

Learning Autodesk®

Inventor® 2012

Modeling, Analysis and Animation

Randy H. Shih



Table of Contents

Preface	i
Acknowledgments	ii
Table of Contents	iii
Chapter 1	
Introduction – Getting Started	
Introduction	1-2
Development of Computer Geometric Modeling	1-2
Feature-Based Parametric Modeling	1-6
Getting Started with Autodesk Inventor	1-7
The Screen Layout and Getting Started Toolbar	1-8
The New File Dialog Box and Units Setup	1-9
Autodesk Inventor Screen Layout	1-10
Application Menu	1-11
Quick Access Toolbar	1-11
Ribbon Tabs	1-11
Online Help Panel	1-11
2D Sketch Toolbar	1-12
Graphics Window	1-12
Graphics Cursor or Crosshairs	1-12
Message and Status Bar	1-13
Mouse Buttons	1-13
[Esc] - Canceling Commands	1-14
Autodesk Inventor Help System	1-14
Data Management using Inventor Project files	1-15
Setup of a New Inventor Project	1-17
The Content of an Inventor Project File	1-19
Leaving Autodesk Inventor	1-19
Chapter 2	
Parametric Modeling Fundamentals	
Introduction	2-2
The Tiger Head Design	2-3
Starting Autodesk Inventor	2-3
Autodesk Inventor Screen Layout	2-5
Creating Rough Sketches	2-6
Step 1: Creating a Rough Sketch	2-7
Graphics Cursors	2-7
Geometric Constraint Symbols	2-8

Step 2: Apply/Modify Constraints and Dimensions	2-9
Dynamic Viewing Functions – <i>Zoom</i> and <i>Pan</i>	2-13
Modifying the Dimensions of the Sketch	2-13
Delete an Existing Geometry of the Sketch	2-14
Using the 3-Point Arc Command	2-15
Step 3: Completing the Base Solid Feature	2-17
Dynamic Rotation of the 3-D Block - 3D Orbit	2-18
Dynamic Viewing - Quick Keys	2-20
Viewing Tools – Standard Toolbar	2-22
Display Modes	2-25
Orthographic vs. Perspective	2-25
Disable the Heads-Up Display Option	2-26
Sketch plane – It is an XY CRT, but an XYZ World	2-27
Step 4-1: Adding an Extruded Feature	2-29
Step 4-2: Adding a Cut Feature	2-33
Save the Model	2-34
Step 5: Adding Additional Feature	2-36
Using the Decal Command	2-39
Save the Model	2-42
Questions	2-43
Exercises	2-44

Chapter 3

CSG Concepts and Model History Tree

Introduction	3-2
Binary Tree	3-3
Model History Tree	3-4
The A6-Knee Part	3-5
Starting Autodesk Inventor	3-5
Modeling Strategy - CSG Binary Tree	3-6
The <i>Autodesk Inventor Browser</i>	3-7
Base Feature	3-7
<i>GRID</i> Intervals Setup	3-8
Creating the Base Feature	3-9
Adding the Second Solid Feature	3-13
Creating a 2D Sketch	3-14
Renaming the Part Features	3-16
Adjusting the Dimensions of the Base Feature	3-16
History-Based Part Modifications	3-19
Adding a Placed Feature	3-20
Using the Offset Command to Create a Feature	3-22
Adding another Hole Feature	3-25
Assigning and Calculating the Associated Physical Properties	3-27
Questions	3-29
Exercises	3-30

Chapter 4

Parametric Constraints Fundamentals

CONSTRAINTS and RELATIONS	4-2
Create a Simple Triangular Plate Design	4-2
Fully Constrained Geometry	4-3
Starting Autodesk Inventor	4-3
Displaying Existing Constraints	4-4
Applying Geometric/Dimensional Constraints	4-6
Over-Constraining and Driven Dimensions	4-10
Deleting Existing Constraints	4-11
Using the Auto Dimension Command	4-12
Constraint and Sketch Settings	4-16
The BORN Technique	4-17
Sketch Plane Settings	4-17
Applying the BORN Technique	4-19
Creating the 2D Sketch for the Base Feature	4-21
Parametric Relations	4-22
Viewing the Established Parameters and Relations	4-24
Sketches vs. Profiles	4-27
Modify the Profile	4-30
Extrusion with the Taper Angle option	4-31
A Profile containing Multiple Closed Regions	4-34
Add a Feature using Existing Geometry	4-36
Saving the Model File	4-37
Using the Measure Tools	4-38
The <i>Boot</i> Part	4-42
Questions	4-45
Exercises	4-46

Chapter 5

Pictorials and Sketching

Engineering Drawings, Pictorials and Sketching	5-2
Isometric Sketching	5-7
Isometric Sketching Exercises	5-9
Oblique Sketching	5-10
Oblique Sketching Exercises	5-11
Perspective Sketching	5-12
Autodesk Inventor Orthographic vs. Perspective	5-13
One-point Perspective	5-14
Two-point Perspective	5-15
Perspective Sketching Exercises	5-16
Questions	5-17
Exercises	5-18

Chapter 6

Symmetrical Features and Part Drawings

Drawings from Parts and Associative Functionality	6-2
The <i>A12- Rear Axle Support</i> Design	6-3
Starting Autodesk Inventor	6-3
Modeling Strategy	6-4
Set Up the Display of the Sketch Plane	6-5
Creating the Base Feature	6-6
Creating a Symmetric Cut Feature	6-9
Using the Projected Geometry Option	6-11
Creating a Revolved Feature	6-11
Creating another Extrude Feature	6-14
Creating a Cut Feature	6-17
Creating a Mirrored Feature	6-19
Drawing Mode – 2D Paper Space	6-20
Drawing Sheet Format	6-21
Using the Pre-defined Drawing Sheet Formats	6-23
Deleting, Activating, and Editing a Drawing Sheet	6-25
Adding a Base View	6-26
Creating Projected Views	6-27
Adjusting the View Scale	6-28
Repositioning Views	6-29
Displaying Feature Dimensions	6-30
Repositioning and Hiding Feature Dimensions	6-32
Adding Additional Dimensions – Reference Dimensions	6-33
Adding Center Marks and Center Lines	6-34
Completing the Drawing Sheet	6-36
Associative Functionality – Modifying Feature Dimensions	6-37
Questions	6-40
Exercises	6-41

