

Center **B** radius r

Ball: $(\mathbf{P}-\mathbf{B})\cdot(\mathbf{P}-\mathbf{B})-r^2=0$

Axis vector **W**

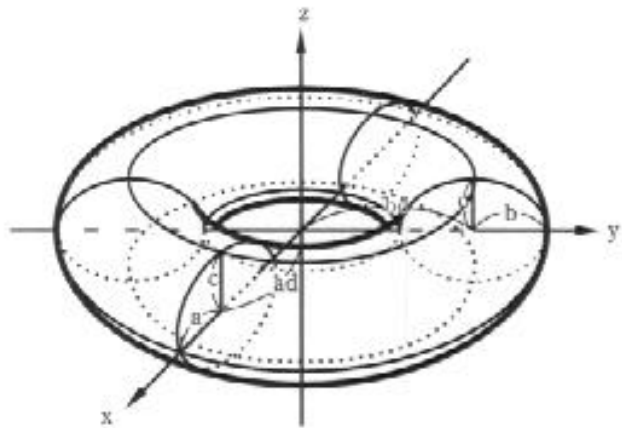
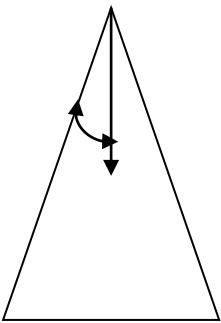
Column: $(\mathbf{P}-\mathbf{B})\cdot(\mathbf{P}-\mathbf{B})-((\mathbf{P}-\mathbf{B})\cdot\mathbf{W})^2-r^2=0$

Cone: $((\mathbf{P}-\mathbf{B})\cdot\mathbf{W})^2-\cos^2\alpha(\mathbf{P}-\mathbf{B})\cdot(\mathbf{P}-\mathbf{B})=0$

[http://en.wikipedia.org/wiki/Cone_\(geometry\)](http://en.wikipedia.org/wiki/Cone_(geometry))

$S(u)=(u\cdot d)^2-(d\cdot d)(u\cdot u)(\cos\theta)^2$

$\left(\sqrt{\frac{x^2}{a^2}+\frac{y^2}{b^2}}-d\right)^2+\frac{z^2}{c^2}-1=0,\quad a,b,c>0$



◆図4.66 標準座標系のトーラス面

$(x^2+y^2+z^2+R^2-r^2)^2=4R^2(x^2+y^2).$

$x^2+y^2+z^2+R^2-r^2-4R^2(x^2+y^2)=0$

$(P-B)(P-B)+R^2-r^2-4R^2(x^2+y^2)=0$

#%

$Z=[1,0,0];$

```
Y=[0,1,0];
```

```
X=[0,0,1];
```

```
external X;
```

```
external Y;
```

```
external Z;
```

```
M=4 4([1,0,0,0],[0,1,0,0],[0,0,1,0],[0,0,0,1]);
```

```
Mi=4 4([1,0,0,0],[0,1,0,0],[0,0,1,0],[0,0,0,1]);
```

```
Mx = 4 1([1],[1],[1],[1]);
```

```
external M;
```

```
external Mi;
```

```
external Mx;
```

```
external xx;
```

```
external yy;
```

```
extern zz;
```

```
rotmat2(M,[1,1,1], d2r(45));
```

```
sub func(n,xyz)
```

```
{
```

```
    #local2wld(X,Y,Z,M,Mi);
```

```
    Mx{0} = xyz[0];
```

```
    Mx{1} = xyz[1];
```

```
    Mx{2} = xyz[2];
```

```
    My = M*Mx;
```

```
    xx = My{0};
```

```
    yy = My{1};
```

```
    zz = My{2};
```

```
    func.ret = 1;
```

```
    return (xx);
```

```
}
```

```

#expr = "(sqrt(x^2/3+y^2/3)-5)^2+z^2/3-1";
#implicitsurface2(getstr(expr), [-15,-15,-15],[15,15,15],[0.0, 0.0, 0.0], 1);

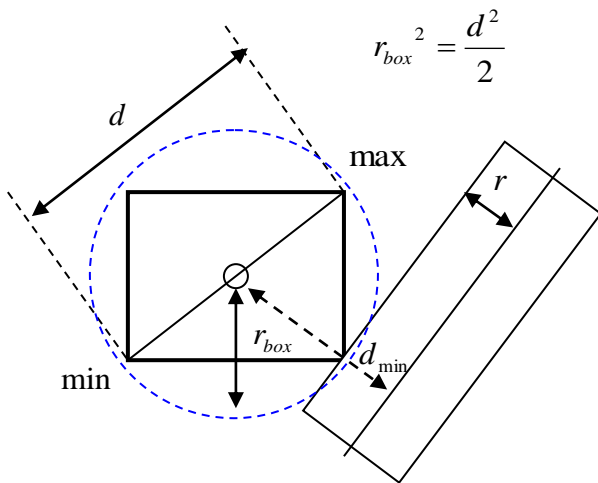
put 1;
modalcolor(255,100,0);
expr      =      "u[0]=x;u[1]=y;      u[2]=z;$func(3,u[]);      x=xx;y=yy;      z=zz;
(x^2+y^2+z^2+5^2-3)^2-4*5^2*(x^2+y^2)";

implicitsurface2(getstr(expr), [-15,-15,-15],[15,15,15],[0.0, 0.0, 0.0], 1);

end;

