Nanyang Technological University

Lab 1 Report: Parametric Curves

CZ2003 Computer Graphics and Visualization

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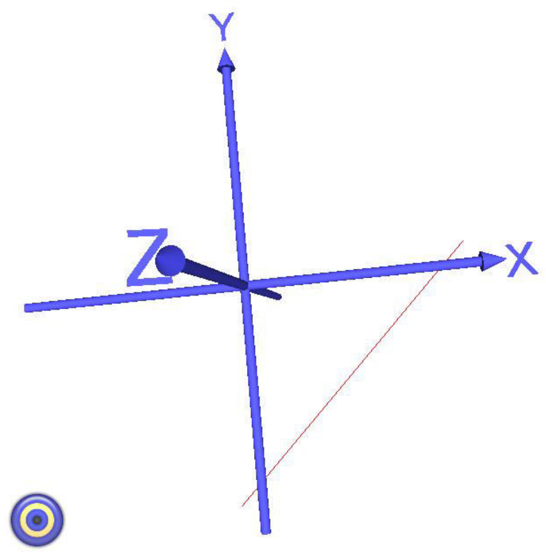
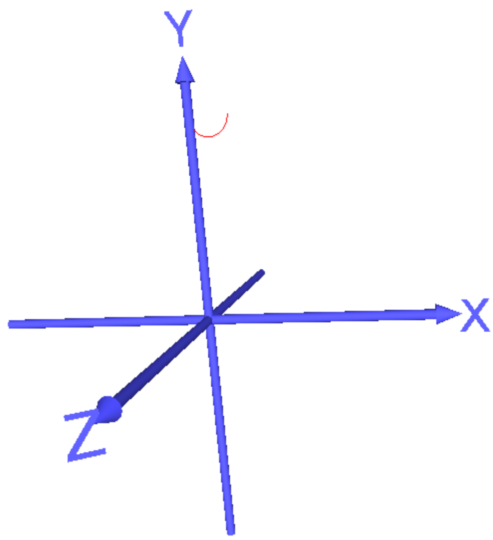
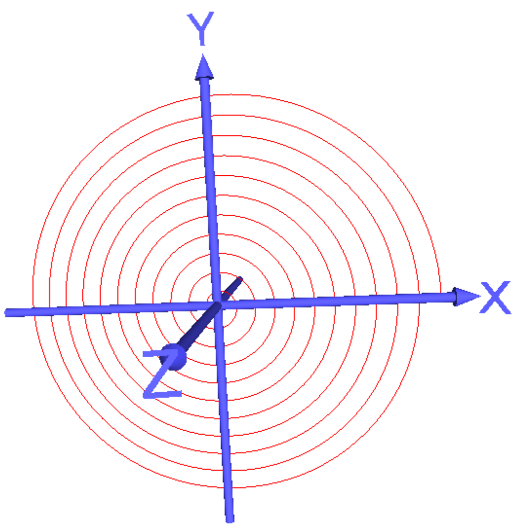
N, M values: [N: 1, M: 10]

1. Define parametrically in 4 separate files using functions $x(u)$, $y(u)$, $u \in [0,1]$ and display:

1a. Straight line segment spanning from the point with coordinates (-***N***, -***M***) to the point with coordinates (***M***, ***N***).	1b. A circular arc with radius ***N***, centred at point with coordinates (***N***,***M***) with the angles $[\frac{\pi}{N}, 2\pi]$.
Point 1 Coordinates: [-1, -10] Point 2 Coordinates: [10, 1] Parametric Definition: $x(u)$ = -1 + 11u $y(u)$ = -10 + 11u z(u) = 0 $u \in [0,1]$ File: 1a.wrl Resolution: 100 Screenshot:  Observations: As long as the sampling resolution is at least 1, a straight line can be plotted since it basically requires only one line to create a straight line	Point Coordinates: [1, 10] Radius = 1 $\alpha \in [\pi, 2\pi]$ Parametric Definition: $x(u)$ = cos(-πu) + 1 $y(u)$ = sin(-πu) + 10 z(u) = 0 $u \in [0,1]$ File: 1b.wrl Resolution: 100 Screenshot:  Observations: The more sampling points used, the smoother the curve, since the circle is created by joining multiple straight line together between points defined in formula

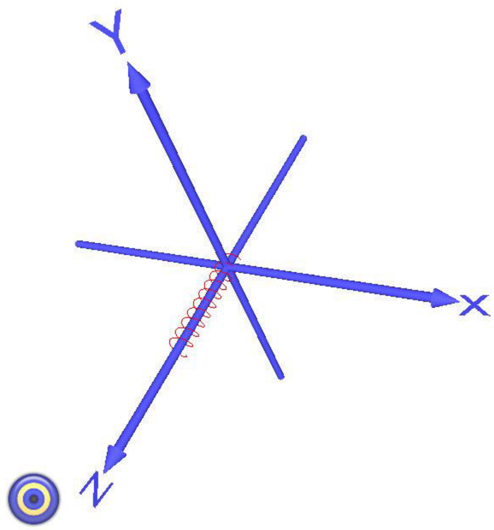
<table>
<tr>
<th>1c. Origin-centred 2D spiral curve which starts at the origin, makes N+M revolutions <u>clockwise</u> and reaches eventually the radius 2*M.</th>
<th>1d. 3D cylindrical helix with radius N which is aligned with axis Z, makes M <u>counterclockwise revolutions</u> about axis Z while spanning from $z1 = -\boldsymbol{N}$ to $z1 = \boldsymbol{M}$.</th>
</tr>
<tr>
<td>Number of clockwise revolutions: 1+10=11
Radius: 2 * 10 = 20

