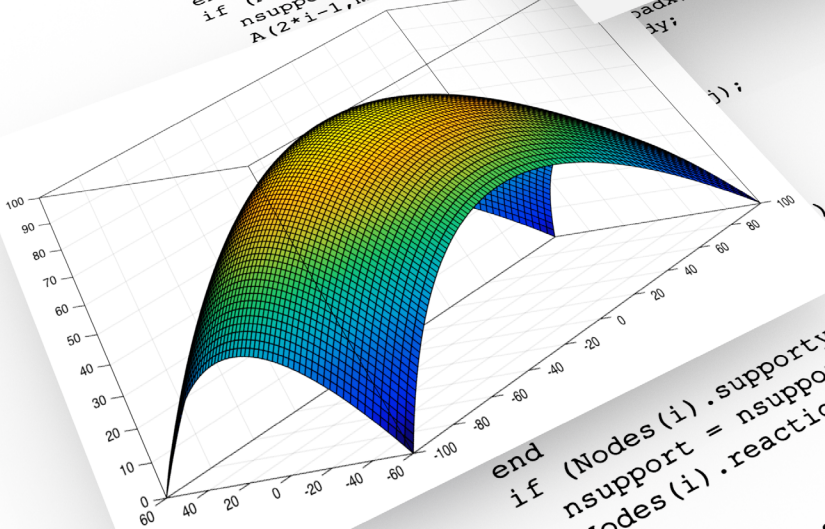


Programming with

MATLAB 2016

```
function [outNodes, outMembers] = solveFEES(nodes, Members)
n = size(nodes,2); m = size(Members,2);
if (m+3) <= 2*n
    disp('Unstable!');
    outNodes = 0; outMembers = 0; return
elseif (m+3) > 2*n
    disp('Statically indeterminate!');
    outNodes = 0; outMembers = 0; return
else
    outNodes = zeros(2*n, 2*n); nsupport = 0;
    end
    A = zeros(2*n, 2*n); loads = zeros(2*n,1);
    for i = 1:n
        for j = 1:m
            n1 = Members(j).node1;
            n2 = Members(j).node2;
            if n1 == i; n2 == Membe
                n1 = i; n2 = Membe
            elseif Members(j).node1 ==
                n1 = i; n2 = Membe
            end
            x1 = Nodes(n1).x; y1 =
            x2 = Nodes(n2).x; y2 =
            L = sqrt((x2-x1)^2 + (y2-y1)^2);
            A(2*i-1, j) = (x2-x1)/L;
            A(2*i, j) = (y2-y1)/L;
        end
        if Nodes(i).support ==
            nsupport = nsupport+1;
            A(2*i-1, m+nsupport) =
            A(2*i, m+nsupport) =
        end
    end
end
```

Node Data		LoadX		LoadY		Reaction	
Node	Node	Node	Node	Node	Node	Node	Node
1	0	0	0	0	0	0	0
2	10	0	0	0	0	0	0
3	20	0	0	0	0	0	0
4	30	0	0	0	0	0	0
5	40	0	0	0	0	0	0
6	50	0	0	0	0	0	0



```

        if Nodes(i).support == 1
            nsupport = nsupport+1;
            Nodes(i).reaction = forces(m+nsupport);
        end
    end
    outNodes = Nodes;
    outMembers = Members;
    disp('Solved successfully.')
```

Visit the following websites to learn more about this book:



[amazon.com](https://www.amazon.com)

[Google books](https://books.google.com)

[BARNES & NOBLE](https://www.barnesandnoble.com)

