The Computer Graphics Process and the Graphics Pipeline

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The Graphics Process

3D Geometric Models
3D Animation Definition
Rendering
Texture Information
Lighting Information
Surface Information
Image Storage and Display
The Graphics Process: Geometric Modeling

3D Scanning
Interactive Geometric Modeling
Model Libraries
Displacement Mapping
Material Properties

The Graphics Process: 3D Animation

Motion Design
Motion Computation (physics)
Motion Capture
Dynamic Deformations

3D Animation Definition
Rendering
The Graphics Process: Texturing

Scanned Image Textures

Procedural (computed) Textures

Painted Textures

Texture Information

Rendering

The Graphics Process: Surface Information

Alpha-Blended Transparency

Refractive Transparency

Reflectivity

Subsurface Scattering

Surface Information

Rendering
The Graphics Process: Surface Information

- Alpha-Blended Transparency
- Refractive Transparency
- Reflectivity
- Subsurface Scattering

The Graphics Process: Lighting

Lighting Types
(point, directional, spot, ...)

Light Positions

Light Colors

Light Intensities

Rendering

Lighting Information

Surface Information

3D Geometric Models

3D Texture Information

Image Storage and Display
The Graphics Process: Rendering

- 3D Geometric Models
- Lighting Information
- Texture Information
- Surface Information
- Rendering

The Graphics Process: Image Storage and Display

- Hardware Framebuffer
- Rendering
- Disk File
- Recording
- Editing

Image Storage and Display
### The Basic Computer Graphics Pipeline

1. **Model Transform**
2. **View Transform**
3. **Per-vertex Lighting**
4. **Projection Transform**
5. **Homogeneous Division**
6. **Viewport Transform**
7. **Fragment Processing, Texturing, Per-fragment Lighting**
8. **Rasterization**
9. **Framebuffer**

**Coordinates:**
- **MC** = Model Coordinates
- **WC** = World Coordinates
- **EC** = Eye Coordinates
- **CC** = Clip Coordinates
- **NDC** = Normalized Device Coordinates
- **SC** = Screen Coordinates