Dynavista

CAA V5 based
V10.2 / V11.2
Formability Fillet

October, 2011
UNIADEX, Ltd.

All Rights Reserved, Copyright(C) 2011 Nihon Unisys, Ltd.
Formability Fillet

High performance and robust fillet creation for complex support shape environment.

- **High robustness**
  It uses specifically developed own geometric engine for supporting fillet functions.
- **Variety of functions**
  1. Fillet options such as variable radius, chord length specification, curve passing fillet, three tangent fillet and Gradation, etc. are provided.
  2. Variable radius/ independent end conditions/ arbitrary stop position, etc. are commonly provided to all the functions.
- **High flexibility**
  Separate or combined running of fillet creation/edit of existing fillet/ merger of fillets to base shape are provided, which supports high quality and efficient fillet creation work.

V5 prerequisite: GSD

Production level evaluation by some Japanese automotive OEM(N) shows 1/3 of panel modeling man hours is spent for fillet modeling and 3-5 times reduction is obtained by Dynavista against CATIA V5 fillet.
Formability Fillet command

- Rounding
  - Face fillet
  - Curve fillet
  - Tri-Tangent fillet
- Batch fillet

Creation

- Fillet spline
- Junction Trim
- Blending
- Fillet Fairing

Modification

- Fillet Embedding
- Batch Trim
- R value measurement
- R Attribute

Embedding

- Surface quality

Robustness
- Smooth or broken (Co) support surface
- Self intersection
- Calculation of Fillet-R ends
- Embedding

All Rights Reserved, Copyright(C) 2011 Nihon Unisys, Ltd.
Rounding - Creation -

- Rounding edge fillet surface will be created. (for both a part body and an open body)
- Robust creation of a fillet surface even for complex shape.
- Extensions to “Edge fillet” of CATIA are as follows.

Dynavista feature

- Connecting element specification for both sides
- Independent extension for each end
- Independent end shape processing for each end
- Adjustment of broken edge angle
- Adjustment of broken support surface angle
- Law(function)

Edge fillet

Variable fillet

No variable point is also allowed

Chord length

Edge distance

Fillet arc calculation: ball, spine or normal plane

Dynavista feature
(1) Constant or variable can be selected for radius and chord length.

- Constant radius
- Variable radius
- Constant chord length
- Variable chord length

(2) Ball/spine/plane can be selected for circular arc calculation.

- [Ball]
  Ball rolling circular arc between two surfaces

- [Spine]
  Circular arcs are on the planes normal to given spine curve.

- [Plane]
  Circular arcs are on a plane normal to specified direction.

- Rounding - Creation -
- Interference of existing edge and fillet end
- Variable chord length, connection and merger
- Normal plane specification
A fillet surface is created so that distance from an edge to an R end curves is different from one of the other side.
Face Fillet - Creation -

- Create a fillet surface by specifying two sets of surfaces and radius or chord length (constant/variable).
- M * N surfaces input is available for support surfaces.
- Extensions to “Face fillet” of CATIA are as follows.

Dynavista feature

Face – face fillet

M*N input of constituent surfaces

Variable input

Shape fillet

M*N input of constituent surfaces

1. Chord length
   - Fillet arc calculation: ball, spine or normal plane
   - Independent end shape processing for each end
   - Independent extension for each end
   - Adjustment of broken edge angle
   - Adjustment of broken support surface angle

2. Edge distance
   - Connecting element specification for both sides
Face Fillet - Creation -

- Variation of fillets is the same as Rounding

(1) Constant or variable can be selected for radius and chord length.

[constant radius] [variable radius] [constant chord length] [variable chord length] [constant edge length] [variable edge length]

(2) Ball/spine/plane can be selected for circular arc calculation.

[Ball] Ball rolling circular arc between two surfaces

[Spine] Circular arcs are on the planes normal to given spine curve.

