Bits & Atoms Computer Aided Design

3rd Semester | 23rd of October 2017

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Overview Bits & Atoms: Computer Aided Design



Rhino Basics

Rhino to Grasshopper

30.10.2017

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6.11.2017

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Parametric Design with Grasshopper



Overview **Bits & Atoms: Computer Aided Design**



Rhino Basics

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EXERCISE 0

Install Rhino 3D WIP

- 1. Install Rhino the Rhino3D for Mac Testversion first (valid for 90 days) <u>https://www.rhino3d.com/download/rhino-for-mac/5/evaluation</u>
- Then download and install Rhino3D WIP as this version includes Grasshopper. <u>https://www.rhino3d.com/download/rhino-for-mac/5/wip</u> The WIP version requires a valid license, therefore you need to install the Testversion first.

Rhino 3D Interface

Rhino 3D Interface - Viewports



Rhino 3D Interface - Toolbar



Rhino 3D Interface - Object Snap



Rhino 3D Interface - Layers



What are Nurbs?



What are Nurbs **Definition**

Non-uniform rational basis spline (NURBS) is a mathematical model commonly used in computer graphics for generating and representing curves and surfaces. It offers great flexibility and precision for handling both analytic (surfaces defined by common mathematical formulae) and modeled shapes. NURBS are commonly used in computer-aided design (CAD), manufacturing (CAM), and engineering (CAE) and are part of numerous industry wide standards, such as IGES, STEP, ACIS, and PHIGS. NURBS tools are also found in various 3D modeling and animation software packages.





Rhino 3D Nurbs vs. Polygons/Meshes







Rhino 3D Nurbs vs. Polygons/Meshes







Create and Edit 2D Geometry

EXERCISE01 2D & 3D Creation and Editing

create & edit 2D:

_line, _circle, _curve, _arc _move / _mirror / _trim / _extend _EditPtOn

Use Osnap / Objektfang Use Gridsnap / Rasterfang

create & edit 3D:

_ExtrudeCrv





EXERCISE02 **Circles and Arcs**

Arc: Start, End, Direction

R2.00-

create & edit 2D:

_line, _circle, _curve, _arc _move / _mirror / _trim / _extend _EditPtOn

Arc: Center, Start, End-

Use Osnap / Objektfang Use Gridsnap / Rasterfang

create & edit 3D:

_ExtrudeCrv





Create and Edit 3D Geometry

EXERCISE03 Modelling with Gumball

Gumball Commands:

move: arrow handles
scale: square handles
rotate: circle segment handles
extrude: click arrow handle > drag > press command&shift
select subsurface: command&shift + selecting surface or edge





EXERCISE03 **Create Solids**







EXERCISE03.1 Edit Solids



- Solean difference Solean intersection P Boolean split Boolean 2 objects Create solid Shell polysurface G Cap planar holes Sextract surface Merge two coplanar faces G Merge all coplanar faces 🔩 Unjoin edge Variable radius fillet Variable radius blend Variable radius chamfer Move face
 face
 Move untrimmed face
 Move face to a boundary Extrude face Extrude face along path
- Extrude face to a boundary
- 🗊 Solid points on
- 👎 Move Edge
- Move untrimmed edge
- 🕄 Split planar face
- Sold planar faces
- Round hole
- Make hole
- Revolved hole

- Array hole polar
- S Delete hole







EXERCISE04 CV Curve Creation and Editing

_curve _move / _mirror / _trim / _extend

_EditPtOn

Use Osnap / Objektfang Use Gridsnap / Rasterfang

Use gumball to to edit and move points





EXERCISE04 CV Curve Creation and Editing



_curve _move / _mirror / _trim / _extend _EditPtOn

Use Osnap / Objektfang Use Gridsnap / Rasterfang

Use gumball to to edit and move points



EXERCISE05 Create Surfaces - Loft





EXERCISE05 Create Surfaces - Loft



Loft > straight sections

Overview **Bits & Atoms: Computer Aided Design**



Rhino Basics



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Overview Grasshopper

Grasshopper is a visual programming language and environment developed by David Rutten at Robert McNeel & Associates, that runs within the Rhinoceros 3D computeraided design (CAD) application. The first version of Grasshopper was released in September 2007, and titled Explicit History. Grasshopper has become part of the standard Rhino toolset in Rhino 6.0 and later.

