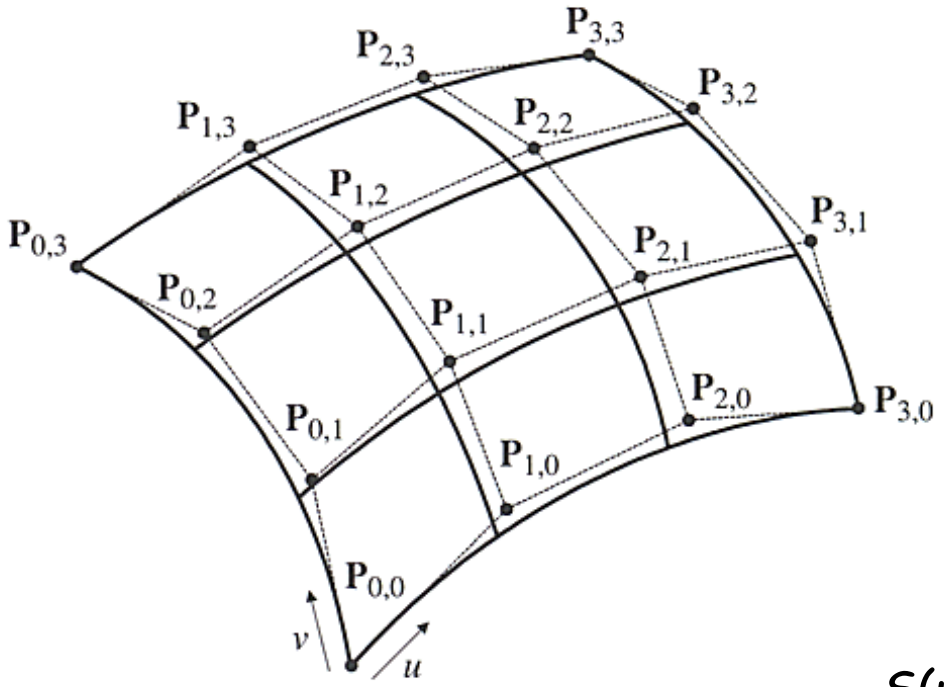
جامعة المنارة
كلية الهندسة
هندسة الروبوت والانظمة الذكية

المحاضرة التاسعة
التصميم بمساعدة الحاسب

الدكتور المهندس
تمّام سلّوم

NURBS Surfaces

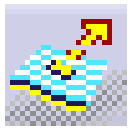
انواع و معادلات السطوح



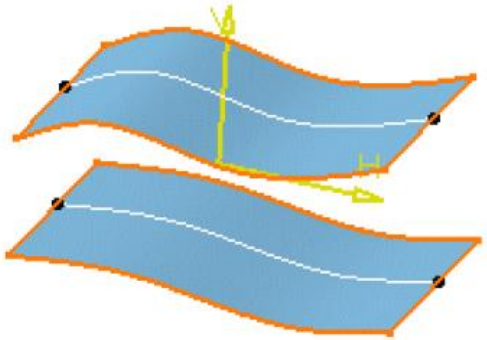
$$S(u,v) = \frac{\sum_{i=0}^{n}\sum_{j=0}^{m} N_{i,p}(u)N_{j,q}(v)w_{i,j}P_{i,j}}{\sum_{i=0}^{n}\sum_{j=0}^{m} N_{i,p}(u)N_{j,q}(v)w_{i,j}}$$

Extrude Surfaces

انشاء سطح عن طريق البثق



1 courbe NURBS: $C(u) = \dfrac{\sum_{i=0}^{n} w_i N_{i,d}(u) P_i}{\sum_{i=0}^{n} w_i N_{i,d}(u)}$ $U = [u_0, u_1, u_2, \ldots, u_{m-1}, u_m]$



Extruded Surfaces

1 vecteur z (direction)

1 scalaire δ

$$S(u,v) = \frac{\sum_{i=0}^{n}\sum_{j=0}^{1} N_{i,d}(u) N_{j,1}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^{n}\sum_{j=0}^{1} N_{i,d}(u) N_{j,1}(v) w_{i,j}}$$

$U = [u_0, u_1, u_2, \ldots, u_{m-1}, u_m]$

$V = [0,0,1,1]$

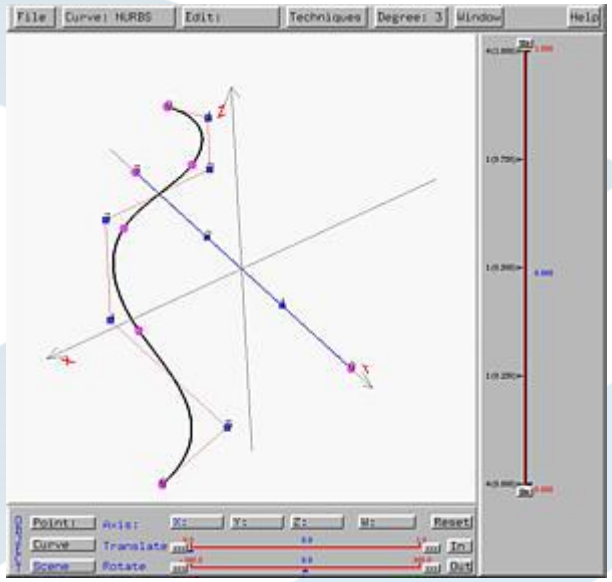
$P_{i,0} = P_i$

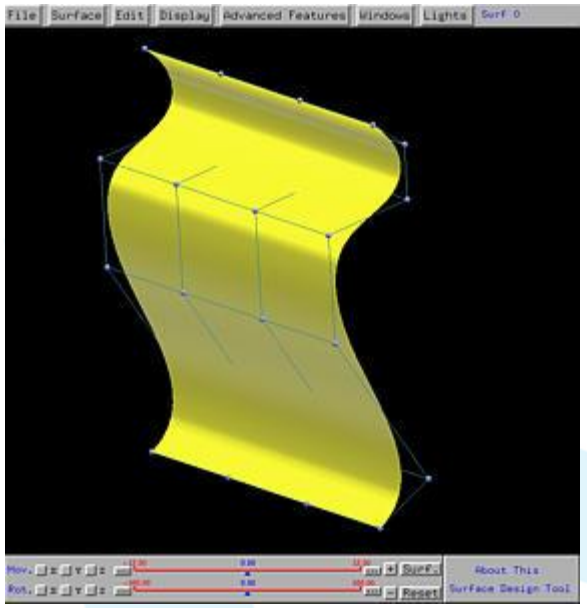
$P_{i,1} = P_i + \delta z$

$w_{i,0} = w_{i,1} = w_i$

Extrude Surfaces

انشاء سطح عن طريق البثق





Extrude Surfaces

انشاء سطح عن طريق البثق

2 courbesNURBS:

