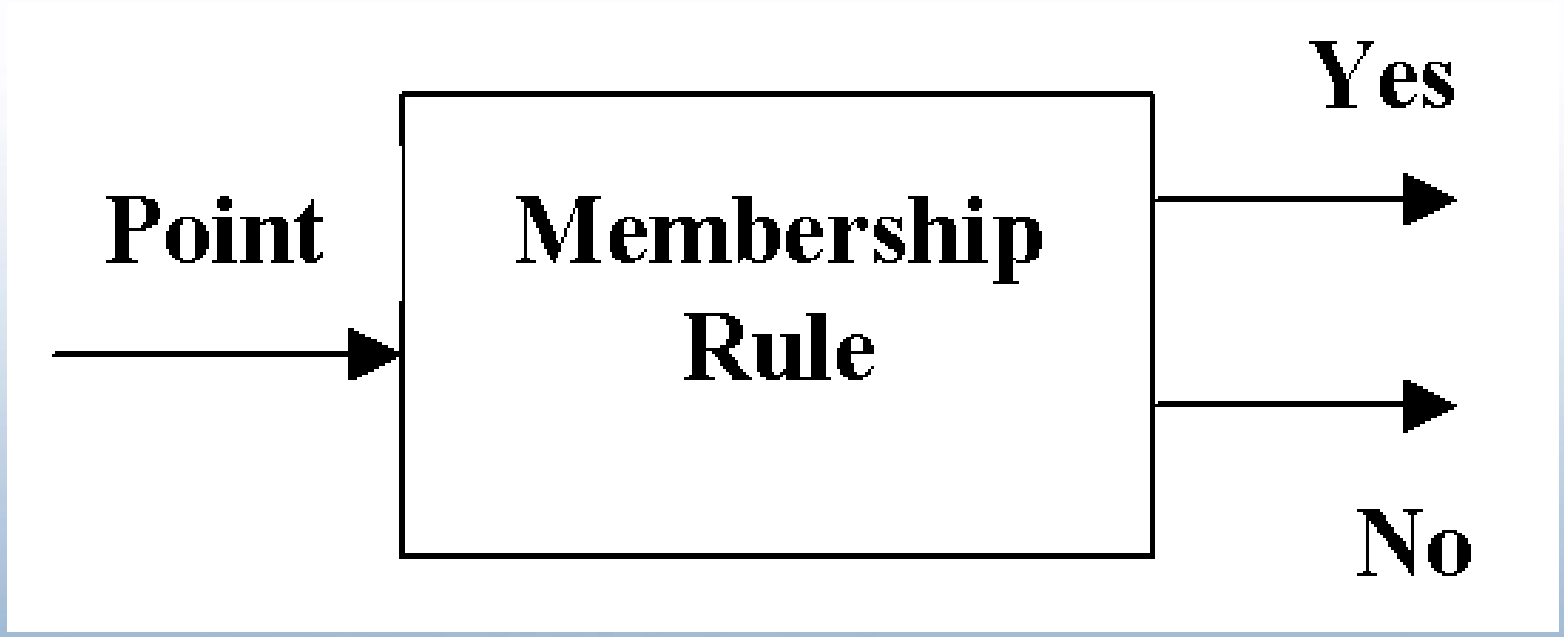
Implicit Surfaces and HyperFun

Contents

- Implicit curves, surfaces, and solids
- HyperFun language
- HyperFun model structure
- Example