[Plane] Circular arcs are on a plane normal to specified direction.
Curve Fillet - Creation -

- Create a fillet of which one or both sides are bounded by a curve.
- Variety of fillet surfaces can be created by the combination of ‘pass through type’ and ‘fillet type’.
- Sweep command is used for this purpose in CATIA. Extensions to CATIA’s sweep function are as follows

Dynavista feature

Curve/surface fillet

Substituted by Sweep command

Law(function)

No variable point is also allowed

Chord length

Fillet arc calculation: ball, spine or normal plane

Independent end shape processing for each end

Independent extension for each end

Adjustment of broken edge angle

Adjustment of broken support surface angle

Connecting element specification for both sides

Curve fillet
- A Fillet surface can be created between two or more faces without any preparation (connection, extraction, etc.), regardless of status of the connection or disconnection of the faces.

[Pass through type]

[Curve-surface]

“Tangent to a surface”

“Pass through a curve”

[Curve-curve]

“Pass through curves on both sides”

[Curve on surface]

“Pass through a curve and tangent to a surface”

“Tangent to a surface”

“Pass through a curve”

“Pass through curves and tangent to surfaces”

[Fillet type]

Constant-R, variable-R, constant chord length or variable chord length are selected depending on the pass through type.

- Either ellipse approximation or parabola approximation can be selected if the fillet section shape is not circular arc.
- Create a fillet surface tangent to three groups of surfaces.
- Difference from “three tangent fillet” of CATIA is that two or more faces can be input for each support.
- A Fillet surface can be created between two or more faces without any preparation (connection, extraction, etc.), regardless of status of the connection or disconnection of the faces.
Batch Fillet - Creation -

- Collective creation of fillets Specifying R value to each edge among edges.
- Start and end points of each fillet can be specified separately.

- Method of fillet embedding can be specified.

Embedded fillets makes an intersection shape.

Secondly created fillet extends to another edge because the corner is rounded by the result of embedding of firstly created fillet.
Fillet Spline - Modification -

- Auxiliary spline curve for user defined fillet surface is created.
- Especially effective for creating a free shape fillet.
- A spline can be created with a few inputs without reversing tangent direction by an automatic calculation of tangent direction by a sequence of input points when tangent curve/tangent surface restraint.

(1) A spline curve tangent to support surfaces can be created.

(2) Real time movement of spline curve end points and change of tangent vector magnitude are available.
- Trim a fillet surface according to a specified trim method.
- Creation of a trim curve beforehand is not required.

Trim method: [Projection-curve]
Trim method: [Projection-point]
Trim method: [Normal plane]
Trim method: [Parameter]
- Fillet surfaces are trimmed at their joining portion.
- Creation of a trim curve beforehand is not required. All of the fillet surfaces are collectively trimmed at the joining portion.
Create a gradation surface where fillets join.

[Gradation]

- When fillet end is open, filling surface is automatically created.
- Any curves or inside edges can be specified as a frame curves.
- Support surfaces where automatically created edges lie should be specified.
- Two or more support surfaces can be specified.

Tangent continuation to specified fillet and supports are guaranteed.
Blending / Connection - Modification -

[connecting surface]

A surface is created which smoothly connects given section curves.

<Can be used for degeneracy portion>

(CATIA requires 55 commands which is not realistic to use)
- Reshape a fillet surface by easy operation in case a wrinkle or distortion is exists on the surface or in case a bend is generated between fillet surface and support or between fillet surfaces.
- It is also possible to specify multiple surfaces or to specify range for fairing.
- A fillet surface is merged into a support open body.
- There is no comparable function in CATIA V5. A trim command of CATIA can merge fillets. But the command cannot solve the case when surfaces contact each other which frequently occurs in production level modeling.

A fillet which reaches to outer boundary of the support

A fillet which terminates at intermediate location

A fillet of which edges are all on a support.

Outer boundary

Side cover face is automatically created and merged.
- Two or more features in an open body are collectively trimmed at R end curve of a fillet surface.
- This command is used in conventional surface modeling. Two or more features can be trimmed without connecting them beforehand.