$$C(u) = \frac{\sum_{i=0}^{n} w_i N_{i,d}(u) P_i}{\sum_{i=0}^{n} w_i N_{i,d}(u)}$$ Génératrice

$$U = [u_0, u_1, u_2, \ldots, u_{m-1}, u_m]$$

$$D(v) = \frac{\sum_{j=0}^{p} s_j N_{j,e}(v) Q_j}{\sum_{j=0}^{p} s_j N_{j,e}(v)}$$ Guide

$$V = [v_0, v_1, v_2, \ldots, v_{p-1}, v_p]$$

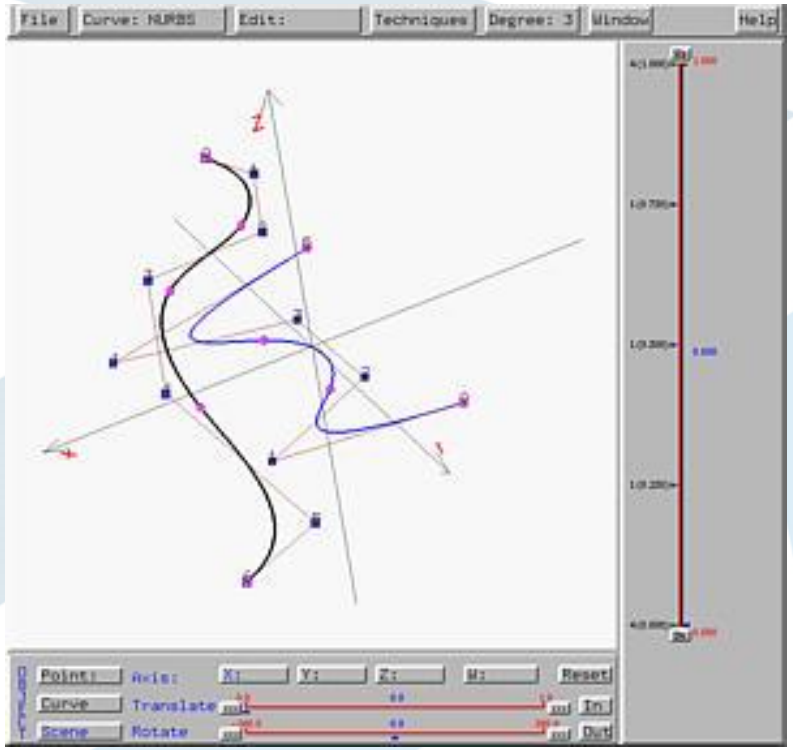
$$S(u,v) = \frac{\sum_{i=0}^{n}\sum_{j=0}^{p} N_{i,d}(u) N_{j,e}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^{n}\sum_{j=0}^{p} N_{i,d}(u) N_{j,e}(v) w_{i,j}}$$

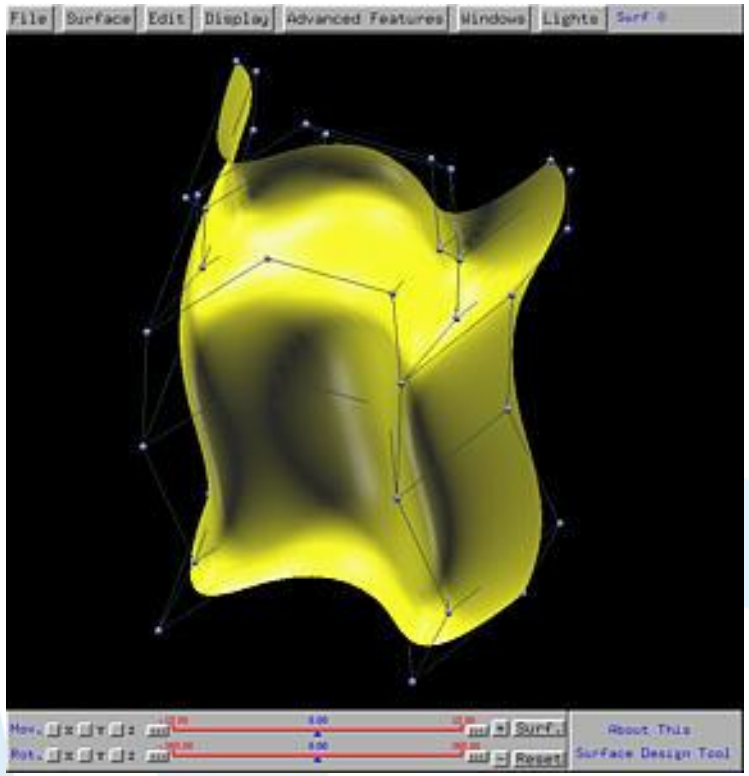
$$P_{i,j} = P_i + Q_j$$

$$w_{i,j} = w_i s_j$$

Extrude Surfaces

انشاء سطح عن طريق البثق





Ruled Surfaces

السطوح الموجهة

2 courbesNURBS:

$$C(u) = \frac{\sum_{i=0}^{n} w_i N_{i,d}(u) P_i}{\sum_{i=0}^{n} w_i N_{i,d}(u)}$$

$$U = [u_0, u_1, u_2, \ldots, u_{m-1}, u_m]$$

$$D(u) = \frac{\sum_{i=0}^{n} s_i N_{i,d}(u) Q_i}{\sum_{i=0}^{n} s_i N_{i,d}(u)}$$

$$U = [u_0, u_1, u_2, \ldots, u_{m-1}, u_m]$$

$$S(u,v) = \frac{\sum_{i=0}^{n}\sum_{j=0}^{1} N_{i,d}(u) N_{j,1}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^{n}\sum_{j=0}^{1} N_{i,d}(u) N_{j,1}(v) w_{i,j}}$$