Point Membership Rule



Implicit curves and surfaces

Implicit Curves and Areas

Set of points on 2D plane with

$$f(x,y) = 0$$

is called implicit curve

2D area (piece of plane, planar patch, 2D solid) is defined as

$$f(x, y) \geq 0$$

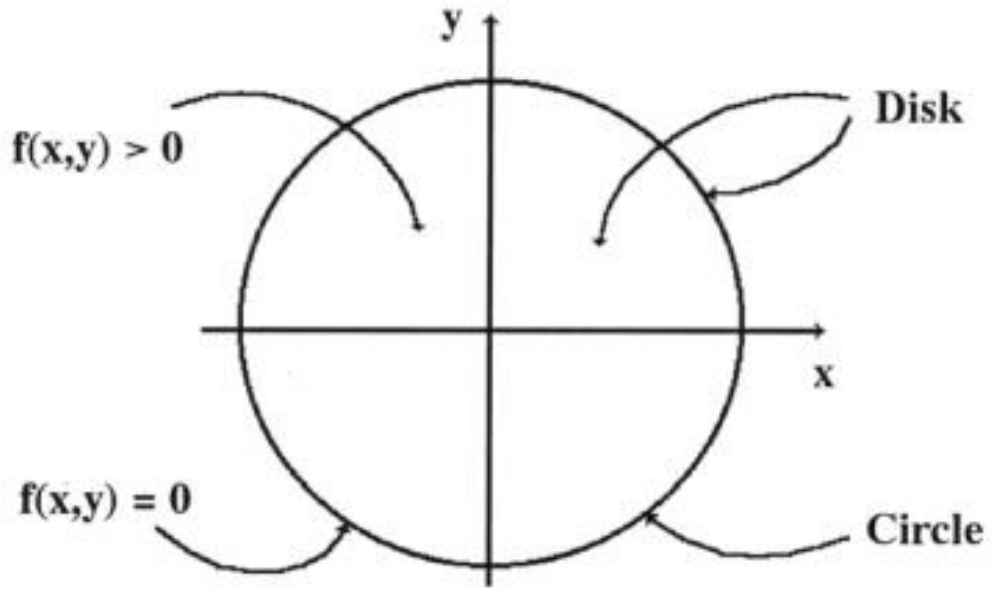
with implicit curve as its boundary.

Circle and Disk

$$f(x,y) = R^2 - x^2 - y^2$$

Disk (k=2) $f(x,y) \geq 0$

Circle (k=1) $f(x,y) = 0$



Implicit Surfaces and Solids

A set of points in 3D space with

$$f(x,y,z) = 0$$

is called an implicit surface

A 3D solid is defined as

$$f(x, y, z) \geq 0$$

with the implicit surface as its boundary.