```

$$d^2 = (\max .x - \min .x)^2 + (\max .y - \min .y)^2 + (\max .z - \min .z)^2$$



$$r_{box} + r > d_{min}$$

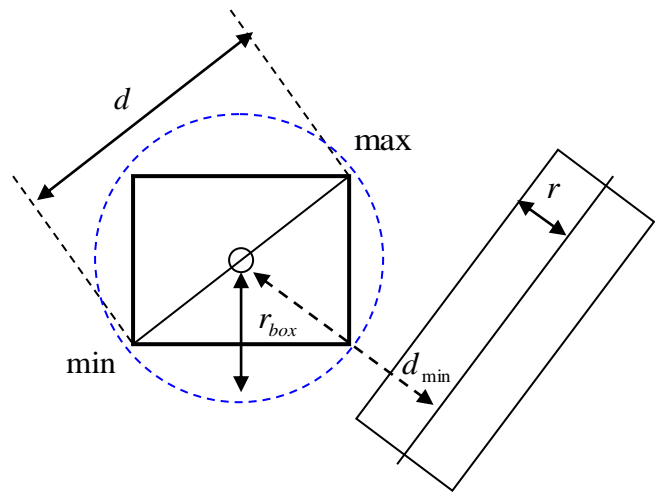
$$(r_{box} + r)^2 > d_{min}^2$$

$$r_{box}^2 + 2r_{box}r + r^2 > d_{min}^2$$

$$r_{box}^2 + 2r_{box}r + r^2 > r_{box}^2 + r^2$$

$$r_{box}^2 + r^2 > d_{min}^2$$

ball



$$r_{box} + r < d_{min}$$

$$r_{box}^2 + r^2 + 2r_{box}r < d_{min}^2$$

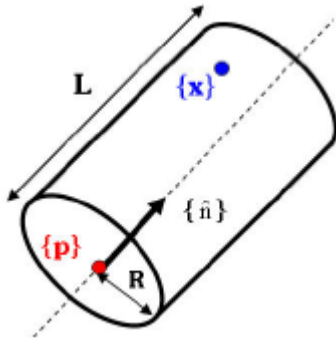
$$r_{box}^2 + r^2 + 2r_{box}r < d_{min}^2$$

$$f(x,y,z)=(x-p_x)^2+(y-p_y)^2+(z-p_z)^2-R^2$$

$$f(x,y,z)=\left(\begin{pmatrix}x&y&z\end{pmatrix}-\begin{pmatrix}p_x&p_y&p_z\end{pmatrix}\right)\left(\begin{pmatrix}x\\y\\z\end{pmatrix}-\begin{pmatrix}p_x\\p_y\\p_z\end{pmatrix}\right)-R^2$$