$$P_{i,0} = P_i$$

$$P_{i,1} = Q_i$$

$$w_{i,0} = w_i$$

$$w_{i,1} = s_i$$

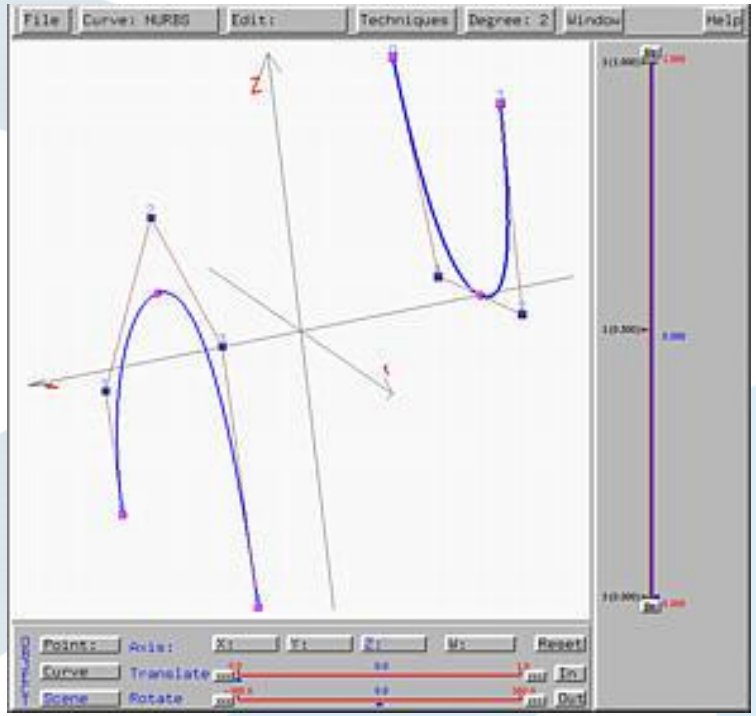
$$U = [u_0, u_1, u_2, \ldots, u_{m-1}, u_m]$$

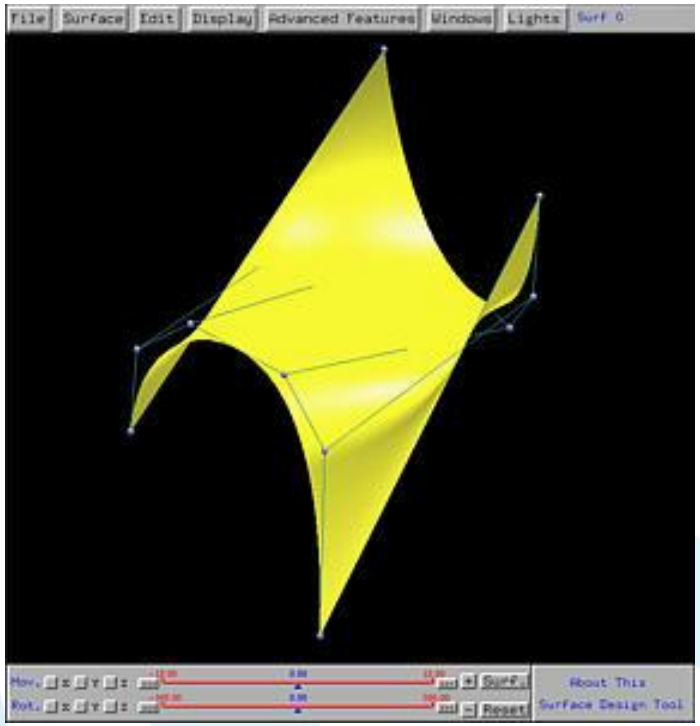
$$V = [0,0,1,1]$$

تستخدم هذه السطوح
في انشاء قوالب الحقن
للنماذج البلاستيكية

Ruled Surfaces

السطوح الموجهة





Surfaces of Revolution

انشاء سطوح عن طريق التدوير

1 courbesNURBS:

$$C(u) = \frac{\sum_{i=0}^{n} w_i N_{i,d}(u) P_i}{\sum_{i=0}^{n} w_i N_{i,d}(u)}$$

$$U = [u_0, u_1, u_2, \ldots, u_{m-1}, u_m]$$

1 droite (Δ)

$$P_i^* = Proj(P_i, \Delta)$$

$$\delta_i = dist(P_i, \Delta)$$

$$S(u,v) = \frac{\sum_{i=0}^{n}\sum_{j=0}^{p} N_{i,d}(u) N_{j,2}(v) w_{i,j} P_{i,j}}{\sum_{i=0}^{n}\sum_{j=0}^{p} N_{i,d}(u) N_{j,2}(v) w_{i,j}}$$

$$w_{i,j} = w_i s_j$$

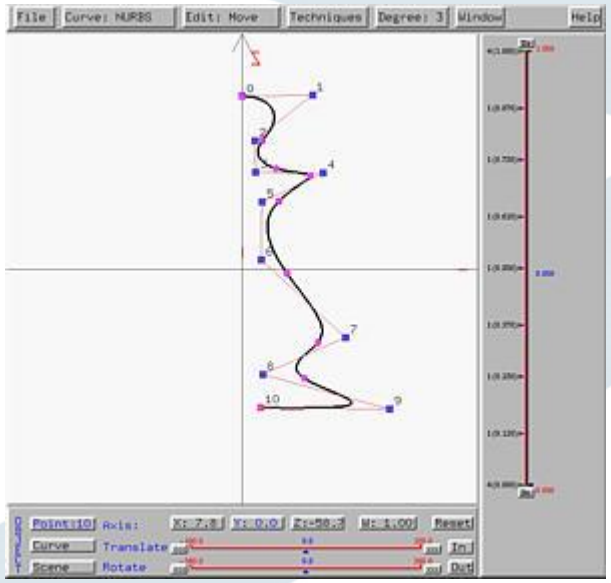
$$P_{i,j} = \delta_i Q_j \Leftarrow P_i^*$$

