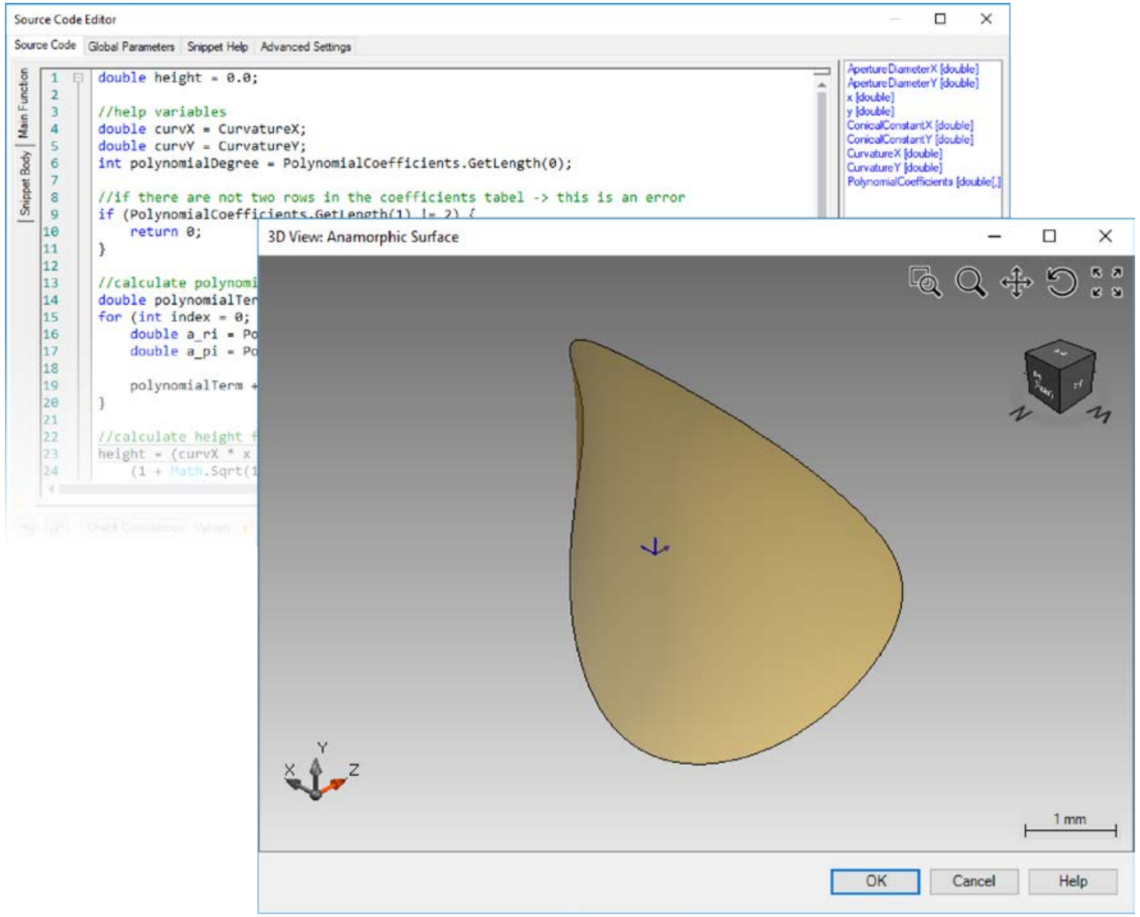
