Computer Graphics

Computer graphics are required to display visuals. There are many fields of computer graphics, ranging from GUIS to CGI.

2D

Image processing allows users to manipulate images by adjusting the underlying pixels.

2D graphics allow users to manipulate shapes. These shapes are scalable and allow resizing without image degradation.

3D

Both 2D and 3D graphics store a mathematical representation of the result and provide a convenient abstraction for the user to manipulate.

3D graphics produce "photographs" of the virtual scenes. These scenes, created on the computer can defy the laws that bind the real world, thus granting great creative control to the user.

The visual a user sees is a 2D representation of the 3D scene. For film, the output can be encoded as video (a form of image sequence).

For video games, however, the resulting images cannot be pre-calculated and therefor must be drawn directly to the screen at a high refresh rate to provide responsiveness to the users.

Whether saved toa file or drawn to a screen, the process required to generate the resulting imagery is known as rendering. Rendering is a computationally expensive, multi-step process.

Rendering requires 3D geometry to be mapped to a 2D camera image window. There are multiple ways this can be achieved; using rasterization, raycasting or raytracing. Each process is reliant on analytic geometry.

Different models and vertexes of those models may have different materials. Materials are used to calculate the colour of the resulting pixel for objects in the image window.

Animation

Animation can be achieved when multiple images are displayed in quick succession, creating the illusion of movement for the viewer.

computers with the appropriate software can produce CGI animations.

2D animation

In 2D animation, master animators draw keyframes for a sequence. These keyframes show the poses of objects/characters at 'key' intervals in time.

Assistant animators are then responsible for drawing the frames in between the keyframes. This process

is called inbetweening.

3D animation

In both 2D and 3D animation animators must create keyframes. For 3D animation, however, the process of inbetweening is handled by the computer.

Animators can choose different interpolation techniques to alter the velocity of the interpolations.

3D characters can be controlled using "bones". the vertexes that define the surface of an object are then mapped to each bone. When a bone is moved, the vertexes mapped to it are also moved.

Bones can be animated using kinematics. Kinematics allows for bone positioning to be calculated relative to another bones position.

Using kinematics an animator can animate afoot, and the leg will automatically accommodate its movement.

Simulations

Dynamics can be applied to objects in scenes allowing them o be animated by the laws of gravity and other forces.

Dynamics are a form of simulation. Advanced simulations can simulate smoke and water dynamics. Simulations these days are also used to generate CGI crowds.

Computer-generated imagery has enabled create the freedom that has previously been impossible due to budget, safety or even the laws of physics.