AUTODESK UNIVERSITY

CLASS ID: PD20930

Product Surfacing with T-Splines and Parametric Solid Modeling Tools

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Description

This class will demonstrate a workflow that uses the T-Splines Module in Fusion 360 software to create NURBS like surface patches based on existing sketches and sculpting the desired surface flows via CV direct modeling.

The resulting generated boundary representations (BREPs) can then be further manipulated with solid and surface modeling tools inside the parametric timeline environment.

The class will also focus on proper T-Spline mesh topology to improve resulting BREP path layout quality and best practice for how to use T-Splines inside the parametric timeline.
This session features Fusion 360.

Learning Objectives

- Learn how to create T-Splines surfaces via sketches and primitives
- Learn about sculpting T-Spline surfaces and maintaining proper topology layouts
- Learn how to use T-Splines with solid/surface modeling tools in the parametric timeline
- Understand best practices and parametric surfacing strategies

Your AU Expert

Claas Kuhnen is a 3D designer with a strong interdisciplinary education bridging industrial and graphic-motion and jewelry design.

He received his undergraduate degree in Color Design for Product and Graphic Design from the University of Applied Science and Art Hildesheim, Germany and his Masters in Fine Arts in 3D Studio Art in Jewelry Design and Digital Arts from Bowling Green State University.

He teaches at Wayne State University in Detroit, Michigan in the Industrial Design department focusing on digital 3D design tools and fabrication technologies. He also serves as a research assistant for the Biomedical Engineering department in the development of medical devices.

In his research and studio practice, he investigates a modern multi-application approach utilizing parametric and generative design steps in a cohesive and productive workflow.

He operates his own design consultancy studioKuhnen LLC and was involved in projects ranging from furniture design, interface design, and consumer products.

In addition Claas also actively contributes to various 3D CG outlets and oine web communities sharing his techniques and knowledge and is an Autodesk Expert Elite Member.You can see his lecture videos at: http://www.youtube.com/user/cekuhnen

Fusion 360 T-Splines Tips:

In the following two pages I have collected some tips and suggestions you could consider to implement into your workflow focusing on T-Spline sculpting and parametric modeling strategies in the timeline. They are based on years of experiencing working with NURBS and Sub-D surfaces in programs such as Maya, Rhino, Blender and Alias for concept modeling as well as rapid prototyping.

Essentially with this you could see T-Splines as a replacement of traditional NURBS cage editing which is a common approach in Rhino and Alias but this right in Fusion with a parametric workflow as a bonus.

Demo files available at: http://tinyurl.com/hpfckdl

NURBS vs. T-Splines:

NURBS:

- Precise
- Curvature graph
- Single 4 sided patch
- Poly surface for complex topology
- Insert isoprams or change degree while keeping the shape
- Cannot refine density locally (only on complete patch)
- To round edges fillet command has/ can to be used

Advantage:

- Clean light weight geometry
- Control over patch layout

Disadvantage:

- Very labor intensive for smooth shapes
- Requires perfect profile layouts
- Design adjustments require manual sketch and surface re-alignments

T-Splines:

- Precise
- Curvature graph (with limitations)
- Single 4 sided patch and NGons
- Single surface for complex topology
- Insert loop-cuts while keeping the exact shape
- Insert edge on a face where needed for local density change
- Fillets can be sculpted via edge loops and mesh topology on the fly

Advantage:

- Incredible easy to sculpt
- Organic flows can be modeled with irregular topology layouts

Disadvantage:

- Patch layout can get messy when T-Splines mesh count is high
- Achieving smooth curvature is harder than blending between NURBS surfaces

Think and treat T-Splines like NURBS that combines the best NURBS and polygon modeling together into one workflow. Then you have NURBS CV sculpting in Fusion 360!

T-Splines:

Topology Layout and Density:

Like with quality NURBS surfacing try to follow the concept of creating light weight mesh surfaces, meaning trying to achieve the desired surfaces with the least amount of control points as possible. This will make adjusting the mesh structure less labor intensive and maintaining smooth surface flows easier

Quad Faces and NGONs:

NURBS prefers quad faces, a face with 4 edges. Try to use those as much as possible as this will help Fusion 360 to create BREP surfaces with a less complex patch layout. Try to minimize the use of NGONS. They can make the BREP result complex. But in some cases like Y-Connections NGONS are a blessing and can strategically used.

