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| Nanyang Technological University |
| Lab 2 Report: Parametric Curves |
| CZ2003 Computer Graphics and Visualization |

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Lab2 report

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| **Parametric Curve** | **Screenshot** | **Notes** |
| Straight line segment A |  | Parametric definition of a straight line segment:  x = x1 + u (x2 – x1)  y = y1 + u (y2 – y1)  u = [0,1]  In this case, I used (0,0) as my starting point and the line segment ends at point (1,1).  definition "x=0 + (1-0)\*u;  y=0 + (1-0)\*u;  z=0;"  parameters [0 1]  Since z=0, the line only lies on the x and y axis.  Length of the line is .  The background colour was changed to black {skyColor 0 0 0} and the line colour was changed from red to white diffuseColor "r=1; g=1; b=1;" |
| Straight line segment B |  | definition "x=-1 + (1-(-1))\*u;  y=-2 + (2-(-2))\*u;  z=0;"  The line segment extends from coordinates (-1, -2) to coordinates (1,2).  The resolution is now set to [10]. However, there is no effect on the line drawn.  It does not matter how many times the resolution along the line segment is sampled because this is just one single line. |
| Straight line segment C |  | definition "x= -1 + (1-(-1)) \* u;  y= 1 + (-1-1) \* u;  z= 0;"  parameters [0 2]  The line segment starts from point (-1, 1). Even thought by definition the line segment is supposed to end at  point (1, -1), but because I changed the parameter domain from [0 1] to [0 2], the line segment ends at  point (3, -3).  When u=2, x = -1 + (2)(2)  y = 1 + (-2)(2) |
| Circle A |  | definition "x=1 \* cos(u\*2 \* pi);  y=1 \* sin(u\*2 \* pi);  z=0;"  parameters [0 1]  resolution [100]  This is a unit circle of radius 1.  Pi is 180 degrees. Hence we use 2\*pi so that it is one full circle.  This other representation produces the same result:  definition "x=1 \* cos(u \* pi);  y=1 \* sin(u \* pi);  z=0;"  parameters [-1 1]  resolution [100]  2D circle parametric representation:  x = rcos(θ) + x0  y = rsin(θ) + y0  where r is the radius and  (x0, y0) is the centre of the circle. |
| Circle B |  | definition "x=1 \* cos(u\* 2\* pi);  y=1 \* sin(u\* 2\* pi);  z=0;"  parameters [0 1]  resolution [10]  In this case, I decreased the resolution from [100] to [10],  Instead of a circle, a 10-sided polygon is displayed.  This other definition also produces the same figure:  definition "x=1 \* cos(u\* 2\* pi);  y=1 \* sin(u\* 2\* pi);  z=0;"  parameters [0 10]  resolution [100] |
| Circle C |  | definition "x=1 \* cos(u\* 2\* pi);  y=1 \* sin(u\* 2\* pi);  z=0;"  parameters [0 20]  resolution [100]  A 5-sided polygon is produced instead of a 10-sided polygon. When the upper bound of the parameters is increased twice, the number of polygon sides decreases twice. |
| Arc A |  | definition "x=2 \* cos(u \* pi);  y=2 \* sin(u \* pi);  z=0;"  parameters [0 1]  resolution [100]  This is a semi-circle of radius 2. Inside the cos and sin functions, we used u \* pi where pi is 180 degrees and u is the parameter set from 0 to 1. |
| Arc B |  | definition "x=1 \* cos(u \* pi);  y=1 \* sin(u \* pi);  z=0;"  parameters [-0.25 0.25]  resolution [100]  While keeping the solution the same, the radius is changed to 1 and the parameters is now from -0.25 to 0.25.  Cos(-0.25 \* pi) = 0.707  Sin(-0.25\*pi) = -0.707  Cos(0.25\*pi) = 0.707  Sin(0.25 \* pi) = 0.707  The top point of the arc is at coordinate (0.707, 0.707) and the bottom point of the arc is at coordinate (0.707, -0.707). |
| Arc C |  | definition "x=1 \* cos(1+ u \* pi);  y=1 \* sin(1+ u \* pi);  z=0;"  parameters [0 1]  resolution [100]  cos(1) = 0.540  sin(1) = 0.841  The semicircle shown as Arc A got displaced by 0.540 in the x-direction and 0.841 in the y-direction. |
| Arc D |  | definition "x=1 \* cos(u \* pi);  y=1 \* sin(u \* pi);  z=0;"  parameters [-0.25 0.25]  resolution [2]  The sampling resolution of 2 is now used. |
| Ellipse A |  | definition "x=2 \* cos(u \* pi);  y=1 \* sin(u \* pi);  z=0;"  parameters [-1 1]  resolution [100]  The definition, parameters and resolution of a circle was used but the radius in the x direction was increased to 2 so that it is stretched out in the x direction. |