Parametric Definition:
$x(u)$ = (20u)cos(-22πu)
$y(u)$ = (20u)sin(-22πu)
z(u) = 0
$u \in [0,1]$

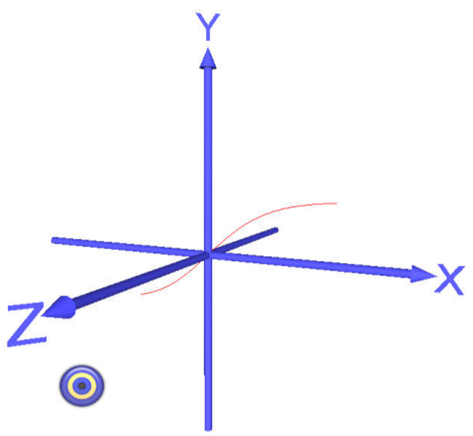
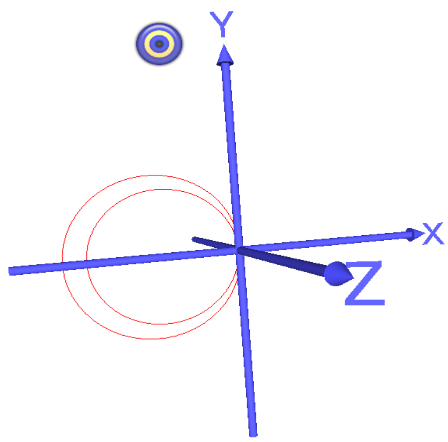
File: 1c.wrl
Resolution: 1000
Screenshot:


Observations:
The coefficient XX in “XX*u*cos(YY*π*u)” and “XX*u*sin(YY*π*u)” controls the radius of the spiral curve, while the coefficient YY controls the number of anti-clockwise rotations. -YY would make the spiral curve rotate clockwise. Likewise, the more sampling points used, the smoother the curve</td>
<td>Radius = 1
Number of counterclockwise revolution: 10
Spanning: -1 to 10

Parametric Definition:
$x(u)$ = cos(20πu)
$y(u)$ = sin(20πu)
z(u) = -1 + 11u
$u \in [0,1]$

File: 1d.wrl
Resolution: 1000
Screenshot:


Observations:
The coefficient XX in “XX*cos(YY*π*u)” and “XX*sin(YY*π*u)” controls the radius of the helix, while the coefficient YY controls the number of anti-clockwise rotations. -YY would make the spiral curve rotate clockwise. z(u) controls the length in which helix would span from. Likewise, the more sampling points used, the smoother the curve</td>
</tr>
</table>

2. With reference to Table 1, convert the explicitly defined curve number ***M*** to parametric representations $x(u)$, $y(u)$, $u \in [0,1]$ and display it. Note that sketches of the curves in Table 1 are done not to the actual scale since the values of ***N*** and ***M*** are different in each variant.	3. With reference to Figure 5, a curve is defined in polar coordinates by: $r = \boldsymbol{N} - (\boldsymbol{M}+5)\cos\alpha,\ \alpha \in [0,2\pi]$ Define the curve parametrically as $x(u)$, $y(u)$, $u \in [0,1]$ and display it.
Number: 10 $y = \tanh x$ $x \in [-1.3, 2]$ Parametric Definition: $x(u) = 3.3u - 1.3$ $y(u) = \tanh(3.3u - 1.3)$ $z(u) = 0$ $u \in [0,1]$ File: 2.wrl Resolution: 100 Screenshot:  Observations: Keeping domain u ∈ [0, 1] constant, by changing the coefficient of u and the constant in x(u), the curve segment will elongate or shorten accordingly. Likewise, keeping the equation of x(u) constant at 3.3u – 1.3 and y(u) = tanh(3.3u – 1.3), varying the lower limit and upper limit of domain u, the curve segment will elongate or shorten along x-axis accordingly as well.	Polar Coordinates: $r = \mathbf{1} - (\mathbf{10} + 5)\cos\alpha,\ \alpha \in [0,2\pi]$ $r = 1 - 15\cos\alpha$ Parametric Definition: $x(u) = (1 - 15\cos(2\pi u))\cos(2\pi u)$ $y(u) = (1 - 15\cos(2\pi u))\sin(2\pi u)$ $z(u) = 0$ $u \in [0,1]$ File: 3.wrl Resolution: 100 Screenshot:  Observations: For polar equation r = (c) – (b)cosα: If c < b, c + b will determine the diameter of the outer oval shape from origin while b – c will control the diameter of the inner oval shape from origin. If c = b, the distance between the 2 x-intercepts of the oval shape will be 2 * c from origin, where one of the x-intercepts is at origin

	If $c > b$, $c + b$ is the distance of the negative x-intercept from origin while $c - b$ is the distance of the positive x-intercept from origin