造型算法——倒圆与倒角

Modeling Algorithms Fillets and Chamfers

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一、倒圆 ***Fillet Constructor***

1. ***BRepFilletAPI_MakeFillet***

使用类 ***BRepFilletAPI_MakeFillet*** 来为形状添加倒圆。倒圆是用光滑面来代替角边。使用方法如下：

- 首先，给定一个需要倒圆的形状；
- 然后，通过 ***Add*** 方法来添加描述倒圆的参数，倒圆所需的参数包括一个边 ***edge*** 和半径 ***radius***。当然，边 ***edge*** 必须由两个面 ***face*** 所共有。倒圆会将原来的边替换成光滑的圆面过渡。
- 最后，通过询问结果来执行倒圆操作。

注：添加一个倒圆两次并不会出错，因为只保留了最后一次添的倒圆。

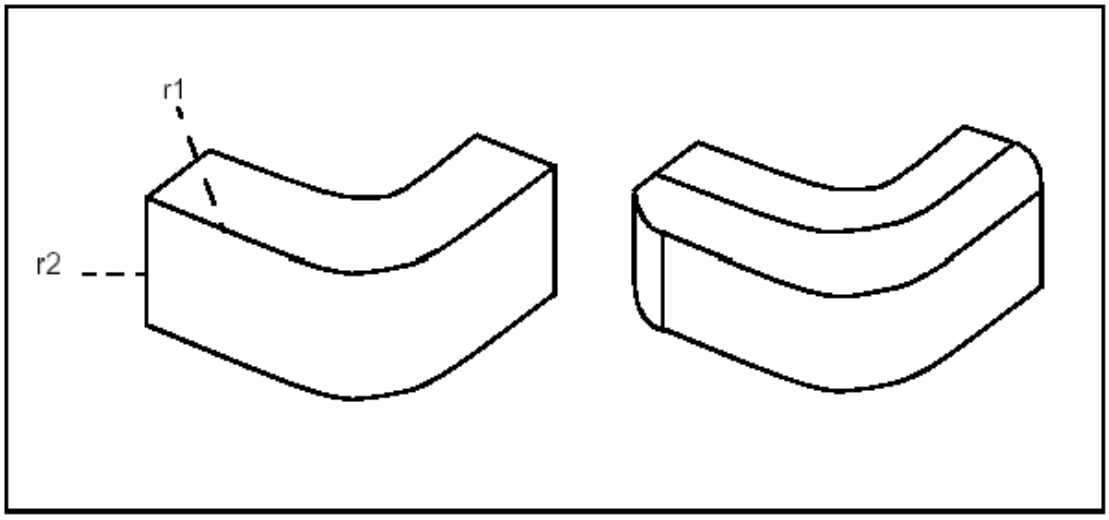

Figure 1. Filleting two edges using radius r1 and r2

下面给出一个将创建一个倒圆的长方体，其尺寸分别为 ***a***，***b***，***c***，倒圆半径 ***r***。

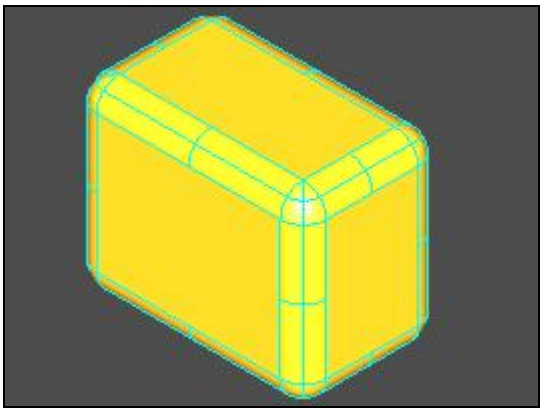

Figure 2. Filleting a box

代码如下所示，创建上图所示的倒圆的长方体的参数分别为：

***a* = 100，*b* = 60，*c* = 80，*r* = 10：**

```
#include <TopoDS_Shape.hxx>
#include <TopoDS.hxx>
#include <BRepPrimAPI_MakeBox.hxx>
#include <TopoDS_Solid.hxx>
#include <BRepFilletAPI_MakeFillet.hxx>
#include <TopExp_Explorer.hxx>


TopoDS_Shape FilletedBox(const Standard_Real a,
      const Standard_Real b,
      const Standard_Real c,
      const Standard_Real r)
{
    TopoDS_Solid Box = BRepPrimAPI_MakeBox(a,b,c);
    BRepFilletAPI_MakeFillet MF(Box);

    // add all the edges to fillet
    TopExp_Explorer ex(Box,TopAbs_EDGE);
    while (ex.More())
    {
        MF.Add(r,TopoDS::Edge(ex.Current()));
        ex.Next();
    }

    return MF.Shape();
}
```

