Hello World!

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Introduction

This course is presented to first year Engineering students. They will learn how to use Autodesk Inventor/Fusion 360 to create more advanced 3D parts, assemblies and technical drawings. In the future we might give more theoretical in depth knowledge of inner workings of functions and features.

The students know how to operate a computer to design basic 3D models in Autodesk Inventor. They have definition and factual knowledge of mathematics which is useful for explaining the functions and features. Most of the students have worked with a CAD application and created simple technical drawings and 3D parts.

The group consists out of around 32 students, work individually on session assignments and in groups of 8 on the final assignment.

We will be using online platforms(1)(2) so the students can prepare for the session by watching video's.

Personally I like an interactive and an open class so students get to feel involved. My goal is to make te students feel they are the owner of their study.

1^{st} Session

This session will be a repetition of the sessions most/all students have taken in the 2^{nd} year of Aviation Engineering.

Goals

After this session, the students are able to:

Projects Create a project to manage their files

Navigation Pan, rotate and zoom using the mouse

Sketch

- Draw basic sketches with lines, circles, arcs, rectangles, slots, ellipses, points, fillet/chamfer, polygon and text
- Project geometry

- Dimension a sketch and naming parameters
- Constrain the sketch by using the coincident, parallel, horizontal, perpendicular, vertical, equal constraints to enhance it by fully constraining
- Pattern a sketch by using the circular, rectangular & mirror pattern
- Modify a sketch by using move, rotate & scale
- Insert AutoCAD files (*.DWG/*.DXF) into a sketch

Part
- Utilise the part origin center point, axis and planes
- Primitives to start with basic geometry
- Create solids using extrude, revolve, loft and sweep
- Modify a solid with hole, fillet, chamfer and shell

Assembly
- Placing self created parts
- Adding constrains: mate/flush, angle, insert, with optional offset

Presentation
- Create view with manual explosion
- Tweak components with linear and rotational movements
- Animate with grouped components

Drawing
- Property fields
- Place views: base, projected, auxiliary, section, detail
- Annotate a drawing: dimension, feature notes, text, symbols

Scheme

10 min Buzzing

2 min Personal introduction

2 min Little introduction about the course and where to find things. Highlighting the blended learning part of the course!

1 min Questions about the topic to test the cognitive and affective predictions.

50 min Demonstration on creating the following assignment parts, assembly, presentation and drawings to refresh the memories. Give resources where to find information for reference and/or learning Inventor.

10 min Break

10 min Create excel from data points and introduce the assignment.

120 min Students work on a small assignment to refresh/test the skills, creating parts, a small assembly, presentation and technical drawing of a part. Creating an assembly of an table airplane model.

5 min Wrap up and remind them to look at DLWO for next week. The quiz of the week: where could the cross product be used for inside Inventor?

Resources

For this session we use the playlist(3) created on Lynda. If students miss the session or want to have a reference they can have a look here.

2^{nd} Session

In this session we will give some in-depth explanation of underlaying functions and features. We are going to create more difficult parts by using 3D sketches, splines and 2D/3D formula's.

Goals

After this session, the students are able to:

Cartesian & Polar Tell what the cartesian & polar coordinate systems are, where it comes from and where it is used for

Mathematics Explain how a sketch is constructed mathematically using vectors and how constrains are constructed

Vector vs Raster Tell the fundamental difference between a vector graphic and raster graphic

Spline Tell about the two types of splines in Inventor (Interpolation & Control Vector) and about the 5 different conditions of connections between (sp)lines

3D Sketch Construct a 3D sketch from points and lines of existing solid or project 2D on 3D solid

Formula Define formulas to create 2D and 3D lines

Loft Using guide lines and explain the differences in the 5 different conditions

Scheme

10 min Buzzing and individually checking what they thought of the video they had to watch, ending with a short introduction of the session and check who has the correct answer to the quiz of the last session

50 min Lecture about the cartesian/polar coordinate system, (vector) mathematics of lines, circles, splines and vector vs raster graphics

5 min Break

60 min Different assignments for learning how to use the new techniques to create more complex sketches in combination with known techniques

10 min Break

60 min Assignment to create an airplane using the newly learned techniques

5 min Wrap up and remind them to look at DLWO for next week. The quiz of the week: what are the three basic elements to construct a polygonal mesh?

Resources

You will need to watch a video about 2D splines(4) and read about Euclidean Geometry(5) and the Cartesian Space(6).

3^{rd} Session

In this session we will take a closer look at a mesh, what is it constructed out of and what defines a solid. We will also start with surface modelling.

Goals

After this session, the students are able to:

Mesh Explain that a 3D computer model mesh is constructed out of vertices, edges and faces

Surface vs Solid Explain the difference between a surface and solid

Surface Modelling Create a model with surface modelling tools: loft, sweep, thicken/offset, stitch, sculpt, patch, trim, delete

Inspect Analyse the surface of the model for smoothness

Scheme

10 min Buzzing and individually checking what they thought of the video they had to watch, ending with a short introduction of the session

50 min Lecture about 3D models and shaders and show them a surface and solid with different shading using Blender. Show them the different tools within Inventor for surface modelling and how to use them.

5 min Break

60 min Different assignments for learning how to use the new techniques to create more complex sketches in combination with known techniques

10 min Break

60 min Assignment to create an airplane using the newly learned techniques

5 min Wrap up and remind them to look at DLWO for next week. The quiz of the week: what is the main difference between parametric and freeform modelling?

