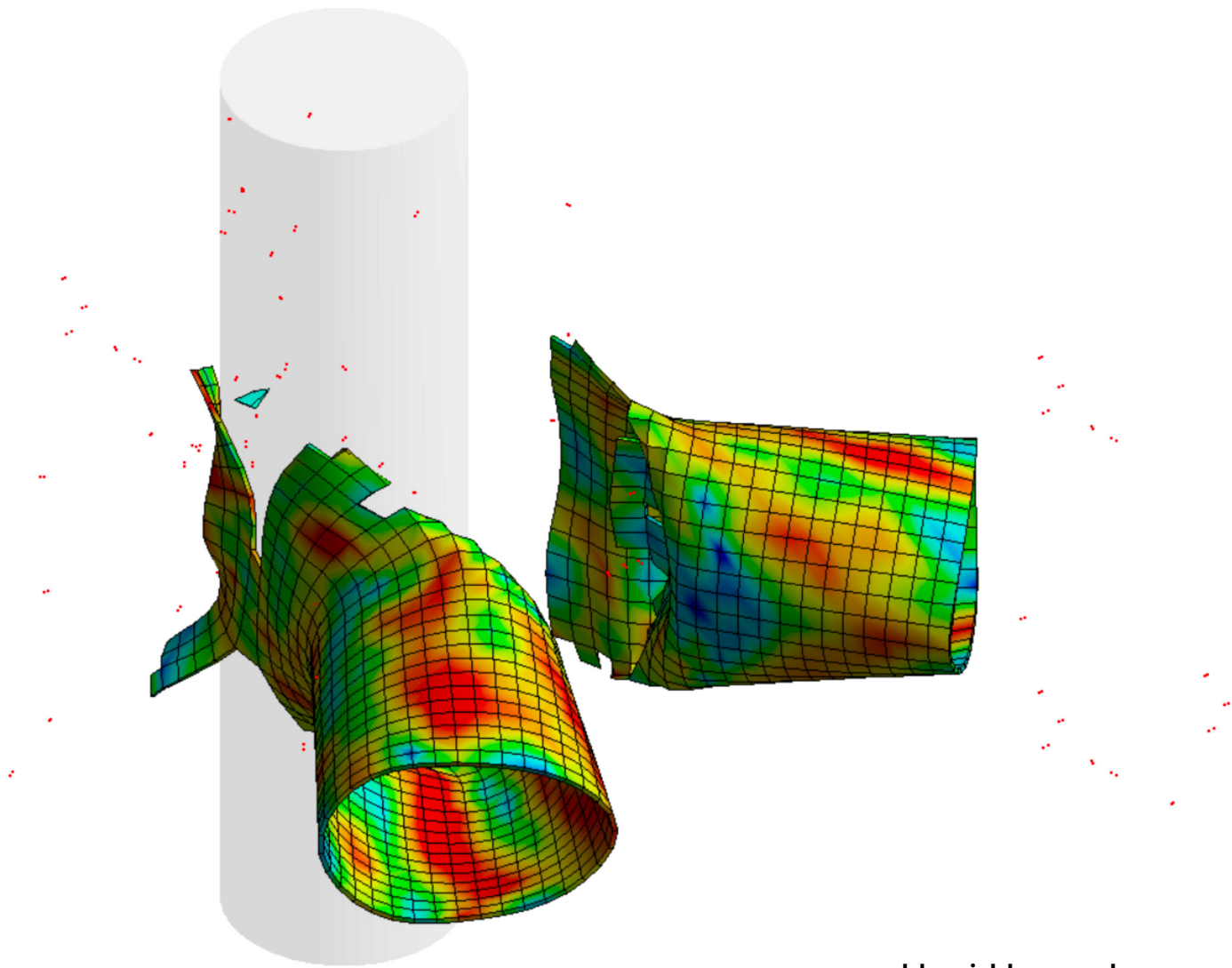


# Finite Element Simulations

with ANSYS® Workbench 2021

Theory, Applications, Case Studies

Printed  
in Full Color



Huei-Huang Lee

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 4

## Chapter 1 Introduction 9

- 1.1 Case Study: Pneumatically Actuated PDMS Fingers 10
- 1.2 Structural Mechanics: A Quick Review 24
- 1.3 Finite Element Methods: A Concise Introduction 35
- 1.4 Failure Criteria of Materials 40
- 1.5 Review 47
- 1.6 Appendix: An Unofficial History of ANSYS 51

