Chapter 4

3D CADD, Animation, and Virtual Reality

Learning Objectives

- After completing this chapter, you will
  - Explain the difference between wireframe, surface, and solid modeling
  - Discuss the function of parametric modeling
  - Explain the use of animation in the design drafting profession
  - Discuss virtual reality as it relates to design drafting

Part I

Types of Solid Models

Limitations of 2D

- 2D drawings are useful for documenting engineering design requirements, however
  - Product might be hard to visualize
  - Product cannot be tested and analyzed virtually
- 3D models provide testable, easy to visualize representations of a product

Wireframe Models

- Most basic of solid models
- Contain information about
  - Object edges
  - Intersection of edges
- Provides an outline of the object
- Primary advantage
  - Small drawing files

Wireframe Models

- Disadvantages
  - No information on product surfaces
  - No representation of complex surfaces
  - Do not define object volume
    - Not useful for calculating mass
    - Not useful for generating machining code

Surface Models

- Similar to wireframes
  - Contain information about object edges
- Provide realistic design representation of objects
- Enable designers to create complex curves and forms
- Used mainly to define object's external shape and appearance

Surface Models

- Because they are hollow, surface models do not
  - Contain mass property data

Solid Models

- Contain data about
  - Object edges
  - Intersections of edges and surfaces
  - Object volume
  - Mass properties
- Can be basic, parametric, or hybrid

Solid Models

- Used by designers to perform
  - Interference and collision checks
  - Mass calculations
  - Simulations
  - Generation of machining code

Solid Models

- Basic or Dumb
  - Not parametric
  - Contain very little information, if any, about
    - Dimensions
    - Constraints
    - Part history
    - Features
  - Window of opportunity to edit/refine is limited

Comparison of Models

Characteristic	Basic Model	Parametric Model	Hybrid Model
Analysis	No	Yes–add on software	Yes
Animation	No	Yes–add on software	Yes
Feature based	No	Yes	Yes
History	No	Yes	Yes
Intelligence	No	Yes	Yes
Surface modeling	No	Limited	Yes
Updateable	No	Yes	Yes
Volumetric Information	Yes	Yes	Yes

Part II

Parametric Solid Modeling

Definition

- Contains parameters
  - Controls
  - Constraints
  - Checks
- Parameters enable designers to make changes and updates quickly to existing geometry

Intelligence

- Parametric model information
  - Stored in a database
  - Model characteristics are managed in the database
    - Calculations
    - Sketches
    - Features
    - Dimensions
    - Geometric parameters

Parametric Model Programs

- Autodesk Inventor
- Pro/Engineer
- Solidworks

Parametric Modeling Elements

- Sketches
  - First step in creating the model
- Sketched features
  - Lofts, sweeps, extrusions, and revolves
- Placed features
  - Shells, fillets, chamfers, holes
- Reference features
  - Workpoints, axes, workplanes

Parametric Modeling Elements

- Catalog features
  - Copy of an existing feature or part created in another file
- Pattern features
  - Polar and rectangular arrays, mirrors

Parametric Modeling Types

- Part Modeling
- Assembly Modeling
  - Existing parts are constrained, or mated, to form an assembly
- Layout Generation
  - Orthographic, section, and auxiliary views generated (assembly or individual part)
  - Pictorials (e.g., isometrics) generated

Part III

Animation and Virtual Reality

Animation

- Process of making drawings or models move and change
  - Sequence of predefined images
- Function depends on type of application and specific requirements
  - Customer needs
  - Marketing needs
  - Engineering needs

Animation

- Design
  - Explore motion and relationship of components
  - Document assembly and disassembly
  - Provide alternative generation ideas
- Film
  - Add visual effects

Animation

- Games
  - Provide realism
- Education
  - “A picture is worth a thousand words”
  - Additional learning tools
    - On-line/Distance learning

Virtual Reality (VR)

- Designer is placed inside a model virtually
  - Sees model from a variety of viewpoints
  - Allows for interaction with the model
- Applications
  - Walking through a virtual house
  - Practicing surgery on a virtual patient
  - Conducting experiments on a molecular level

HMD

- Head-mounted display
  - Tracks the user's head movements
  - Adjusts and regenerates viewpoint
  - Delivers sounds
- Moving to smaller, less cumbersome units

Summary

- 3D CADD
  - Can be basic or parametric
  - Parametric models enable designers to easily update geometry and create complex assemblies
- Animation and VR
  - Used in a variety of disciplines to enhance user experience and interaction with computer images