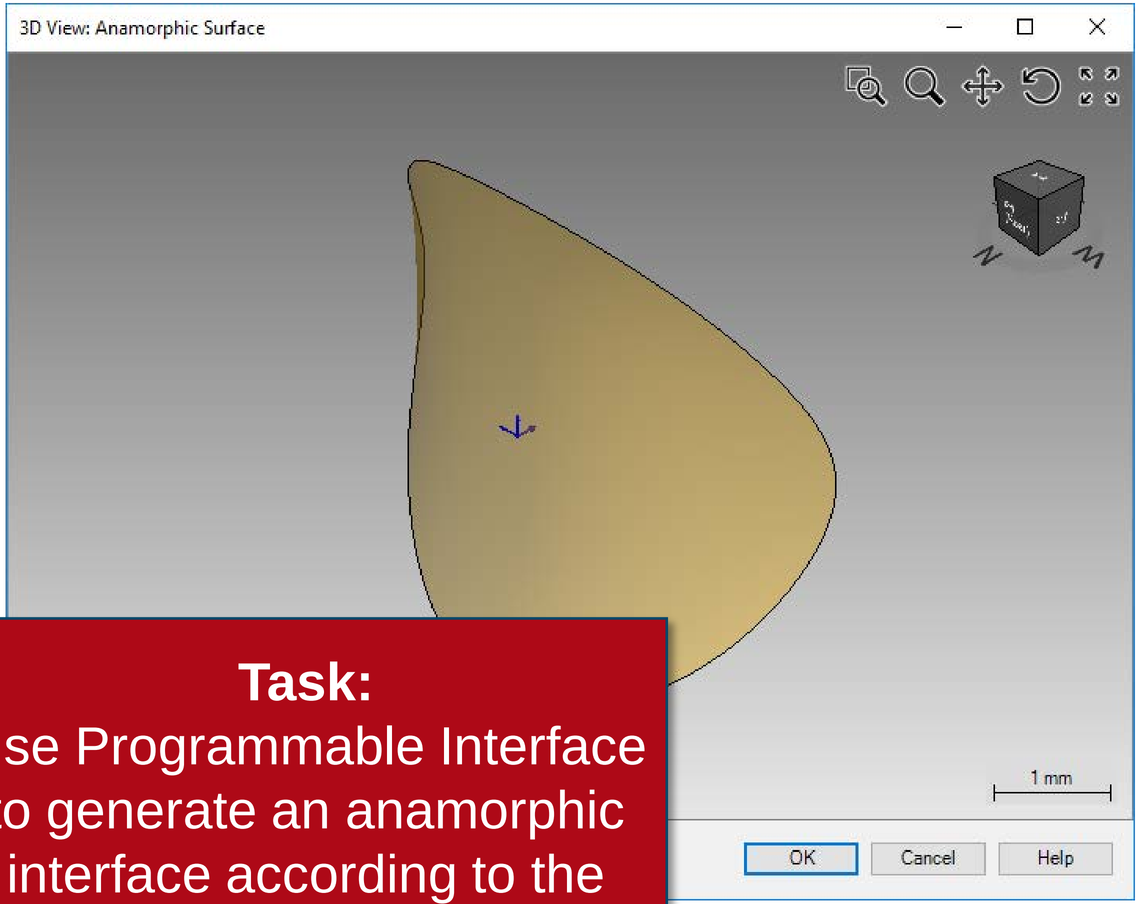
Programming an Anamorphic Surface