如下图所示为创建一个半径变化的倒圆操作：

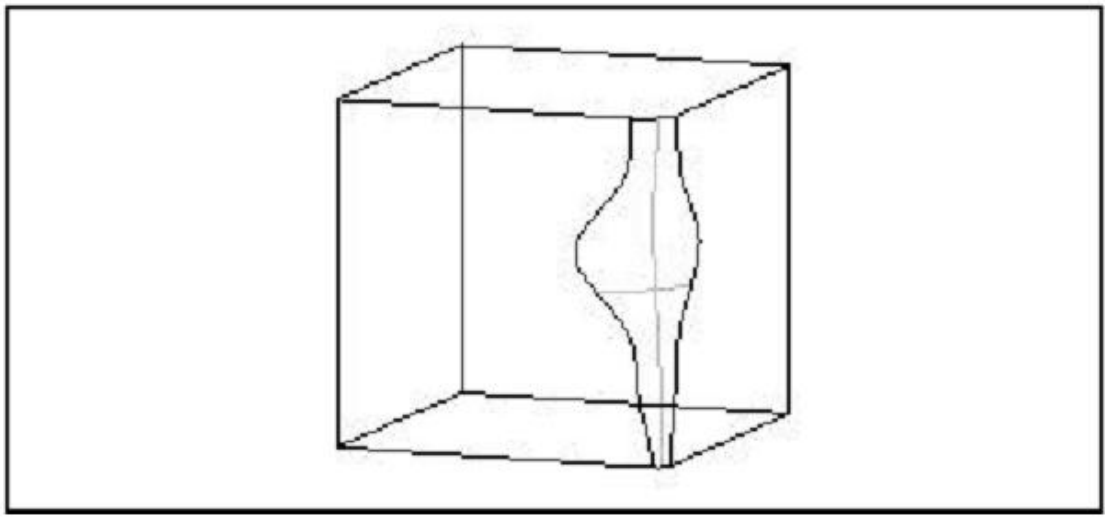

Figure 3. Evolutive radius fillet

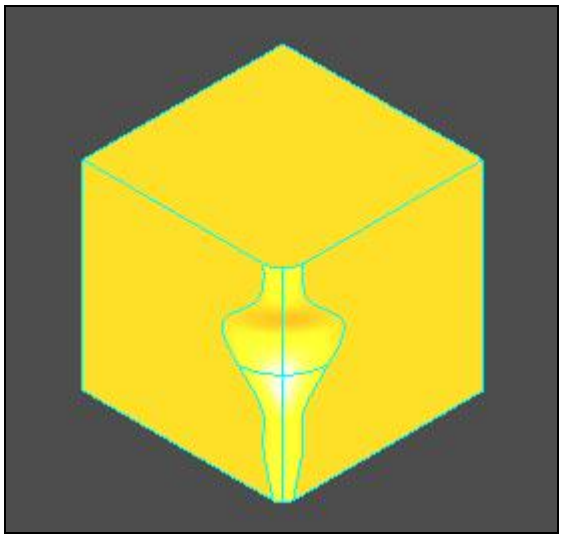

Figure 4. Evolutive radius fillet a box

程序代码如下所示：

```
TopoDS_Shape theBox = BRepPrimAPI_MakeBox(200, 200, 200);
BRepFilletAPI_MakeFillet Rake(theBox);
ChFi3d_FilletShape FSH = ChFi3d_Rational;
Rake.SetFilletShape(FSH);

TColgp_Array1OfPnt2d parAndRad(1, 6);
parAndRad.SetValue(1, gp_Pnt2d(0, 10));
parAndRad.SetValue(2, gp_Pnt2d(50, 20));
parAndRad.SetValue(3, gp_Pnt2d(70, 20));
parAndRad.SetValue(4, gp_Pnt2d(130, 60));
parAndRad.SetValue(5, gp_Pnt2d(160, 30));
parAndRad.SetValue(6, gp_Pnt2d(200, 20));

TopExp_Explorer ex(theBox, TopAbs_EDGE);
Rake.Add(parAndRad, TopoDS::Edge(ex.Current()));
TopoDS_Shape evolvedBox = Rake.Shape();
```

2. ***BRepFilletAPI_MakeFillet2d***

BRepFilletAPI_MakeFillet2d is used to construct fillets and chamfers on planar faces.

我按照示例代码运行了一下程序，结果程序总是崩溃，其操作的效果不得而知，所以也得不到真实的效果图。将其程序代码列出如下所示：

```
#include “BRepPrimAPI_MakeBox.hxx”
#include “TopoDS_Shape.hxx”
