

Polygon mesh shapes examples

Using two basic methods: extrusion and rotation

Fixed: cube, tetrahedron, barn

Extruded: prism. Start with points in x,z plane, and extrude up.

Given: polyline $p[i] = \langle x_i, 0, z_i \rangle$ for i in 0 to $n-1$ (n points)

Create: polyline $p[i] = \langle x_i, h, z_i \rangle$ for i in n to $2n-1$ (n points)

Discrete surface of revolution: Start with polyline in x,y plane, sweep around y-axis

Given: polyline $p[i] = \langle x_i, y_i, 0 \rangle$

Create: grid $g[i,t] = \langle x_i \cos t, y_i, x_i \sin t \rangle$ for t in range $[0, 2\pi)$ with dt

Parametric surface of revolution: Start with parametric curve in x,y plane, sweep!

Given: curve $p(u) = \langle p_x(u), p_y(u), 0 \rangle$ for s in $[0, 2\pi)$

Create: surface $p(u,v) = \langle p_x(u) \cos(v), p_y(u), p_x(u) \sin(v) \rangle$ for t in $[0, 2\pi)$

Sphere: Start with parametric circle in x,y plane, sweep around y-axis

Given: curve $p(u) = \langle R \cos(u), R \sin(u), 0 \rangle$

Create: surface $p(u,v) = \langle R \cos(u) \cos(v), R \sin(u), R \cos(u) \sin(v) \rangle$

Cylinder: Start with parametric line in x,y plane, sweep around y-axis

Given: curve $p(u) = \langle W, uH, 0 \rangle$ u in $[0, 1]$

Create: surface $p(u,v) = \langle W \cos(v), uH, W \sin(v) \rangle$

Cone: Start with tilted parametric line in x,y plane, sweep around y-axis

Given: curve $p(u) = \langle (1-u)W, uH, 0 \rangle$ u in $[0, 1]$

Create: surface $p(u,v) = \langle W(1-u)\cos(v), uH, W(1-u)\sin(v) \rangle$

Bilinear patch: Start with line in 3D space, sweep along a second line

Given: four points in 3D, p_0, p_1, p_2, p_3

Create: $P_1(t) = (1-t)p_0 + tp_1$ and $P_2(t) = (1-t)p_3 + tp_2$

Blend: $P(s,t) = (1-s)P_1(t) + sP_2(t)$

Parametric patch: Start with two parametric curves in 3D space, sweep along line

Given: two curves in 3D, $P_1(t)$ and $P_2(t)$, blend them

Create: $P(s,t) = (1-s)P_1(t) + sP_2(t)$