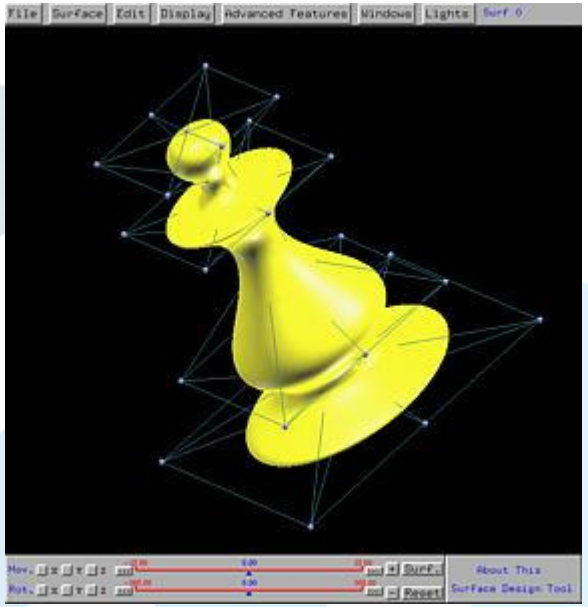
$$U = [u_0, u_1, u_2, \ldots, u_{m-1}, u_m]$$

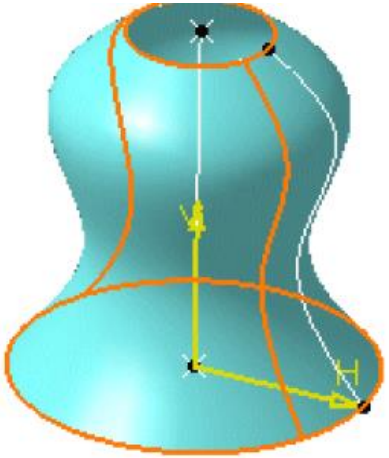
$$V = [s_0, s_1, s_2, \ldots, s_{q-1}, s_q]$$