CV Spacing:

Like with NURBS one can pinch a surface when moving edges or CVs closer together. To achieve smooth surface flows maintain even spacing between edges or CVS similar to the control cage spacing with NURBS.

Edge Slide:

Make use of edge slide to smoothly move CV between neighbor CVs instead of moving them by hand as much as possible.

Global and Local Translation:

Local translation for move and scale is an incredible useful tool when your geometry is not orientated along global X Y Z. Use this when moving or scaling faces or edges.

Curvature Graph:

Make use of the Curvature Comb Analysis in T-Splines to observe surface curve flows. What is smooth to an eye is sometimes not smooth - not bending evenly.

Zebra Analysis:

Make use of the Zebra Analysis in T-Splines to evaluate your design for having pinched corners or other problematic surface to surface transitions.

Tangent Handle:

CV Tangent Handles allow you to deform a surface flow without adding additional loop cuts maintaining a light weight mesh which is easy to manipulate.

Surface Subdivision:

T-Splines offers two modes to subdivide. Simple subdivision smoothly subdivides the mesh density which will result into a surface change. Exact subdivides the mesh density but redistributes the CV positions to maintain the same surface flow. Use the last mainly.

Extrude from Sketch:

T-Splines allows you to extrude a mesh from a sketch with even or curvature matched mesh topology. Each has that advantage or disadvantage. Often hand adjusted CV with a light mesh can be a close match to a more dense curvature matched surface. Balance out density versus ability to comfortably manipulate the mesh.

Rounding:

With Sub-D like sculpting you model your fillets on the fly. To adjust the radius you can use the Edge Slide command to adjust the CV spacing.

Break Edges:

To break an edge or edge loops you can use the crease command to add sharp edges to an otherwise smooth design.

Disconnect Surfaces:

To disconnect a surface or surface loops you an use the "Unweld Edges" command. In the timeline you will then get two BREP objects to work with.

Symmetry:

Make use of the mirror function as much a possible. Modeling only half of the model reduces the labor for adjusting the T-Splines mesh and guarantees perfect symmetry in addition.

Blend Surfaces:

You can use loft or bridge command to create secondary blend surfaces. Loft in addition will allow you to create the new T-Spline mesh being G1 or G2 to the target mesh surfaces.

Offset Surfaces:

If you need to offset a surface, you can use the "Thickness" command in T-Splines and use the "No Edges" option for "Thicken Type". Do not delete the not needed T-Splines surface. You can rather remove the not needed BREP surface in the timeline.

Surface Thickness:

In T-Splines generate the input surface and use the parametric ability of the "Thickness" command in the Timeline instead. This has the advantage that you only have to adjust a single surface to sculpt details, while the timeline will always adjust the surface thickness for you automatically.

Workflow:

Designing is a process:

Break up bigger problems into smaller easier to digest steps.
Focus on blocking out main proportions of the design following a hard edge model idea.
Details such as fillets or secondary surfaces can be added at the end.
This will also keep the design and timeline very responsive.

Low-Res and High-Res models:

Start sculpting basic proportioned in T-Splines with the least amount of CVs as possible. To sculpt refined details you can export the T-Spline mesh as OBJ and then import the mesh into a new T-Spline container and subdivide it there to get a denser mesh to manipulate and sculpt. This way you always maintain you original start model.

Create individual T-Spline forms for individual objects:

A complex T-Spline mesh can take some time to convert to BREP. Thus is it good practice to put specifically complex T-Splines meshes into their own T-Spline container in the timeline.

Structure your modeling steps and approach:

Grouping feature types such as sketches, surface creation, and fillets will visually help maintaining good readability of the timeline

Organize objects into components from the start:

An advantage of using components from the beginning is that a change in the timeline will only affect the features in that component resulting into only short computation times. This can be very useful when the design is very complex or detailed.

Not everything has to be a separate part from the beginning:

Specifically during the initial concept modeling phase where you explore ideas quickly it might be a good idea to create components inside one design and later if needed create individual files with only one component inside.

Not everything has to be perfectly constrained:

Fusion 360 offers you the ability to approach a design using an engineering like constrained sketch or a designer like freeform surface approach. The beauty is that in the parametric timeline you can utilize each method. Use what is best for the given task.