Elements specified for trimming (Two or more features in an open body)

Fillet surface

Sides which are not covered by fillet surface (outer side) remain after trimming.

Can be connected smoothly to the specified fillet.

Trimming is extended if the trim line does not reach to outer boundary of the elements to be trimmed.

Only this element is trimmed.

These elements are not processed because they cannot be divided by the trim line.

Elements specified for trimming (Two or more features in an open body)
- R value of a fillet can be measured.
- It is also useful for checking R value change at variable fillet and the check of R value of a fillet in a model imported from other CAD systems. Gradation surface can also be processed.
- Result of the measurement remains as a temporary figure for easing visual confirmation.
- By giving R value as an attribute at rounding edges or vertex (gradation portion), reduction of the input operations and prevention of input error are expected.
- R values and edges can be collectively input only by hitting R-attributes.
- By the use of confirmation function of R attribute, missing of input can be checked visually.

Hit a R-attribute

Edges with the R-attribute are selected at the same time.

A curve with R-attribute

Convex 5 mm
Convex 7 mm
Convex 8 mm
- Curve with R attribute
  - Constant/variable R attribute is attached to a curve or component curve.
  - Variable position by a mouse picking and fine adjustment by spinner.
  - Can be referred by Flange expansion and Fillet.
  - Classification such as priority or convex/concave.

- Curve with R attribute
  - R attribute is attached at intersecting point of two or more curves with R attribute.
  - Comments can be input for header character string.
**R-attribute – Related functions**

- **Switch R attribute display**
  - Switching of display on/off according to attribute type

- **Switch convex/concave of R attribute**
  - Collective switching of convex/concave

- **Analyze R attribute value**
  - Analysis and display of R value at any position on a curve with variable R attribute

- **Customization of R attribute**
  - Arbitrary customization of display property.
  - Color/line type (point type)/line thickness (point symbol shape) can be customized by type of attribute or R value.
  - Color before attribute attachment can be seen by the use of standard mode/original line display mode of CATIA.

---

*Dynavista*

All Rights Reserved, Copyright(C) 2011 Nihon Unisys, Ltd. 23
Degeneracy, non-smoothness (C0) and self-intersection of support surfaces - Robustness -

Fillet robustness

- Inheritance of fillet creation and merge algorithms used in the well established hybrid modeling.
- High robustness guaranteed even for complex shaped automotive parts.

- Both sides gradually become tangent connection
- Self intersection case
- Degeneration at the end of a curve
- Small non-smoothness between surfaces
- Small bend
- Removal of self intersection

Tolerance for judging broken surface or edge can be specified.
Contact or coincidence of an fillet R-end edge and another edge on a support surface

When only small portion allows the calculation of fillet shape.

Fillet shape is created using this portion
Embedding - Robustness -

Contact of a side cover surface and a fillet surface

Contact of a fillet surface and a support surface

Surface-surface contact

Other cases of tough merger

(1) Extension of a cover consisting of 2 surfaces
(2) Mixture of extension and trim of a cover
(3) A fillet trimmed by a hole shape
(4) Multiple end surfaces
(5) Trim at the end of support surfaces
- Special consideration is taken to prevent “wrinkle”.

“Wrinkle” is created by the concentration of patch boundaries caused by complex shape change.

“Wrinkle” is avoided by the smooth gradation where fillet surfaces are tangent to adjacent fillet surfaces and support surfaces.
Dynavista® is a registered trade mark of Nihon Unisys, Ltd. In Japan.
CATIA® and DELMIA® are registered trade marks of Dassault Systèmes S.A.
ENOVIA is a registered trade mark of Dassault Systèmes S.A.
SMARTEAM® is a registered trade mark of Smarteam Corporation.

All Rights Reserved, Copyright(C) 2011 Nihon Unisys, Ltd.