLINE (STANDARD FORMS)	4
1.3 LINEAR SPLINE (PARAMETRIC FORM)	10
1.4 QUADRATIC SPLINE (STANDARD FORM)	13
1.5 QUADRATIC SPLINE (PARAMETRIC FORM)	15
1.6 CUBIC SPLINE (STANDARD FORM)	18
1.7 CUBIC SPLINE (PARAMETRIC FORM)	22
1.8 PIECEWISE SPLINES (STANDARD FORM)	25
1.9 PIECEWISE SPLINES (PARAMETRIC FORM)	31
1.10 CHAPTER SUMMARY	39
1.11 REVIEW QUESTIONS	39
1.12 PRACTICE PROBLEMS	40
CHAPTER 2 ■ Blending Functions and Hybrid Splines	41
2.1 INTRODUCTION	41
2.2 BLENDING FUNCTIONS	41
2.3 BLENDING FUNCTIONS OF INTERPOLATING SPLINES	46
2.4 HERMITE SPLINE	52
2.5 CARDINAL SPLINE	57
2.6 CATMULL-ROM SPLINE	61
2.7 BEZIER SPLINE	63
2.8 SPLINE CONVERSIONS	69

2.9	CHAPTER SUMMARY	74
2.10	REVIEW QUESTIONS	74
2.11	PRACTICE PROBLEMS	75
CHAPTER 3 ■ Approximating Splines		77
3.1	INTRODUCTION	77
3.2	LINEAR UNIFORM <i>B</i> -SPLINE	78
3.3	CHANGING NUMBER OF CONTROL POINTS	88
3.4	QUADRATIC UNIFORM <i>B</i> -SPLINE	89
3.5	JUSTIFICATION FOR KNOT-VECTOR VALUES	102
3.6	QUADRATIC OPEN-UNIFORM <i>B</i> -SPLINE	105
3.7	QUADRATIC NON-UNIFORM <i>B</i> -SPLINE	108
3.8	CUBIC UNIFORM <i>B</i> -SPLINE	109
3.9	CHAPTER SUMMARY	131
3.10	REVIEW QUESTIONS	131
3.11	PRACTICE PROBLEMS	132
CHAPTER 4 ■ 2D Transformations		133
4.1	INTRODUCTION	133
4.2	HOMOGENEOUS COORDINATES	135
4.3	TRANSLATION	136
4.4	SCALING	138
4.5	ROTATION	140
4.6	FIXED-POINT SCALING	143
4.7	FIXED-POINT ROTATION	145
4.8	REFLECTION	147
4.9	FIXED-LINE REFLECTION	149
4.10	SHEAR	152
4.11	AFFINE TRANSFORMATIONS	155
4.12	PERSPECTIVE TRANSFORMATIONS	159
4.13	VIEWING TRANSFORMATIONS	163
4.14	COORDINATE SYSTEM TRANSFORMATIONS	167
4.15	CHAPTER SUMMARY	168
4.16	REVIEW QUESTIONS	169
4.17	PRACTICE PROBLEMS	169

CHAPTER 5 ■ Spline Properties	171
5.1 INTRODUCTION	171
5.2 CRITICAL POINTS	172
5.3 TANGENT AND NORMAL	176
5.4 LENGTH OF A CURVE	181
5.5 AREA UNDER A CURVE	183
5.6 CENTROID	189
5.7 INTERPOLATION AND CURVE FITTING	192
5.8 NOTES ON 2D PLOTTING FUNCTIONS	199
5.9 CHAPTER SUMMARY	205
5.10 REVIEW QUESTIONS	205
5.11 PRACTICE PROBLEMS	206
CHAPTER 6 ■ Vectors	207
6.1 INTRODUCTION	207
6.2 UNIT VECTOR	208
6.3 DIRECTION COSINES	210
6.4 DOT PRODUCT	212
6.5 CROSS PRODUCT	214
6.6 VECTOR EQUATION OF A LINE	215
6.7 VECTOR EQUATION OF PLANE	218
6.8 VECTOR ALIGNMENT (2D)	222
6.9 VECTOR EQUATIONS IN HOMOGENEOUS COORDINATES (2D)	225
6.10 VECTOR EQUATIONS IN HOMOGENEOUS COORDINATES (3D)	229
6.11 NORMAL VECTOR AND TANGENT VECTOR	234
6.12 CHAPTER SUMMARY	239
6.13 REVIEW QUESTIONS	239
6.14 PRACTICE PROBLEMS	240
CHAPTER 7 ■ 3D Transformations	241
7.1 INTRODUCTION	241
7.2 TRANSLATION	241
7.3 SCALING	245
7.4 ROTATION	248
7.5 FIXED-POINT SCALING	251

7.6	FIXED-POINT ROTATION	254
7.7	ROTATION PARALLEL TO PRIMARY AXES	256
7.8	VECTOR ALIGNMENT (3D)	264
7.9	ROTATION AROUND A VECTOR	270
7.10	ROTATION AROUND AN ARBITRARY LINE	273
7.11	REFLECTION	277
7.12	SHEAR	280
7.13	CHAPTER SUMMARY	283
7.14	REVIEW QUESTIONS	284
7.15	PRACTICE PROBLEMS	284
CHAPTER 8 ■ Surfaces		287
8.1	INTRODUCTION	287
8.2	PARAMETRIC SURFACES	288
8.3	BEZIER SURFACES	293
8.4	IMPLICIT SURFACES	298
8.5	EXTRUDED SURFACES	307
8.6	SURFACES OF REVOLUTION	308
8.7	NORMAL VECTOR AND TANGENT PLANE	312
8.8	AREA AND VOLUME OF SURFACE OF REVOLUTION	317
8.9	TEXTURE MAPPING	320
8.10	SURFACE ILLUMINATION	329
8.11	NOTES ON 3D PLOTTING FUNCTIONS	335
8.12	CHAPTER SUMMARY	349
8.13	REVIEW QUESTIONS	350
8.14	PRACTICE PROBLEMS	350
CHAPTER 9 ■ Projection		353
9.1	INTRODUCTION	353
9.2	2D PROJECTION	354
9.3	3D PROJECTION	361
9.4	MULTI-VIEW PROJECTION	366
9.5	AXONOMETRIC PROJECTION	369
9.6	FORESHORTENING FACTORS	371
9.7	ISOMETRIC, DIMETRIC, AND TRIMETRIC	375
9.8	OBLIQUE PROJECTION	382

9.9 PERSPECTIVE PROJECTION	387
9.10 CHAPTER SUMMARY	391
9.11 REVIEW QUESTIONS	392
9.12 PRACTICE PROBLEMS	392
<hr/>	
APPENDIX I: MATLAB® FUNCTION SUMMARY	395
APPENDIX II: ANSWERS TO PRACTICE PROBLEMS	399
REFERENCES	407
INDEX	409