Surfaces of Revolution

انشاء سطوح عن طريق التدوير





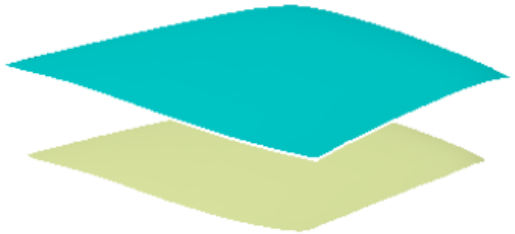


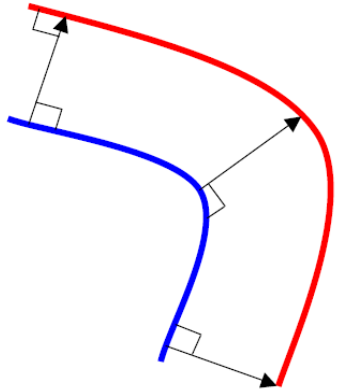
Surfaces of Revolution

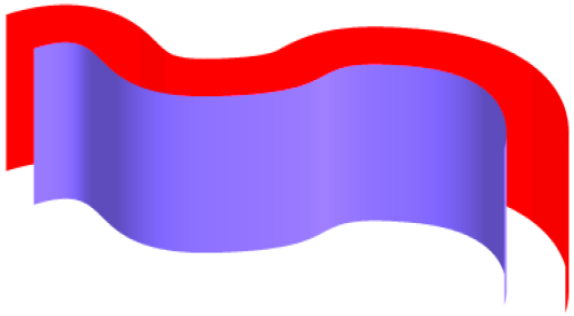
Offset Surfaces

انشاء سطح بالازاحة

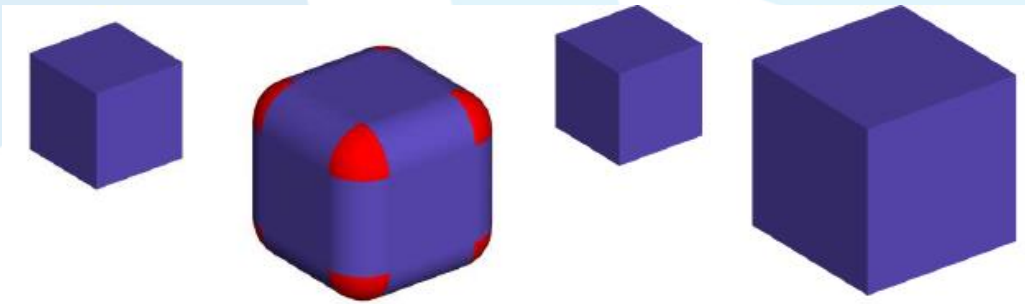
$$S_{Off}(u,v) = S(u,v) + dN(u,v)$$



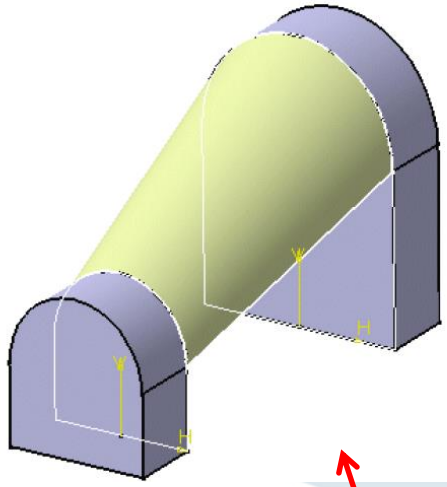


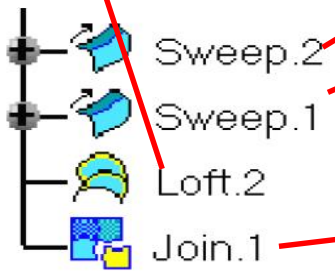


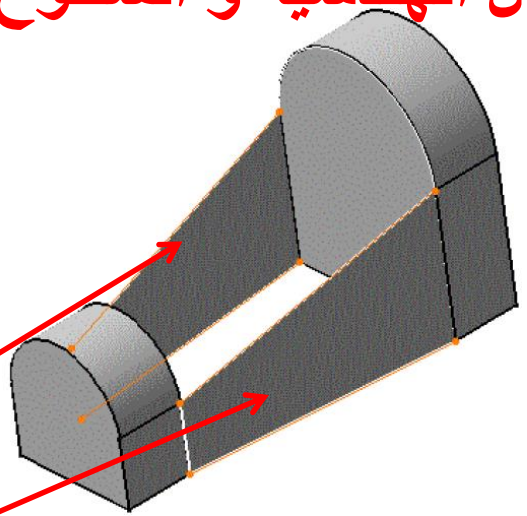
Offset Surfaces

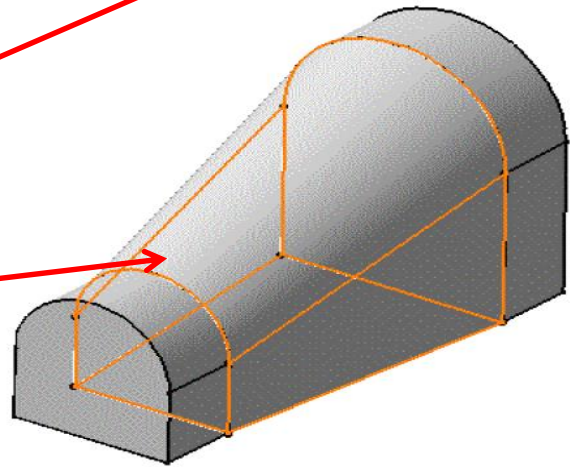


تصميم الاشكال الهندسية و السطوح و الحجوم

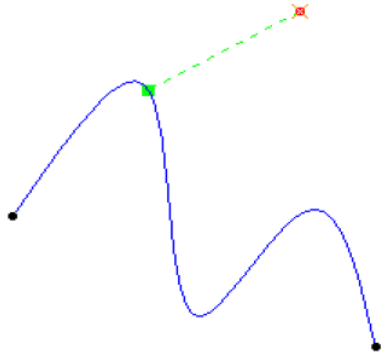






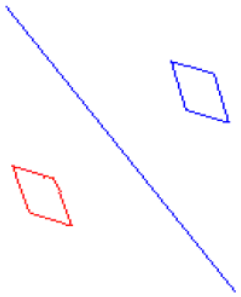


Creating Wireframe Geometry توليد الاشكال الهندسية بكافة أنواعها

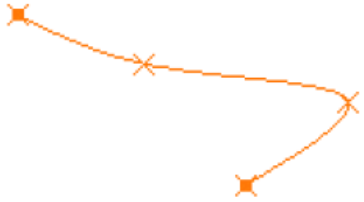


Points