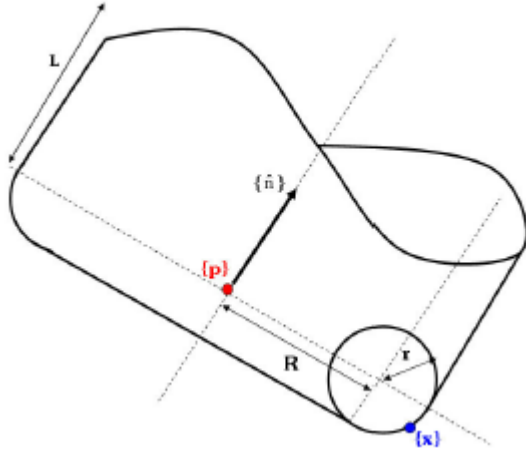
$$\begin{pmatrix}x\\y\\z\end{pmatrix}-\begin{pmatrix}p_x\\p_y\\p_z\end{pmatrix}=\begin{pmatrix}x-p_x\\y-p_y\\z-p_z\end{pmatrix}$$

$$f(x,y,z)=\begin{pmatrix}x-p_x\\y-p_y\\z-p_z\end{pmatrix}^T\begin{pmatrix}x-p_x\\y-p_y\\z-p_z\end{pmatrix}-R^2$$



$$f(x,y,z)=-\left(\begin{pmatrix}x&y&z\end{pmatrix}-\begin{pmatrix}p_x&p_y&p_z\end{pmatrix}\right)\begin{pmatrix}n_x^2-1&n_xn_y&n_xn_z\\n_xn_y&n_y^2-1&n_yn_y\\n_xn_z&n_yn_z&n_z^2-1\end{pmatrix}\left(\begin{pmatrix}x\\y\\z\end{pmatrix}-\begin{pmatrix}p_x\\p_y\\p_z\end{pmatrix}\right)-R^2$$

$$f(x,y,z)=-\begin{pmatrix}x-p_x\\y-p_y\\z-p_z\end{pmatrix}^T\begin{pmatrix}n_x^2-1&n_xn_y&n_xn_z\\n_xn_y&n_y^2-1&n_yn_y\\n_xn_z&n_yn_z&n_z^2-1\end{pmatrix}\begin{pmatrix}x-p_x\\y-p_y\\z-p_z\end{pmatrix}-R^2$$