Contents

Preface 6

Chapter 1 Getting Started, Overview, and Environment 8

- 1.1 Start and Quit MATLAB 9
- 1.2 Entering Commands 11
- 1.3 Array Expressions 14
- 1.4 Two-Dimensional Graphics 15
- 1.5 MATLAB Scripts 16
- 1.6 Three-Dimensional Graphics 18
- 1.7 Symbolic Mathematics 20
- 1.8 Screen Text Input/Output 24
- 1.9 Text File Input/Output 26
- 1.10 Running Programs in Blocks 28
- 1.11 Running Programs with Break Points 29
- 1.12 Binary File Input/Output 30
- 1.13 Images and Sounds 31
- 1.14 Flow Controls 33
- 1.15 User-Defined Functions 34
- 1.16 Cell Arrays 36
- 1.17 Structures 37
- 1.18 Tables 38
- 1.19 Graphical User Interfaces 39
- 1.20 GUIDE: Graphical User Interface Development Environment 42
- 1.21 Creating Standalone Applications 47
- 1.22 MATLAB On-Line Tutorials 50

Chapter 2 Data Types, Operators, and Expressions 52

- 2.1 Numerical Data Types 53
- 2.2 Character Data Type 57
- 2.3 Logical Data Type 59
- 2.4 Arrays 61
- 2.5 Sums, Products, Minima, and Maxima 65
- 2.6 Arithmetic Operators 67
- 2.7 Relational and Logical Operators 71
- 2.8 String Manipulations 73
- 2.9 Expressions 75
- 2.10 Example: Function Approximations 77
- 2.11 Example: Series Solution of a Laplace Equation 81
- 2.12 Example: Deflection of Beams 83
- 2.13 Example: Vibrations of Supported Machines 85
- 2.14 Additional Exercise Problems 89

Chapter 3 Flow Controls, Functions, and Programs 92

- 3.1 If-Blocks 93
- 3.2 Switch-Blocks 95
- 3.3 While-Loops 97
- 3.4 For-Loops 98
- 3.5 User-Defined Functions 100
- 3.6 Subfunctions 103
- 3.7 Nested Functions 104
- 3.8 Function Handles 105
- 3.9 Anonymous Functions 107
- 3.10 Function Precedence Order 109
- 3.11 Program Files 110
- 3.12 Example: Deflection of Beams 111
- 3.13 Example: Sorting and Searching 112
- 3.14 Example: Statically Determinate Trusses (Version I) 115
- 3.15 Example: Statically Determinate Trusses (Version II) 118
- 3.16 Additional Exercise Problems 127

Chapter 4 Cell Arrays, Structures, Tables, and User-Defined Classes 128

- 4.1 Cell Arrays 129
- 4.2 Functions of Variable-Length Arguments 131
- 4.3 Structures 134
- 4.4 Example: Statically Determinate Trusses (Version III) 136
- 4.5 Tables 140
- 4.6 Conversion of Cell Arrays 143
- 4.7 Conversion of Structure Arrays 145
- 4.8 Conversion of Tables 147
- 4.9 User-Defined Class: Poly 149
- 4.10 Additional Exercise Problems 153

Chapter 5 Data Visualization: Plots 156

- 5.1 Graphics Objects and Their Parent/Children Relationship 157
- 5.2 Graphics Objects Properties 160
- 5.3 Figure Objects 164
- 5.4 Axes Objects 165
- 5.5 Line Objects 169
- 5.6 Text Objects 171
- 5.7 Legend Objects 174
- 5.8 Bar Plots 175
- 5.9 Pie Plots 177
- 5.10 3-D Line Plots 178
- 5.11 Surface and Mesh Plots 179
- 5.12 Contour Plots 183
- 5.13 Vector Plots 185
- 5.14 Streamline Plots 186
- 5.15 Isosurface Plots 188
- 5.16 Additional Exercise Problems 189

Chapter 6 Animations, Images, Audios, and Videos 192

- 6.1 Animation of Line Plots: Comet 193
- 6.2 Stream Particles Animations 194
- 6.3 Movie: Animation of an Engine 196
- 6.4 Indexed Images 198
- 6.5 True Color Images 200
- 6.6 Audios 202
- 6.7 Videos 204
- 6.8 Example: Statically Determinate Trusses (Version IV) 205
- 6.9 Additional Exercise Problems 208