#include “TopExp_Explorer.hxx”
#include “BRepFilletAPI_MakeFillet2d.hxx”
#include “TopoDS.hxx”
#include “TopoDS_Solid.hxx”

TopoDS_Shape FilletFace(const Standard_Real a,
    const Standard_Real b,
    const Standard_Real c,
    const Standard_Real r)
{
    TopoDS_Solid Box = BRepPrimAPI_MakeBox (a,b,c);
    TopExp_Explorer ex1(Box,TopAbs_FACE);

    const TopoDS_Face& F = TopoDS::Face(ex1.Current());
    BRepFilletAPI_MakeFillet2d MF(F);
    TopExp_Explorer ex2(F, TopAbs_VERTEX);

    while (ex2.More())
    {
        MF.AddFillet(TopoDS::Vertex(ex2.Current()),r);
        ex2.Next();
    }

    // while...
    return MF.Shape();
}
```

二、倒角 ***Chamfer Constructor***

1. BRepFilletAPI_MakeChamfer

类 ***BREpFilletAPI_MakeChamfer*** 的使用方法与 ***BRepFilletAPI_MakeFillet*** 大致类似，但稍有不同：

a) ***The surfaces created are ruled and not smooth***;

b) ***The Add syntax for selecting edges requires one or two distances, one edge and one face(contiguous to the edge)***;

Add(dist, E, F);

Add(d1, d2, E, F); with d1 on the face F.