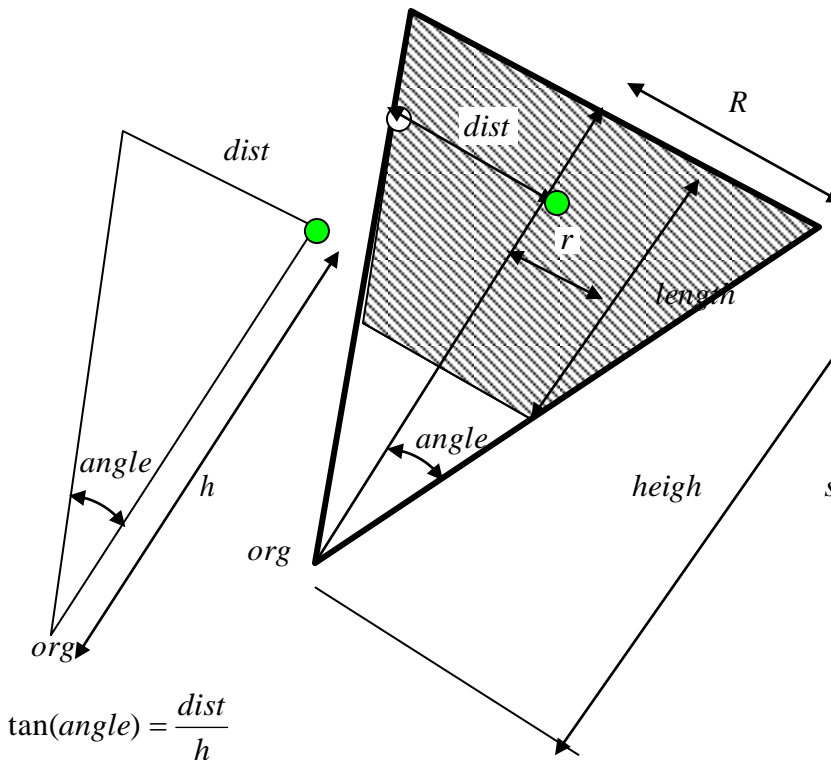
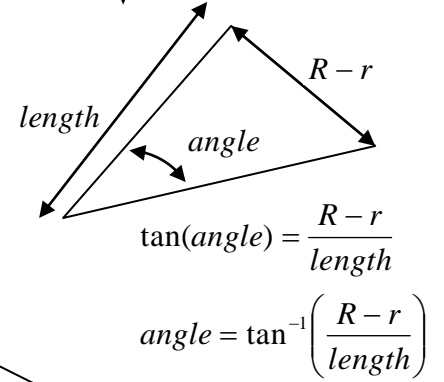
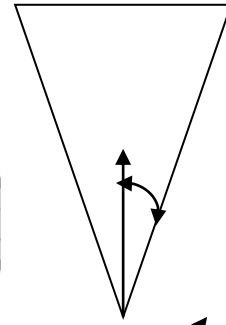
$$f(x, y, z) = \left(- \begin{pmatrix} x & y & z \end{pmatrix} - \begin{pmatrix} p_x & p_y & p_z \end{pmatrix} \begin{pmatrix} n_x^2 - 1 & n_x n_y & n_x n_z \\ n_x n_y & n_y^2 - 1 & n_y n_z \\ n_x n_z & n_y n_z & n_z^2 - 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} - \begin{pmatrix} p_x \\ p_y \\ p_z \end{pmatrix} \right)^2 + \left(\begin{pmatrix} n_x & n_y & n_z \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} - \begin{pmatrix} p_x \\ p_y \\ p_z \end{pmatrix} \right)^T \begin{pmatrix} n_x & n_y & n_z \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} - \begin{pmatrix} p_x \\ p_y \\ p_z \end{pmatrix} \right)^2 - 4R^2 \left(\begin{pmatrix} x & y & z \end{pmatrix} - \begin{pmatrix} p_x & p_y & p_z \end{pmatrix} \begin{pmatrix} n_x^2 - 1 & n_x n_y & n_x n_z \\ n_x n_y & n_y^2 - 1 & n_y n_z \\ n_x n_z & n_y n_z & n_z^2 - 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} - \begin{pmatrix} p_x \\ p_y \\ p_z \end{pmatrix} \right)^2$$

$$f(x, y, z) = \left(- \begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix}^T \begin{pmatrix} n_x^2 - 1 & n_x n_y & n_x n_z \\ n_x n_y & n_y^2 - 1 & n_y n_z \\ n_x n_z & n_y n_z & n_z^2 - 1 \end{pmatrix} \begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix} + \begin{pmatrix} n_x & n_y & n_z \end{pmatrix} \begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix} \right)^T \begin{pmatrix} n_x & n_y & n_z \end{pmatrix} \begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix} - 4R^2 \begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix}^T \begin{pmatrix} n_x^2 - 1 & n_x n_y & n_x n_z \\ n_x n_y & n_y^2 - 1 & n_y n_z \\ n_x n_z & n_y n_z & n_z^2 - 1 \end{pmatrix} \begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix}$$

cone

$$((\mathbf{P} - \mathbf{B}) \cdot \mathbf{W})^2 - \cos^2 \alpha (\mathbf{P} - \mathbf{B}) \cdot (\mathbf{P} - \mathbf{B}) = 0$$

$$f(x, y, z) = - \left(\begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix}^T \begin{pmatrix} n_x \\ n_y \\ n_z \end{pmatrix} \right)^2 + \cos^2(\alpha) \begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix}^T \begin{pmatrix} x - p_x \\ y - p_y \\ z - p_z \end{pmatrix}$$



$$\tan(\text{angle}) = \frac{\text{dist}}{h}$$

$$\text{dist} = h \tan(\text{angle})$$

$$\text{dist}^2 = h^2 \tan^2(\text{angle})$$