Abstract



The Programmable Interface in VirtualLab Fusion enables the definition of customized freeform surfaces. This example shows how to define an anamorphic surface as a height function, and especially with the surface gradient analytically given as well. Surface specification parameters, like conical constant, curvature, and polynomial coefficients values, are all customizable for the user.

Task Description



Task:
Use Programmable Interface to generate an anamorphic interface according to the equation.

The height function of an anamorphic surface is defined by

$$h(x,y)=\frac{C_x x^2+C_y y^2}{1+\sqrt{1-(1+k_x)C_x^2x^2-(1-k_y)C_y^2y^2}}$$

$$+\sum_{i=2}^{1} a_{r,i}\left((1-a_{p,i})x^2+(1+a_{p,i})y^2\right)^i$$

C_x and C_y are the curvatures in x and y direction with

$$C_x=\frac{1}{R_x}$$

$$C_y=\frac{1}{R_y}$$

R_x and R_y are the radii of the surface and k_x and k_y the conical constants in x and y direction. $a_{r,i}$ and $a_{p,i}$ are polynomial coefficients of the surface.

Programming a Anamorphic Surface (Height)

Source Code Editor

Source Code | Global Parameters | Snippet Help | Advanced Settings

Main Function | Snippet Body

```
double height = 0.0;

//help variables
double curvX = CurvatureX;
double curvY = CurvatureY;
int polynomialDegree = PolynomialCoefficients.GetLength(0);

//if there are not two rows in the coefficients tabel -> this is an erro
if (PolynomialCoefficients.GetLength(1) != 2) {
    return 0;
}

//calculate polynomial term for position (x,y)
double polynomialTerm = 0;
for (int index = 0; index < polynomialDegree; index++) {
    double a_ri = PolynomialCoefficients[index, 0];
    double a_pi = PolynomialCoefficients[index, 1];

    polynomialTerm += a_ri * Math.Pow((1 - a_pi) * x * x + (1 + a_pi) * y * y, index + 2);
}

//calculate height for position (x,y)
height = (curvX * x * x + curvY * y * y) /
    (1 + Math.Sqrt(1 - (1 + ConicalConstantX) * curvX * curvX * x * x - (1 + ConicalConstantY) * curvY * curvY * y * y))
    + polynomialTerm;


return height;
```

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Global Parameters (User Defined)

Variable	Value	Allowed range
double ConicalConstantX	0	-1000 – 1000
double ConicalConstantY	0	-1000 – 1000
double CurvatureX	348.7992127	0 – 1000
double CurvatureY	0	0 – 1000
double PolynomialCoefficients	{-2948903.66, 73895084200, -3.46, 8.19}; {0.188,-1.35,-0.767,-1.02}	0 – 1000

Programming a Anamorphic Surface (Gradient)

Source Code Editor

Source Code | Global Parameters | Snippet Help | Advanced Settings

```
VectorD gradient = new VectorD();
gradient.X = 0;
gradient.Y = 0;

//help variables
double v = Math.Sqrt(1 - (1 + ConicalConstantX) * CurvatureX * CurvatureX * x * x - (1 + ConicalConstantY) * CurvatureY * CurvatureY * y * y);
double sumTermX = 0, sumTermY = 0;

int polynomialDegree = PolynomialCoefficients.GetLength(0);

for (int index = 0; index < polynomialDegree; index++) {
    double a_ri = PolynomialCoefficients[index, 0];
    double a_pi = PolynomialCoefficients[index, 1];
    sumTermX += 2 * (index + 2) * (1 - a_pi) * x * a_ri * Math.Pow((1 - a_pi) * x * x + (1 + a_pi) * y * y, index + 1);
    sumTermY += 2 * (index + 2) * (1 + a_pi) * y * a_ri * Math.Pow((1 - a_pi) * x * x + (1 + a_pi) * y * y, index + 1);
}

gradient.X = 2 * CurvatureX * x / (1 + v) - (CurvatureX * x * x + CurvatureY * y * y) *
    (-2 * CurvatureX * CurvatureX * x * (1 + ConicalConstantX)) / (2 * v * (1 + v) * (1 + v)) +
    sumTermX;

gradient.Y = 2 * CurvatureY * y / (1 + v) - (CurvatureX * x * x + CurvatureY * y * y) *
    (-2 * CurvatureY * CurvatureY * y * (1 + ConicalConstantY)) / (2 * v * (1 + v) * (1 + v)) +
    sumTermY;


return gradient;
```

ApertureDiameterX [double]
ApertureDiameterY [double]
x [double]
y [double]
ConicalConstantX [double]
ConicalConstantY [double]
CurvatureX [double]
CurvatureY [double]
PolynomialCoefficients [double[,]]

Check Consistency | Validity: | OK | Cancel | Help

Document Information

title	Programming an Anamorphic Surface
document code	CZT.0034
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	7.4.0.49
category	Feature Use Case
further reading	- How to Work with the Programmable Interface & Example (Spherical Surface) - Programming a Sinusoidal Surface - Construction of a Truncated Pyramid Surface