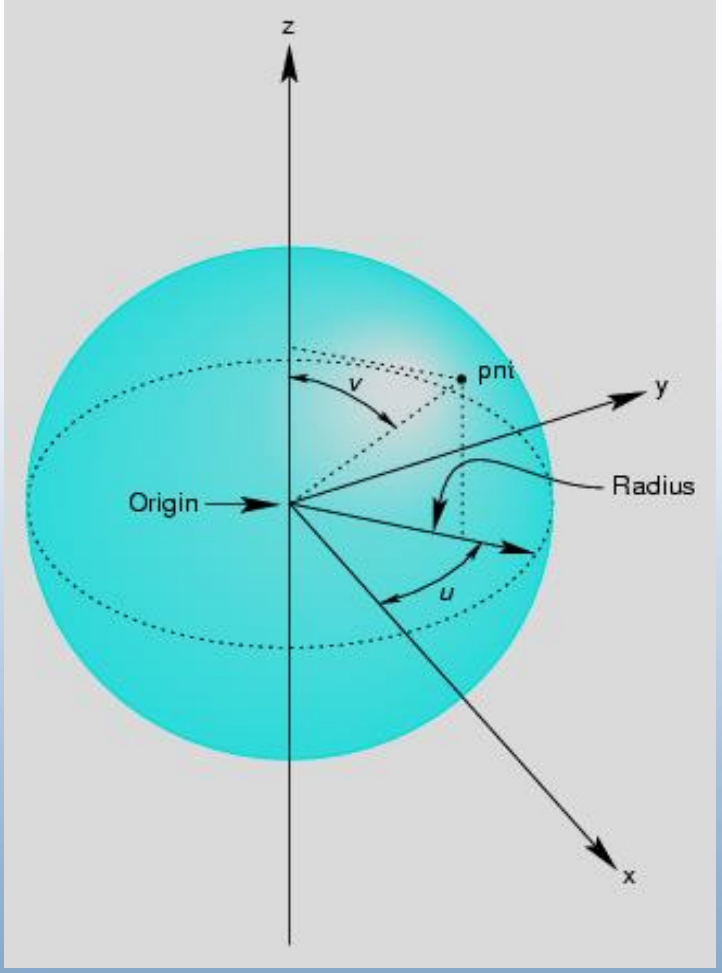
Sphere and Solid Ball

Sphere surface:

$$R^2-x^2-y^2-z^2 = 0$$

Solid ball:

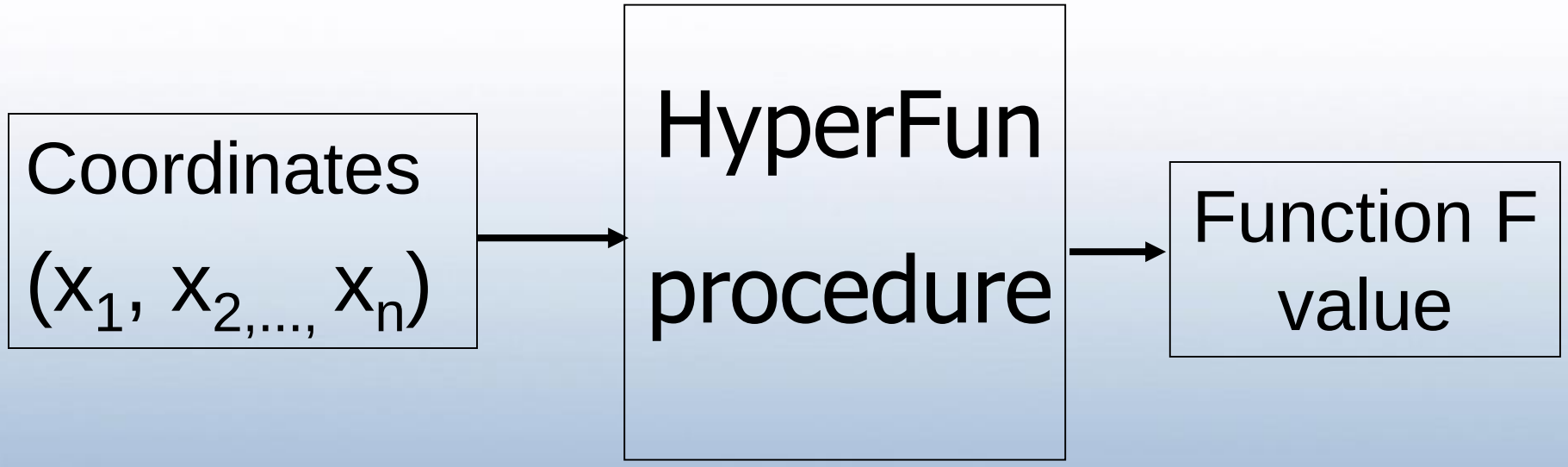
$$R^2-x^2-y^2-z^2 \geq 0$$



HyperFun Language

- HyperFun is a minimalist language (simplified C)
- Purpose: modeling implicit curves, surfaces, and solids
- Mathematical equations
- Library of primitives and operations
- Structured programming constructs
- Not case sensitive

Procedural function definition



HyperFun syntax

The program in HyperFun consists of one or few objects.