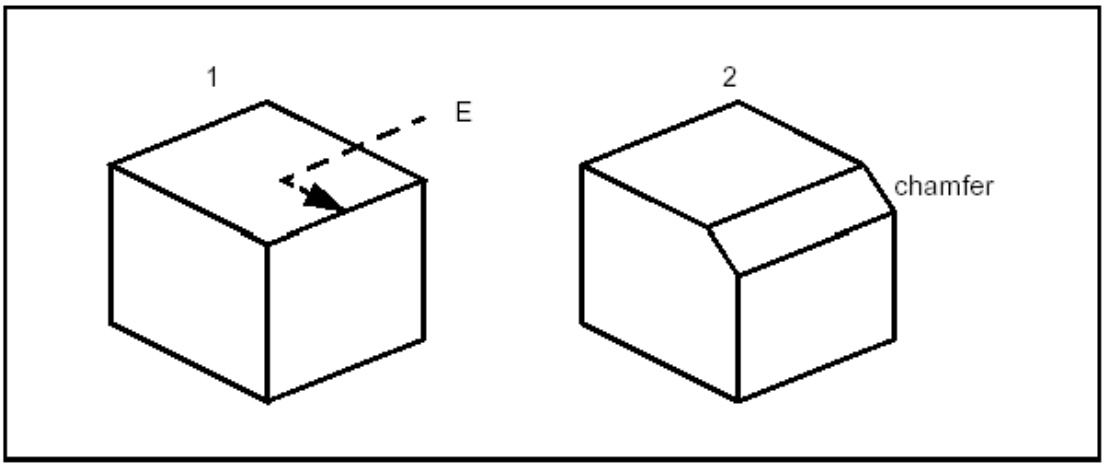

Figure 5. Creating a chamfer

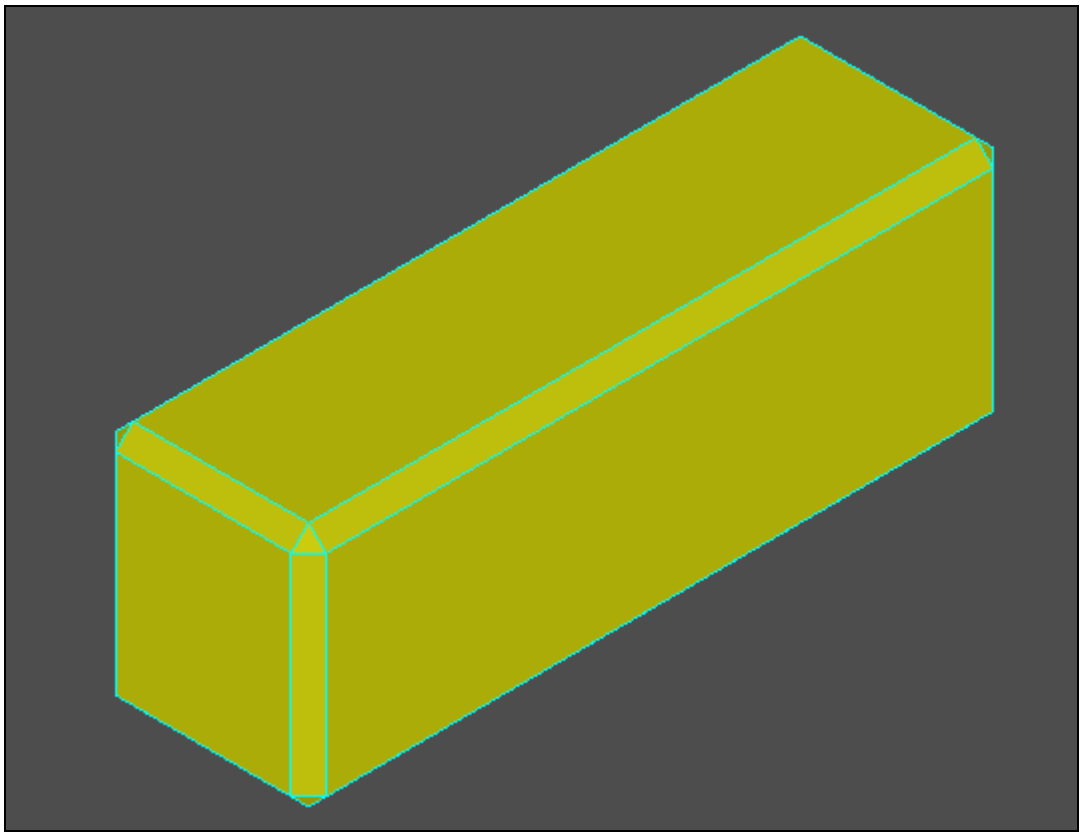

Figure 6. The box with chamfers

程序代码如下所示：

```
TopoDS_Shape theBox = BRepPrimAPI_MakeBox(130,200,170);
BRepFilletAPI_MakeChamfer MC(theBox);
TopTools_IndexedDataMapOfShapeListOfShape M;
TopExp::MapShapesAndAncestors(theBox,TopAbs_EDGE,TopAbs_FACE,M);

for (Standar1d_Integer i;i<M.Extent();i++)
{
    TopoDS_Edge E = TopoDS::Edge(M.FindKey(i));
    TopoDS_Face F = TopoDS::Face(M.FindFromIndex(i).First());
    MC.Add(15,15,E,F);
}

TopoDS_Shape ChanfrenedBox = MC.Shape();
```