Chapter 7 Data Import and Export 210

- 7.1 Screen Text I/O 211
- 7.2 Low-Level Text File I/O 214
- 7.3 Low-Level Binary File I/O 217
- 7.4 MAT-Files 218
- 7.5 ASCII-Delimited Files 219
- 7.6 Excel Spreadsheet Files 220
- 7.7 Additional Exercise Problems 221

Chapter 8 Graphical User Interfaces 224

- 8.1 Predefined Dialog Boxes 225
- 8.2 UI-Controls: Pushbuttons 228
- 8.3 Example: Image Viewer 231
- 8.4 UI-Menus: Image Viewer 233
- 8.5 Panels, Button Groups, and More UI-Controls 235
- 8.6 UI-Controls: Sliders 239
- 8.7 UI-Tables: Truss Data 240
- 8.8 Example: Statically Determinate Trusses (Version V) 243
- 8.9 GUIDE: Graphical User Interface Development Environment 249
- 8.10 Additional Exercise Problems 260

Chapter 9 Symbolic Mathematics 262

- 9.1 Symbolic Constants, Variables, Functions, and Expressions 263
- 9.2 Simplification of Expressions 266
- 9.3 Example: Curvature of a Planar Curve 268
- 9.4 Example: Normal Distributions 270
- 9.5 Limits 271
- 9.6 Example: Taylor Series 272
- 9.7 Algebraic Equations 273
- 9.8 Inverse of Matrix: Hookes's Law 275
- 9.9 Ordinary Differential Equations (ODE) 276
- 9.10 Additional Exercise Problems 280

Chapter 10 Linear Algebra, Polynomial, Curve Fitting, and Interpolation 282

- 10.1 Products of Vectors 283
- 10.2 Systems of Linear Equations 286
- 10.3 How Does Backslash Operator Work? 289
- 10.4 Eigenvalue Problems 292
- 10.5 Polynomials 293
- 10.6 Polynomial Curve Fittings 296
- 10.7 Using Interactive Curve-Fitting Tools 298
- 10.8 Linear Regression Through Origin: Brake Assembly 300
- 10.9 Interpolations 303
- 10.10 Two-Dimensional Interpolations 305

Chapter 11 Differentiation, Integration, and Differential Equations 306

- 11.1 Numerical Differentiation 307
- 11.2 Numerical Integration: `trapz` 309
- 11.3 Length of a Curve 310
- 11.4 User-Defined Function as Input Argument: `integral` 312
- 11.5 Area and Centroid 313
- 11.6 Placing Weight on Spring Scale 315
- 11.7 Double Integral: Volume Under Stadium Dome 317
- 11.8 Initial Value Problems 318
- 11.9 IVP: Placing Weight on Spring Scale 321
- 11.10 ODE-BVP: Deflection of Beams 323
- 11.11 IBVP: Heat Conduction in a Wall 326

Chapter 12 Nonlinear Equations and Optimization 330

- 12.1 Nonlinear Equations: Intersection of Two Curves 331
- 12.2 Kinematics of Four-Bar Linkage 333
- 12.3 Asymmetrical Two-Spring System 336
- 12.4 Linear Programming: Diet Problem 338
- 12.5 Mixed-Integer Linear Programming 342
- 12.6 Unconstrained Single-Variable Optimization 344
- 12.7 Unconstrained Multivariate Optimization 347
- 12.8 Multivariate Linear Regression 350
- 12.9 Non-Polynomial Curve Fitting 352
- 12.10 Constrained Optimization 355

Chapter 13 Statistics 360

- 13.1 Descriptive Statistics 361
- 13.2 Normal Distribution 367
- 13.3 Central Limit Theory 370
- 13.4 Confidence Interval 374
- 13.5 Chi-Square Distribution 376
- 13.6 Student's t -Distribution 380
- 13.7 One-Sample t -Test: Power Supply 382
- 13.8 Linear Combination of Random Variables 384
- 13.9 Two-Sample t -Test: Injection Molded Plastic 385
- 13.10 F -Distribution 387
- 13.11 Two-Sample F -Test: Injection Molded Plastic 389
- 13.12 Comparison of Means by F -Test 391

Index 393