

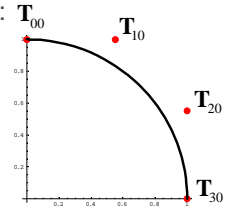
Surface of revolution

- Exact rotation of the control points works only for interpolating splines
- For approximating splines control points along a circle arc generally don't give a circular spline shape

Example: 8 patch Bézier surface

- We need to place the control points in such a way that the described arc is circular

- Approximation for Bézier:
 - $T_{00} = (0, 1, 0)$
 - $T_{10} = (c, 1, 0)$
 - $T_{20} = (1, c, 0)$
 - $T_{30} = (1, 0, 0)$
 - $c \approx 0.552$



Example: 8 patch Bézier surface

- This gives us a bottom patch
- Next we rotate the profile curve

- ...and place it above the 'spokes'

Example: 8 patch Bézier surface

- This is accomplished by matrix multiplication (only one patch shown):

$$\begin{bmatrix} P_{00} & P_{10} & P_{20} & P_{30} \\ P_{10} & P_{11} & P_{12} & P_{13} \\ P_{20} & P_{21} & P_{22} & P_{23} \\ P_{30} & P_{31} & P_{32} & P_{33} \end{bmatrix} = \begin{bmatrix} T_{10} \\ T_{20} \\ T_{30} \end{bmatrix} \begin{bmatrix} r_0 & r_1 & r_2 & r_3 \end{bmatrix} + \begin{bmatrix} k \\ k \\ k \end{bmatrix} \begin{bmatrix} z_0 & z_1 & z_2 & z_3 \end{bmatrix}$$

$k = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

Example: x,y coord of S_0

Example: 8 patch Bézier surface

Curve, Control points

3D Control points (approximate)