Object:

```
model(x[3],a[1])
 {
 …;
 …;
 }
```

Statements

There are four types of the statements:

- Assignment statement for a variable
- Assignment statement for an array
- Conditional statement
- Iterative statement

- Assignment statement for a variable

```
i = i + 1;
x1 = x[1] + a[1];
Metric[2] = b + aa[i]*
        exp(-sqrt(xx1^2 + x[2]^3);
```

- Assignment statement for an array

```
array pz[4]; -- defined at the top
…
pz = [100., -20, 2, 0.5];
```

- Conditional statement

```
if (t = 0) then m = CSGobject;
   else if (t = 1) then m = blobbyobject;
        endif;
endif;
```

- Iterative statement

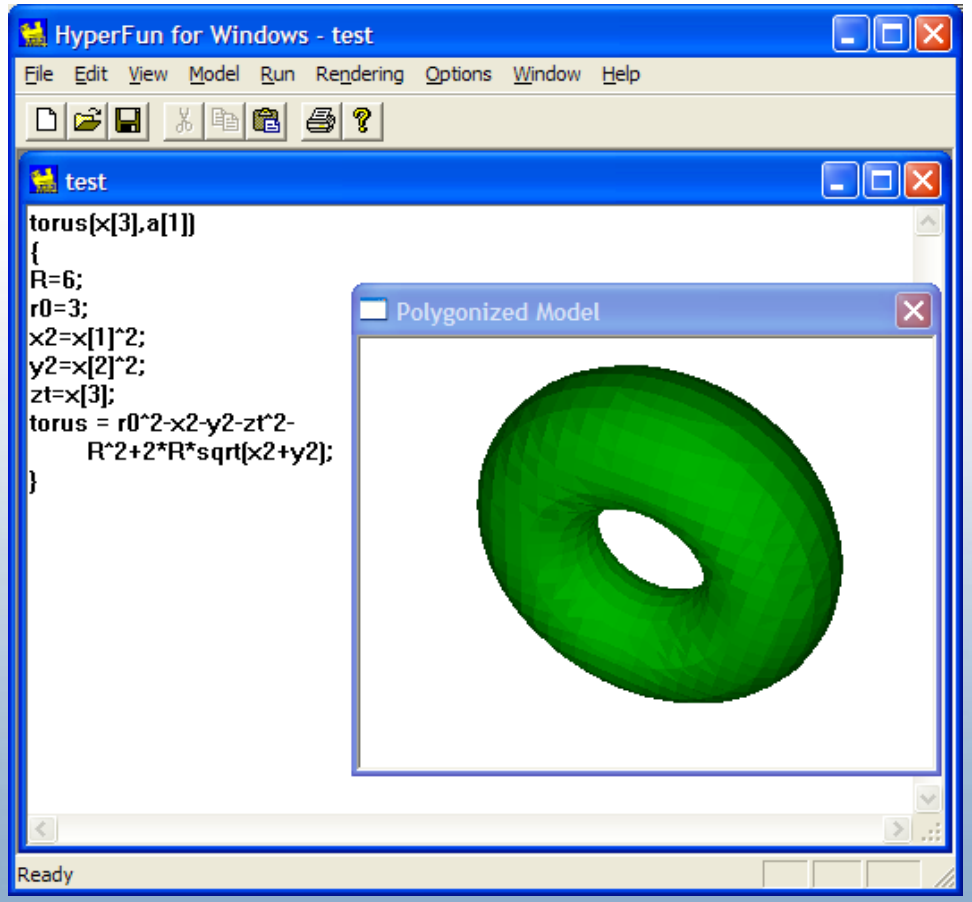
```
i=1;
while (i<10) loop
   xt[i] = x[1] - x0[i];
   i = i+1;

endloop;
```

HyperFun model of torus

```
torus(x[3],a[1])
{
R=6;
r0=3;
x2=x[1]^2;
y2=x[2]^2;
zt=x[3];
torus = r0^2-x2-y2-zt^2-
        R^2+2*R*sqrt(x2+y2);
}
```

HyperFun for Windows

- Specifying function of point coordinates in HyperFun
- Make triangular mesh on the surface
- Drawing (rendering) the mesh
- Rotating, zooming
- Changing rendering parameters: mesh quality, color, etc.



References

- HyperFun Project

http://www.hyperfun.org

see

HyperFun language

F-rep Library

Gallery

Tutorial