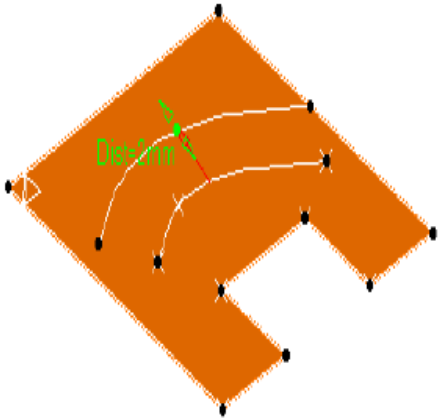
Lines



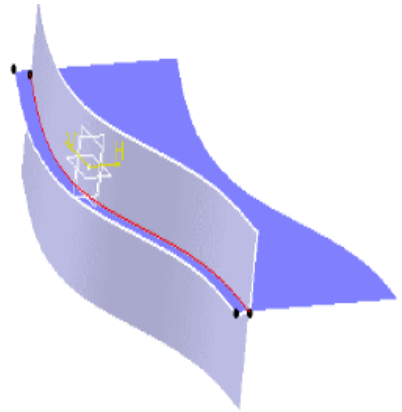
Planes



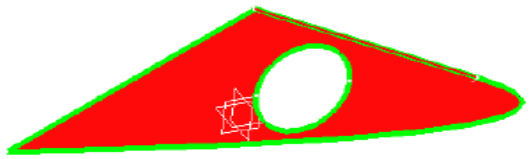
Splines



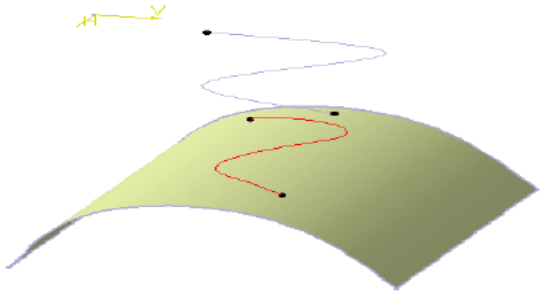
Parallel Curves



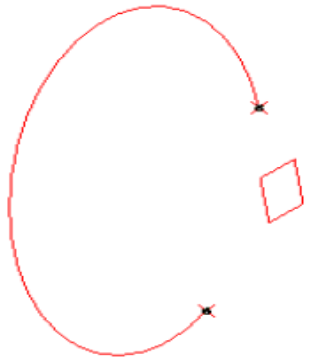
Intersections



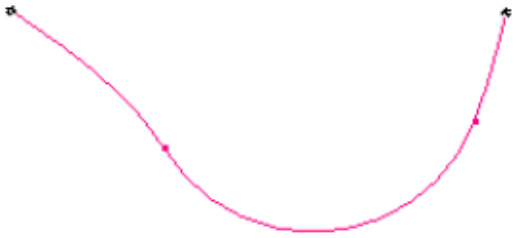
Boundary Curves



Projections



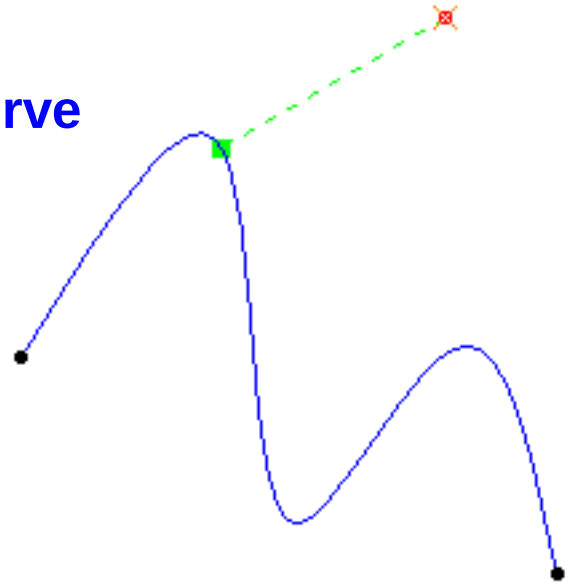
Circles

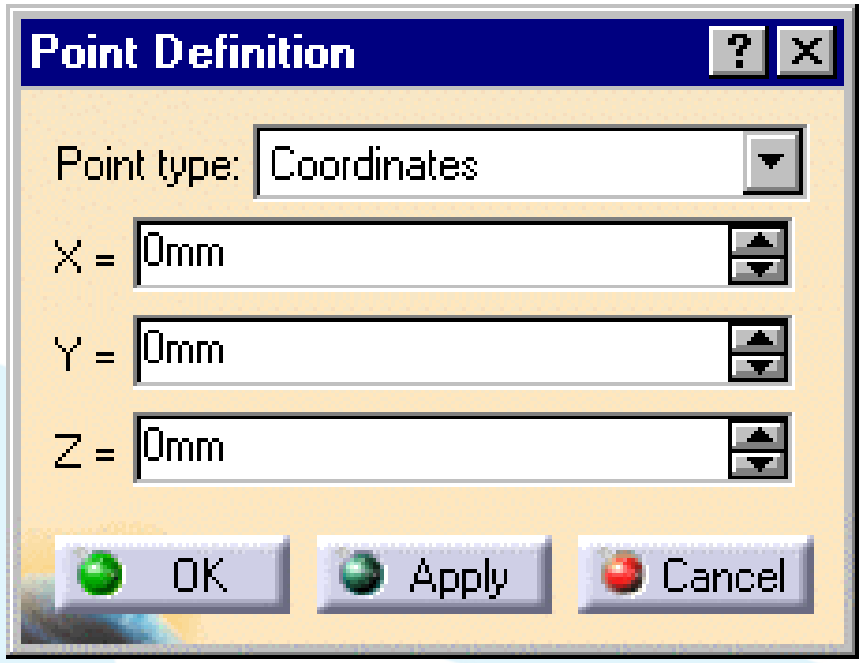


Corners

Points النقاط

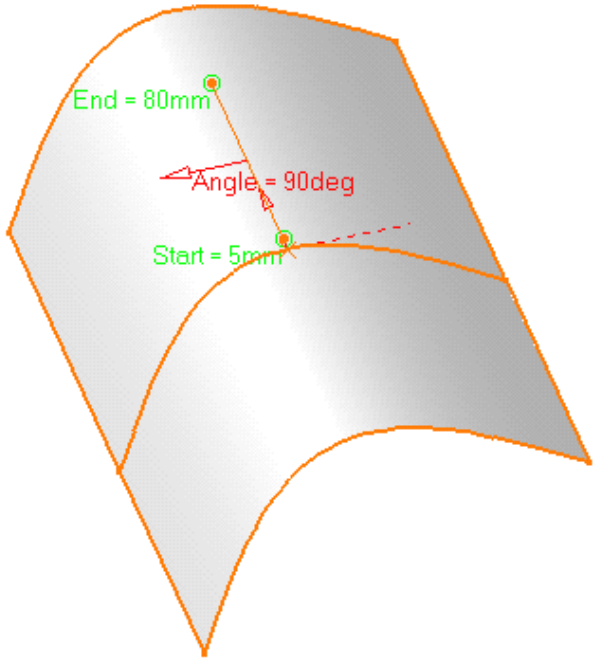
1- by coordinates
2- on a curve
3- on a plane
4- on a surface
5- at a circle center
6- tangent points on a curve



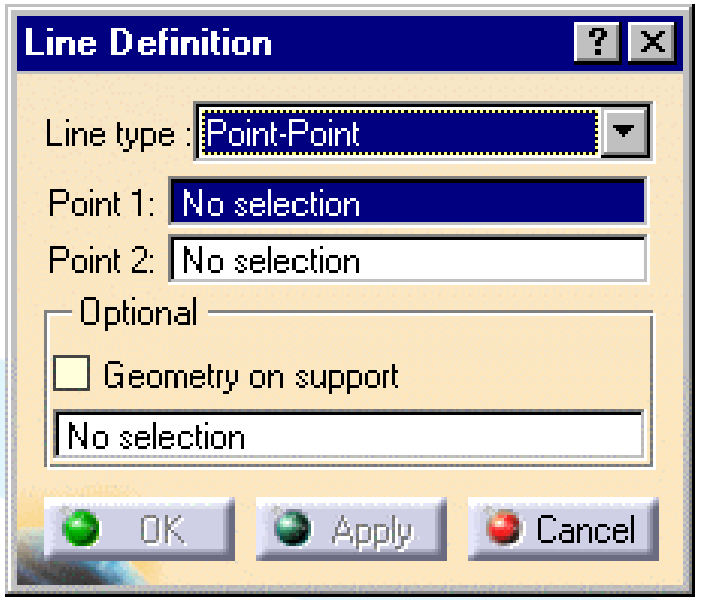


Lines المستقيمات

1- point to point
2- point and direction
3- angle or normal to curve
4- tangent to curve
5- normal to surface.