## Chapter 2 Sketching 56

- 2.1 W16x50 Beam 57
- 2.2 Triangular Plate 70
- 2.3 More Details 81
- 2.4 M20x2.5 Threaded Bolt 92
- 2.5 Spur Gears 97
- 2.6 Microgripper 103
- 2.7 Review 107

## Chapter 3 2D Simulations 109

- 3.1 Triangular Plate 110
- 3.2 Threaded Bolt-and-Nut 125
- 3.3 More Details 140
- 3.4 Spur Gears 151
- 3.5 Structural Error, FE Convergence, and Stress Singularity 157
- 3.6 Review 170

## Chapter 4 3D Solid Modeling 172

- 4.1 Beam Bracket 173
- 4.2 Cover of Pressure Cylinder 179
- 4.3 Lifting Fork 190
- 4.4 More Details 197
- 4.5 LCD Display Support 203
- 4.6 Review 207

## Chapter 5 3D Simulations 209

- 5.1 Beam Bracket 210
- 5.2 Cover of Pressure Cylinder 219
- 5.3 More Details 227
- 5.4 LCD Display Support 231
- 5.5 Review 236

## Chapter 6 Surface Models 238

- 6.1 Bellows Joints 239
- 6.2 Beam Bracket 249
- 6.3 Gearbox 256
- 6.4 Review 269

## Chapter 7 Line Models 271

- 7.1 Flexible Gripper 272
- 7.2 3D Truss 283
- 7.3 Two-Story Building 295
- 7.4 Review 309

## Chapter 8 Optimization 311

- 8.1 Flexible Gripper 312
- 8.2 Triangular Plate 323
- 8.3 Review 329

## Chapter 9 Meshing 330

- 9.1 Pneumatic Fingers 331
- 9.2 Cover of Pressure Cylinder 346
- 9.3 Convergence Study of 3D Solid Elements 353
- 9.4 Review 365

## Chapter 10 Buckling and Stress Stiffening 367

- 10.1 Stress Stiffening 368
- 10.2 3D Truss 379
- 10.3 Beam Bracket 383
- 10.4 Review 387

## Chapter 11 Modal Analysis 389

- 11.1 Gearbox 390
- 11.2 Two-Story Building 395
- 11.3 Compact Disk 402
- 11.4 Guitar String 410
- 11.5 Review 417

## Chapter 12 Transient Structural Simulations 419

- 12.1 Basics of Structural Dynamics 420
- 12.2 Lifting Fork 429
- 12.3 Harmonic Response Analysis: Two-Story Building 441
- 12.4 Disk and Block 448
- 12.5 Guitar String 456
- 12.6 Review 466

## Chapter 13 Nonlinear Simulations 468

- 13.1 Basics of Nonlinear Simulations 469
- 13.2 Translational Joint 481
- 13.3 Microgripper 495
- 13.4 Snap Lock 508
- 13.5 Review 524

## Chapter 14 Nonlinear Materials 526

- 14.1 Basics of Nonlinear Materials 527
- 14.2 Belleville Washer 536
- 14.3 Planar Seal 553
- 14.4 Review 568

## Chapter 15 Explicit Dynamics 570

- 15.1 Basics of Explicit Dynamics 571
- 15.2 High-Speed Impact 577
- 15.3 Drop Test 587
- 15.4 Review 599

## Index 601