Resources

You will need to watch a video series about surface modelling(9).

4^{th} Session

In this session we will take a look at freeform modelling using NURBS, Subdivision Surface and T-Splines. If you have a Mac you will need to install the client of Fusion 360 beforehand to work with T-Splines. If you have Inventor 2015 or 2016 installed on your computer you will not need to install Fusion, else you will. Autodesk Inventor has T-Splines implemented from 2015 on.

Goals

After this session, you will be able to:

NURBS Tell where NURBS (Non-uniform rational B-Spline) stands for and explain the (dis)advantages of it

Subdivision Surface Tell what the technique does and the (dis)advantages of it

T-Spline Create 3D models using surfaces and solids with the T-Spline technique

Scheme

10 min Buzzing and individually checking what they thought of the video they had to watch, ending with a short introduction of the session

45 min Lecture and demonstration about NURBS using the knowledge of B-Spline from session 2, show and explain subdivision surface, show T-Spline and how to use it within Fusion 360

10 min Break

60 min Different assignments for learning how to use the new techniques to create more free shapes in combination with known techniques

10 min Break

60 min Assignment to create an airplane using the newly learned techniques

5 min Wrap up and remind them to look at DLWO for next week.

Resources

You will need to watch a video about freeform modelling using
T-Splines in Autodesk Fusion(10) or Autodesk Inventor(11).

5^{th} Session

In this session we will take a break from modelling and have a look at 3D printing. You will get an introduction on 3D print history, techniques, applications and properties. Then we will give the required information to get you started with 3D printing plus some advanced techniques to check a model. We will also introduce the basics in creating a mold and plastic part features in Inventor.

Goals

After this session, you will be are able to:

History Tell what technique was first invented, by who and what techniques followed

Mold & Plastic Create a mold of a part and apply plastic part features

Model Visualise and check properties of a model for 3D printing, using Blender. (manifold, intersections, overhang and thickness)

3D Print Operate any FDM 3D printer using any given application

Scheme

10 min Buzzing and individually checking what they thought of the video they had to watch, ending with a short introduction of the session

45 min Lecture about 3D printing history, application and model requirements. Demonstration about how to visualise properties of a model. Introducing mold creation and plastic part features

10 min Break

60 min Different assignments for learning how to operate a PrintrBot using Cura.

10 min Break

60 min Assignment to model and print a (mold) of a vertical/horizontal stabilizer.

5 min Wrap up and remind them to look at DLWO for next week

Resources

You will need to install Blender and have watched an introductory video(**?**)

6^{th} Session

In this session we will start with FEM analysis with basic materials.

Goals

After this session, you will be are able to:

Modify Simplify a given part in preparation for simulation

Mesh Refine a mesh to improve simulation

Constrain/Force Apply a fix/pin/frictionless constraint and force/pressure load on a given part to simulate reality

Simulation Simulate stresses on isotropic parts

Results Interpret Von Mises, Displacement and Safety factor from simulations and explain what the data means

Scheme

10 min Buzzing and individually checking what they thought of the video they had to watch, ending with a short introduction of the session

45 min Demonstration on simulation

10 min Break

60 min Different assignments for learning how to use the new techniques to create more free shapes in combination with known techniques

10 min Break

60 min Assignment to create an airplane using the newly learned techniques

5 min Wrap up and remind them to look at DLWO for next week

7^{th} Session

FEM Extended

8^{th} Session

Technical Drawing only..

9^{th} Session

Open for questions and help.

10^{th} Session

Open for questions and help.

References

[1] Lynda.com,
http://lyndaportal.ict.hva.nl/.

[2] Youtube.com,
http://youtube.com/

[3] Playlist Session 1,
http://www.lynda.com/SharedPlaylist/9b4956be88514f5891239ea6799266ba?org=hva.nl

[4] Interpolation & Control Vertex Splines,
https://www.youtube.com/watch?v=2vr_Xi83U1E

[5] Euclidean Geometry,
https://en.wikipedia.org/wiki/Euclidean_geometry

[6] Cartesian Coordinate System,
https://en.wikipedia.org/wiki/Cartesian_coordinate_system

[7] Polar Coordinate System,
https://en.wikipedia.org/wiki/Polar_coordinate_system

[8] Math behind parallel and perpendicular constraints,
https://www.youtube.com/watch?v=Q6phH6FTw34
https://www.youtube.com/watch?v=guf2gp6XqY4

[9] Autodesk Inventor - Surfacing Tutorial,
https://www.youtube.com/watch?v=5tIk-7o9AxA&list=PLi2lgPZb_Qu-VEm2ll2Dvv0KmsMYKlJxZ

[10] Autodesk Fusion T-Splines,
https://www.youtube.com/watch?v=UyhfrZYYQLs&list=PLoAbN_B-an_sLELkrpxorcNEcu7sGKKxJ&index=1

[11] Autodesk Inventor T-Splines,
https://www.youtube.com/playlist?list=PLoAbN_B-an_uR1B0BIPLJ2d84CTxRfkLq

[12] Aircraft Modelling,
https://www.youtube.com/watch?v=TEioh73jScY

[13] Mastering Autodesk Inventor,
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[14] O'Reilly T-Spline,
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