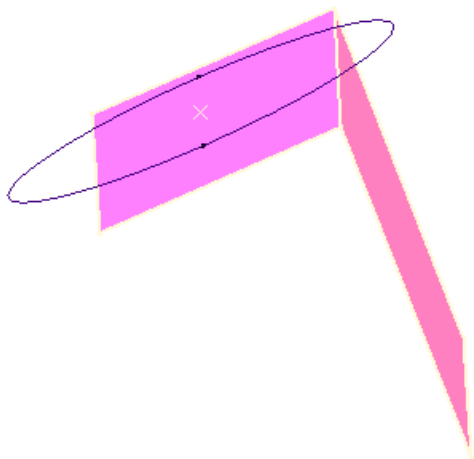


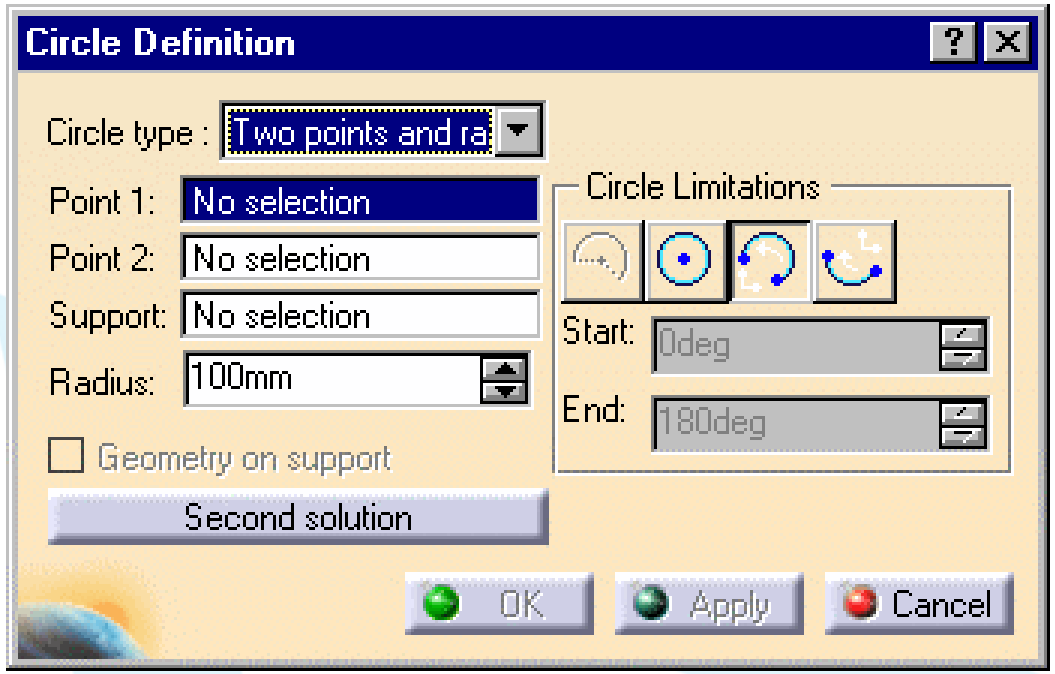
Angle or normal to curve



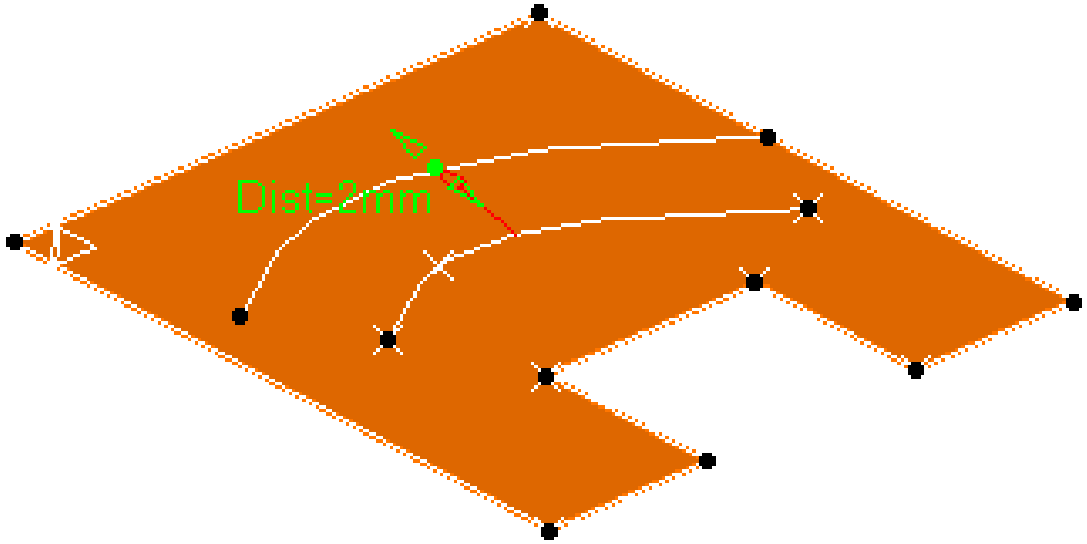
Circles الدوائر

1- center and radius
2- center and point
3- two points and radius
4- three points
5- bitangent and radius
6- bitangent and point
7- tritangent