- Grasshopper is primarily used to build generative algorithms, such as for generative art. Many of Grasshopper's components create 3D geometry.

- Advanced uses of Grasshopper include parametric modelling for structural engineering, parametric modelling for architecture and fabrication, lighting performance analysis for eco-friendly architecture and building energy consumption.

Grasshopper is "The new Grasshopper environment provides an intuitive way to explore designs without having to learn to script." (AEC Magazine)



							Grasshop
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Component Panels (Container System)

































Component Panels (Container System)







Component Panels (Container System)

and you will see a list of parameters or components that match your request.

							Grassho	pp
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You can also find components by name, by double-clicking anywhere on the canvas; launching a pop-up search box. Type in the name of the component you are looking for







Component Panels (Container System)

components are then connected to the inputs of subsequent components.



- The program gets created by dragging components onto a canvas. The outputs to these



Overview Component Panels (Container System)















Component Panels (Container System)

<u>Parameters</u> contain data, meaning that they <u>store</u> stuff. <u>Components</u> contain actions, meaning that they <u>do</u> stuff.





Component Panels (Container System)

When you hover your mouse over the individual parts of a Component object, you'll see different tooltips that indicate the particular type of the (sub)object currently under the mouse. Tooltips are quite informative since they tell you both the type and the data of individual parameters:

Div. C (Curve)	
Curve to divide	
Local Curve list (1 values) Referenced Curve	
Div. N (Integer)	1-1-1-1-1
Number of segments	
Local Integer list (1 values) 10	
Div.K (Boolean)	
Split segments at kinks	
Local Boolean list (1 values)	





Component Panels (Container System)

All objects on the Canvas have their own context menus that expose most of the features for that particular component.

Right click on the Parameter or Component indicates those features:

Or Blank space button shows the same features in symbols:



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	Wire Display	
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	Flatten	
	Graft	
	Expression	
-	Set one Point	
	Set Multiple Points	
_	Manage Point collection	
	Clear values	
	Internalise data	
	Extract parameter	
	Help	





Exercise I







1. Parameter Points: Parameter wants to store stuff - still empty



2. Connect Rhino and Grasshopper points:

In Grasshopper: **Right click, set one point**

In Rhino: **Click on point**







Primitive: Line



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Exercise I

BoxMorph

Loft: To create a surface from joined lines

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Exercise I





Slider:

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	Max	00000000000010
	Range	00000000000010
	Numeric value	9
		000000000005
		5
		OK Cancel



- R = Real Numbers (reelle Zahlen)
- N = Integer Numbers (ganze Zahlen) E = ?
- O = ?



Exercise I





Exercise I



Exercise I **BoxMorph - Main Part**

The Bounding Box is a reference Brep for the BoxMorph component. The Bounding Box creates a reference of the geometry that you wish to morph. i.e. the corners of that BBox will be mapped to the corners of the Target Boxes. Any Geometry within that BBox will then be mapped relative to the space of that box.

You can still change your base surface, pattern geometry, and the U and V subdivisions (sliders) to control any number of panels on a surface.

Exercise I

BoxMorph - Main Part

BoxMorph sorts the geometry to each containing box, so we can stretch and distort geometry in a very precise way.

The difference between <u>Box Morph</u> and <u>Surface</u> <u>Morph</u> is that a box morph only takes the 8 corners into account. It assumes a linear deformation between the corners. The Surface Morph component on the other hand actually pays attention to the surface curvature in

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Surface section

Exercise I

Exercise I BoxMorph - Main Part

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Exercise I

BoxMorph - Main Part

... that`s how your components should look like.

Now we add a <u>Slider to the Scale.</u>

Exercise I BoxMorph - Finish - play with Sliders, Gumball and X, Y, Z Coordinates

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Rhino to Grasshopper

Parametric **Design with** Grasshopper

Modelling Beispiele

Modelling Bösendorfer GT

Übersicht smartskull

BRIGHTNESS SENSOR ACCELEROMETER

LED FRONTLIGHT

VIBRATING INDICATOR FEEDBACK

Übersicht Kaputt.R