| Ellipse B (arc) |  | definition "x=2 \* cos(u \* pi);  y=1 \* sin(u \* pi);  z=0;"  parameters [0 0.5]  resolution [100]  By changing the parameters, ¼ of the ellipse is displayed instead. |
| Ellipse C |  | definition "x=2 \* cos(u \* pi);  y=1 \* sin(u \* pi);  z=0;"  parameters [-1 1]  resolution [5]  The definition and parameters was kept the same for a complete ellipse (ellipse A). However, the resolution is now changed from 100 to 5. As shown in the screenshot, there are only five points plotted here. |
| Ellipse D |  | definition "x=2 \* cos(u \* pi);  y=1 \* sin(u \* pi);  z=0;"  parameters [-1 1]  resolution [20]  The resolution is now increased to 20. Although it now looks closer to a smooth ellipse as compared to ellipse C, the edges are still rough. |
| 2D\_helix |  | definition "x=u \* cos(u \* pi \* 5);  y=u \* sin(u \* pi \* 5);  z=0;"  parameters [0 1]  resolution [100]  Since x = cos(2\*pi\*u) and y = sin(2\* pi \* u) is used for drawing one circle (assuming parameter is kept at [0 1]), using 5 instead of 2 will produce 2.5 rounds.  The sampling resolution of 100 is used. |
| 2dhelixA |  | definition "x=u \* cos(u\*pi \* 10);  y=u \* sin(u \*pi \* 10);  z=0;"  parameters [0 1]  resolution [100]  While keeping the parameters and resolutions the same, the values in sin and cos is doubled from 5 to 10. Hence, the number of spirals is also doubled.  With the same sampling resolution, it is shown that the edges are getting more uneven and rough. |
| 2dhelixB |  | definition "x=u \* cos(u\*pi \* 10);  y=u \* sin(u\* pi \* 10);  z=0;"  parameters [0 1]  resolution [250]  The resolution is now set to 250. The result is a much smoother helix. |
| 2dhelixC |  | definition "x=u \* cos(u \* pi \* 5);  y=u \* sin(u \* pi \* 5);  z=0;"  parameters [0 2]  resolution [20]  Changing the parameters from [0 1] to [0 2] has the effect of doubling the number of cycles of the helix.  In this case, 20 sampling resolution is set for 5 cycles. Hence, there would be 4 points drawn for each cycle.  The result would be a square-like helix instead of a smooth and round helix. |
| 3dhelixA |  | definition "x=u \* cos(u \*pi \*10);  y=u \* sin(u \*pi \* 10);  z=-2 + u \* (1-(-2));"  parameters [0 1]  resolution [200]  Instead of setting z as a constant fixed value, we use z = -2 + u\*(1-(-2)). The helix now grows from -2 to 1 along the z axis. |
| 3dhelixB |  | definition "x=u \* cos(u\*pi \* 10);  y=u \* sin(u \*pi \* 10);  z=-1 + u;"  parameters [0 1]  resolution [20]  With the resolution now set to 20, the helix looks square-like for each cycle instead of looking like a circle. This is because 4 points are plotted for each cycle. There are 5 cycles and a total of 20 points. |
| 3dhelixC |  | definition  "x=(1+u\*(0.2-1)) \*cos(u\*pi\* 10); y=(1 + u\*(0.2-1)) \*sin(u\*pi \*10); z=-2 + u \* (1-(-2));"  parameters [0 1]  resolution [200]  By manipulating the first part of the right hand side equation in x and y, the helix’s radius now grows from 1 to 0.2. Previously, the helix’s radius grows larger along the positive z-axis direction. Now in shrinks instead. |
| sineCurveA |  | definition "x=u;  y=sin(u\*2\*pi);  z=0;"  parameters [0 1]  resolution [100]  This is one complete sine curve |
| sineCurveB |  | definition "x=u;  y=(1+ u\* (0.2-1)) \*sin(u\*pi\* 10);  z=0;"  parameters [0 1]  resolution [200]  The sine curve decreases in amplitude along the positive x direction from amplitude = 1 to amplitude = 0.2. |
| sineCurveC |  | definition "x=u;  y=(1 + u\*(0.2-1)) \*sin(u \*pi \* 5);  z=0;"  parameters [0 1]  resolution [2]  The resolution is now set to 2. |
| sineCurveD |  | definition "x=u;  y=(1 + u\*(0.2-1))\* sin(u \*pi \* 5);  z=0;"  parameters [-2 1]  resolution [200]  The sine curve grows from x =-2 to x = 1. The amplitude of the sine curve decreases along the positive x axis. The amplitude decreases from 2.6 to 0.2.  2.6 = 1 + (-2)(-0.8) |
| sineCurveE |  | definition "x=u \* t;  y=(1 + u \* (0.2-1)) \* sin(u \* pi \* 5 \* t) ;  z=0 + u \* (1-0) \* t;"  parameters [0 1]  resolution [200]  The t is used here for animation purposes. The sine curve will grow from high amplitude to low amplitude. |