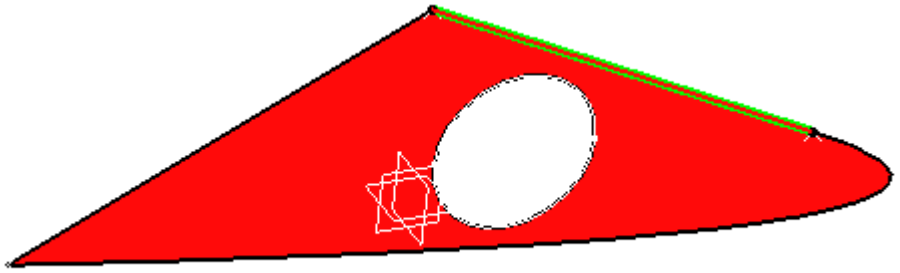


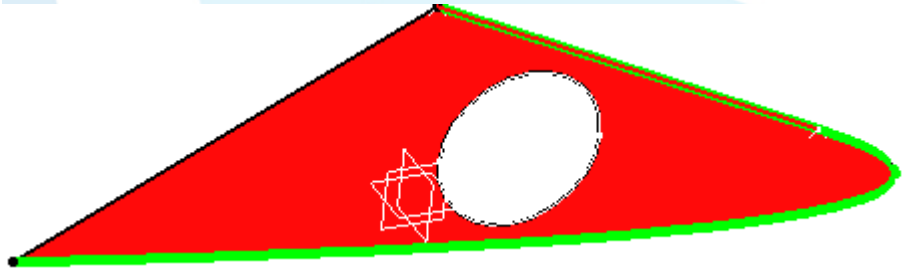


Parallel Curves

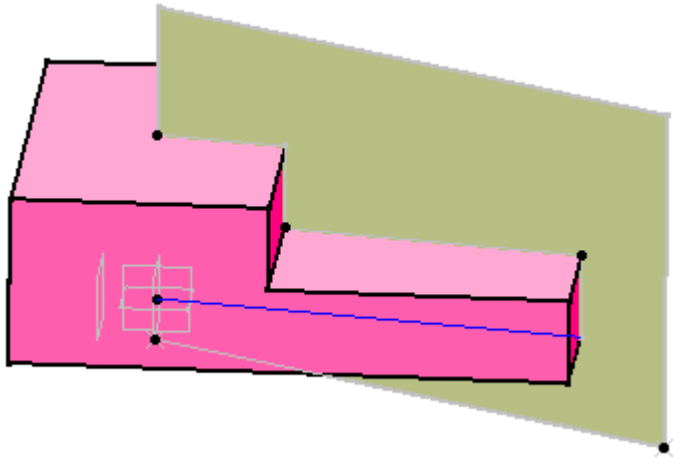


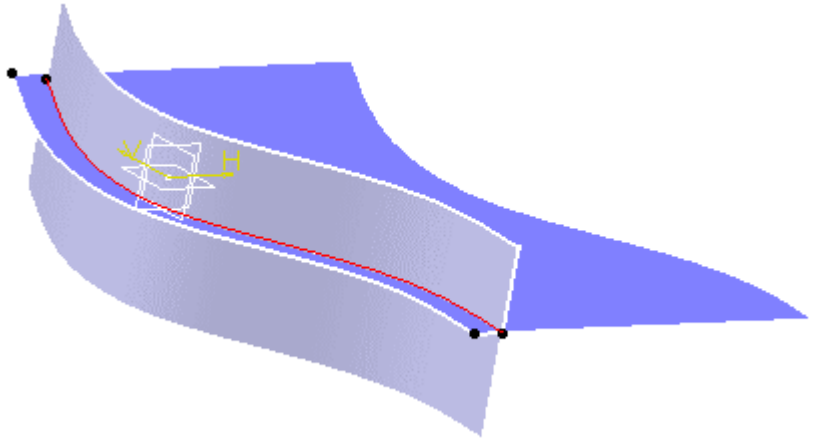
Boundary Curves



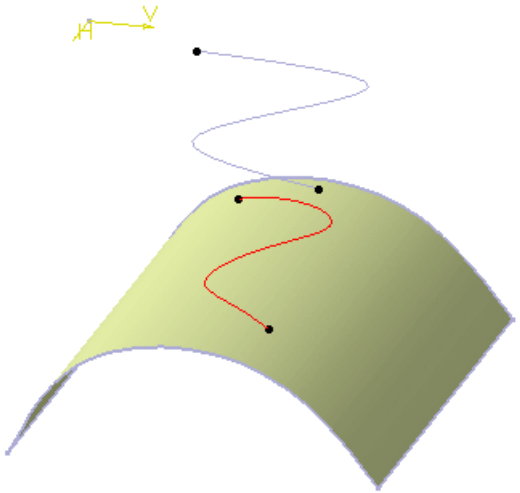


Intersectionsالتقاطعات

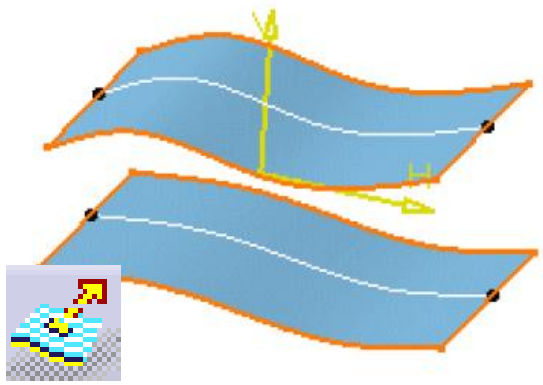




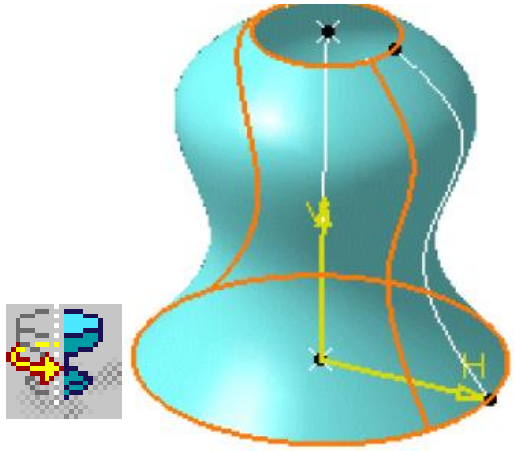
Projections
الإسقاطات



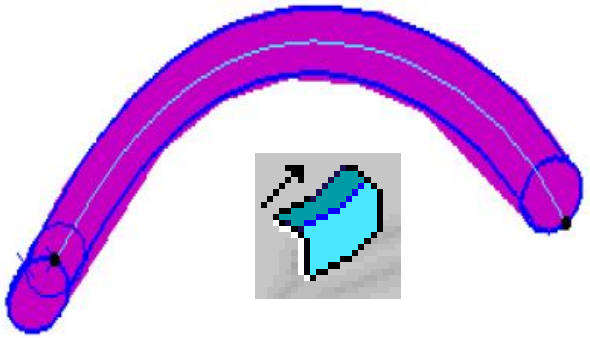
Creating Surfaces توليد السطوح



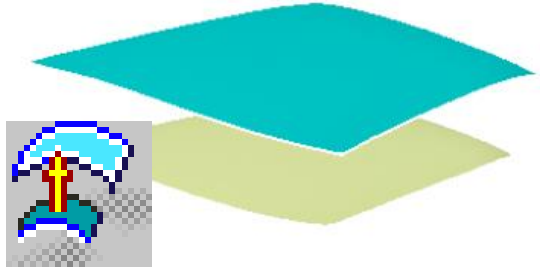
Extruded Surfaces



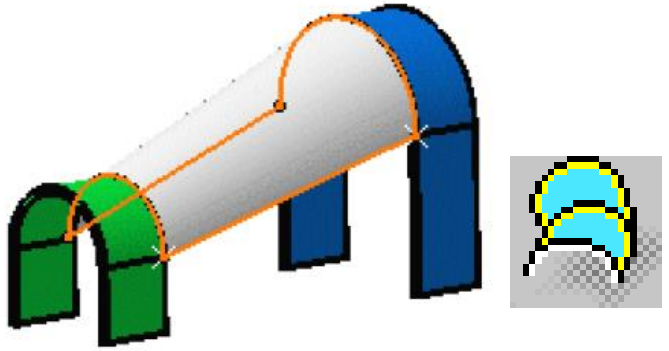
Surfaces of Revolution



Swept Surfaces



Offset Surfaces



Lofted Surfaces