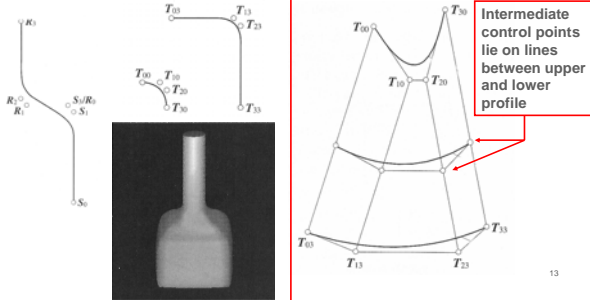
Surface of revolution

Example: 8 patch Bézier surface

- Technique extends to any 'revolution', even non-circular paths

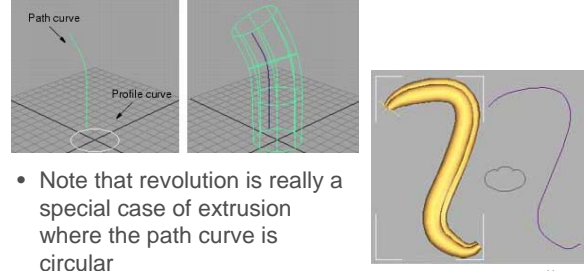
Example: 8 patch Bézier surface

- Technique extends to varying revolution curve

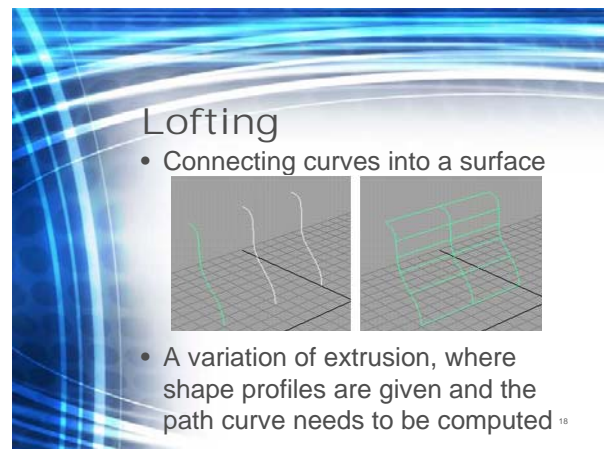
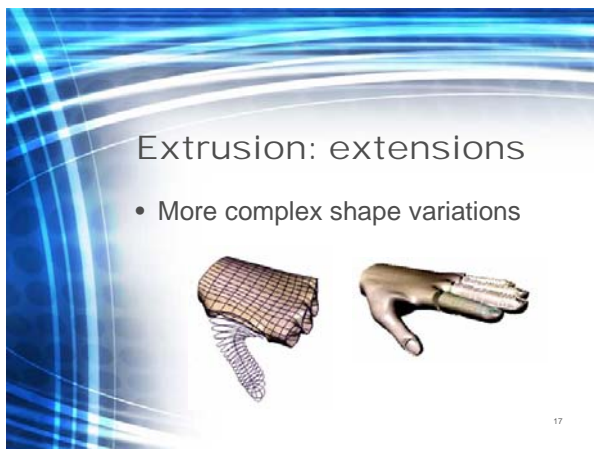
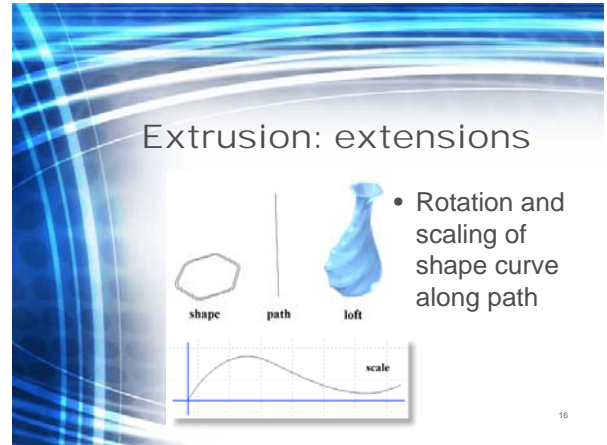
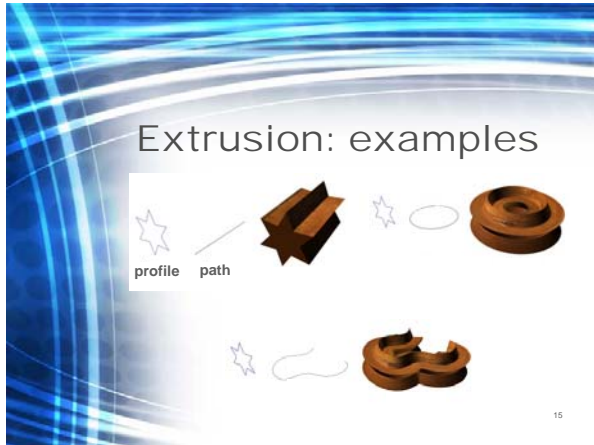


Extrusion

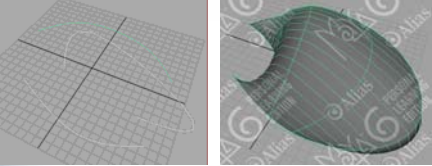
- Extruded surfaces are created by sweeping a profile curve along a path curve



- Note that revolution is really a special case of extrusion where the path curve is circular



Lofting

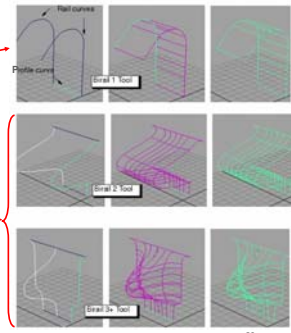


- Mesh may be (naïvely) generated by equalizing the number of control points of each curve and connecting them (in order)

19

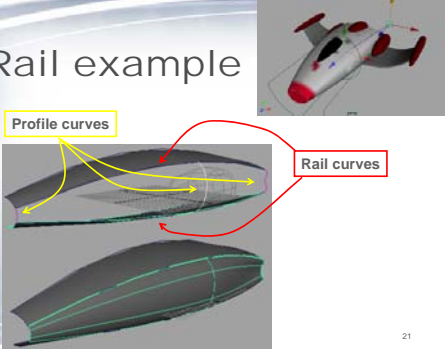
Railing

- = Sliding a profile curve between two rail curves



- Variation: using multiple profile curves
- Equals lofting the rails with a given profile shape

Rail example



21

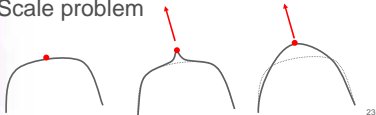
Modelling with patches

- **Sweeping**
- **Interaction**
Editing control points, usually of primitive geometric shapes
- **Creating a mesh**
from a set of 3D points

22

Interaction: editing control points

- 'Free-form sculpting'
- Problems:
 - Maintain patch continuity
 - Scale problem

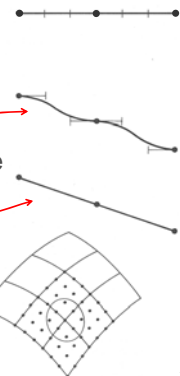


Which is desired?

23

Patch continuity

- To maintain C^1 continuity with Bézier curves, we need each 3 join points to be moved collinearly
- Introduces staircasing, while what we may have wanted was
- With patches, we need to move 9 join points collinearly. Introduces a similar effect



Patch continuity

- Can be solved by **refining** the control point mesh: we can compute a larger set of control points *that defines the same surface*