Chapter 7

Datum Features in Designs

Work Features	7-2
The <i>B2-Chassis</i> Part	7-2
Modeling Strategy	7-3
Starting Autodesk Inventor	7-4
Applying the BORN Technique	7-5
Creating the Base Feature	7-6
Creating the Tapered Extruded Feature	7-10
Creating an Offset Work Plane	7-11
Creating a Revolved Feature	7-12
Creating an Angled Work Plane	7-15
Creating another Offset Work Plane	7-16

Creating a 2D Sketch on Work Plane3	7-17
Completing the Solid Feature	7-19
Changing the Color of the Solid Model	7-20
The <i>Crank Right</i> Part	7-21
The <i>A10-Crank Left</i> Part	7-23
The <i>Motor</i>	7-25
The <i>A1-Axle End Cap</i> Part	7-28
The <i>Hex Shaft with Collar</i> Part	7-29
The <i>A8-Rod Pin</i> Part	7-33
Questions	7-34
Exercises	7-35

Chapter 8

Content Center and Gear Generator

Introduction	8-2
Starting Autodesk Inventor	8-3
Using the Content Center	8-4
Introduction to Gears	8-7
Spur Gear Nomenclatures	8-9
Basic Involute Tooth Profile	8-11
Gear Ratio	8-12
The Inventor Spur Gear Generator	8-14
Modify the Generated Gears	8-18
Completing the Solid Feature	8-20
Create a Mirrored Feature	8-21
Importing the Profile of the Pinion Gear	8-22
Create the <i>G3-Spur Gear</i> Part	8-27
Create another Spur Gear set	8-30
Create the <i>G0-Pinion</i> Part	8-31
Start a New Part File	8-33
Export/Import the Generated Gear Profile	8-37
Questions	8-45
Exercises	8-46

Chapter 9

Advanced 3D Construction Tools

Introduction	9-2
A Thin-Walled Design: <i>Battery Case</i>	9-2
Modeling Strategy	9-3
Starting Autodesk Inventor	9-4
Set Up the Display of the Sketch Plane	9-4
Creating the Base Feature	9-5
Creating a Cut Feature	9-8

Creating a Shell Feature	9-12
Creating a Cut Feature	9-13
Creating another Extruded Feature	9-15
Creating another Cut Feature	9-19
Mirroring Features	9-21
Creating another Cut Feature	9-23
Create the Last Feature	9-25
A Thin-Wire Design: <i>Linkage Rod</i>	9-28
Start another Model	9-28
Creating a Swept Feature	9-29
Create a Mirrored Feature	9-33
The <i>Gear Box Right</i> Part	9-28
The <i>Gear Box Left</i> Part	9-39
Questions	9-43
Exercises	9-44

Chapter 10

Planar Linkage Analysis using GeoGebra

Introduction to Four-Bar Linkage	10-2
Introduction to GeoGebra	10-5
Hide the Display of Objects	10-14
Adding a Slider Control	10-16
Using the Animate Option	10-19
Tracking the Path of a Point on the Coupler	10-20
Exercises	10-25

Chapter 11

Design Makes the Difference

Engineering Analysis – How does this work?	11-2
Identify the Six-bar Linkage of the <i>Mechanical Tiger</i>	11-4
Starting GeoGebra	11-6
Adding a Slider Control	11-14
Create the Second Four-bar Mechanism	11-16
Using the Animate Option	11-20
Tracking the Paths of the Feet	11-21
Adjusting the Crank Length	11-23
The Jansen Mechanism	11-24
The Klann Mechanism	11-25
Exercises	11-33

Chapter 12

Assembly Modeling and Motion Analysis

Introduction	12-2
Assembly Modeling Methodology	12-3
The <i>Mechanical Tiger</i> Assembly	12-4
Additional Parts	12-4
Starting Autodesk Inventor	12-6
Creating the Leg Subassembly	12-7
Placing the Second Component	12-8
Degrees of Freedom and Constraints	12-9
Assembly Constraints	12-10
Apply the First Assembly Constraint	12-12
Apply a Second MATE Constraint	12-14
Constrained Move	12-15
Placing the Third Component	12-16
Applying an Insert Constraint	12-17
Apply a Flush Constraint	12-19
Edit Parts in the Assembly Mode	12-21
Assemble the <i>Boot</i> Part	12-25
Using the Content Center and Assemble Two Screws	12-27
Starting the <i>Main Assembly</i>	12-29
Assemble the <i>Gear Box Right</i> Part	12-31
Assemble the <i>Motor</i> and the <i>Pinion Gear</i>	12-33
Assemble the <i>G1 Gear</i>	12-38
Animation with the Inventor Drive Constraint Tool	12-40
Assemble the <i>G2 Gear</i> and the <i>G3 Gear</i>	12-41
Assemble the <i>Crank</i> Parts	12-47
Assemble the <i>Rear Shaft</i> and <i>Legs</i>	12-51
Assemble the <i>Linkage-Rods</i>	12-53
Complete the Assembly Model	12-55
Record an Animation Movie	12-56
Conclusion	12-58
Questions	12-59
Exercises	12-60

Index