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 ∈ [0,1] and display:

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| 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 [ , 2𝜋]. |
| Point 1 Coordinates: [-1, -10]  Point 2 Coordinates: [10, 1]  Parametric Definition: 𝑥(𝑢) = -1 + 11u 𝑦(𝑢) = -10 + 11u  z(𝑢) = 0 𝑢 ∈ [0,1]  File: 1a.wrl  Resolution: 100  Screenshot:  A close up of a logo  Description automatically generated  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  α ∈ [π,2π]  Parametric Definition: 𝑥(𝑢) = cos(-πu) + 1 𝑦(𝑢) = sin(-πu) + 10  z(𝑢) = 0  𝑢 ∈ [0,1]  File: 1b.wrl  Resolution: 100  Screenshot:  A close up of a logo  Description automatically generated  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 |

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| 1c. Origin-centred 2D spiral curve which starts at the origin, makes ***N****+****M*** revolutions **clockwise** and reaches eventually the radius 2\****M****.* | 1d. 3D cylindrical helix with radius ***N*** which is aligned with axis *Z*, makes ***M* counterclockwise revolutions** about axis *Z* while spanning from 𝑧1 = −𝑵 to 𝑧1 = 𝑴. |
| 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 ∈ [0,1]  File: 1c.wrl  Resolution: 1000  Screenshot:  A picture containing tower  Description automatically generated  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 | 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 ∈ [0,1]  File: 1d.wrl  Resolution: 1000  Screenshot:  A close up of a logo  Description automatically generated  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 |

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| 2. With reference to Table 1, convert the explicitly defined curve number ***M*** to parametric representations 𝑥(𝑢), 𝑦(𝑢), 𝑢 ∈ [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=𝑵−(𝑴+5)cos𝛼, 𝛼∈[0,2𝜋]  Define the curve parametrically as 𝑥(𝑢), 𝑦(𝑢), 𝑢 ∈ [0,1] and display it. |
| Number: 10 𝑦 = tanh𝑥 𝑥 ∈ [−1.3, 2]  Parametric Definition: 𝑥(𝑢) = 3.3u – 1.3 𝑦(𝑢) = tanh(3.3u – 1.3) z(𝑢) = 0 𝑢 ∈ [0,1]  File: 2.wrl  Resolution: 100  Screenshot:  A close up of a logo  Description automatically generated  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 = **1** – (**10** + 5)cos𝛼, 𝛼∈[0,2𝜋] r = 1 – 15cos𝛼  Parametric Definition: 𝑥(𝑢) = (1 - 15cos(2𝜋u))cos(2𝜋u) 𝑦(𝑢) = (1 - 15cos(2𝜋u))sin(2𝜋u) z(𝑢) = 0 𝑢 ∈ [0,1]  File: 3.wrl  Resolution: 100  Screenshot:  A close up of a logo  Description automatically generated  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 |