

AIRCRAFT CONCEPTS MODELLING WITH SUBDIVISION SURFACES

CATIA Imagine & Shape for Aircraft Conceptual Design at SAAB AEROSPACE

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AGENDA

- Advanced Design division
- Surface modelling:
 - Requirements
 - Recurrent features
 - Problems
- IMA Master Thesis
- Conclusions



ADVANCED DESIGN

- Requirements Capture
 - Operational requirements
 - Technical requirements
 - Business requirements
 - Regulations, Standards
- Design and Analysis
 - Concept candidates and baseline
 - Technology needs
 - Life Cycle Cost
 - Project schedule
 - Project risk



REQUIREMENTS ON OUTER MOLD LINE



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RECURRENT DESIGN FEATURES



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PERCEIVED **PROBLEMS**

Until IMA, most modelling work carried out in GSD/ICEM

- "Indirect" creation and modification of surfaces
- Complex model structure
- Patchwork of different surfaces
- Time consuming search for errors



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CAN IT BE DONE **DIFFERENTLY**?

Master thesis project(*) to investigate:

- CATIA V5 Imagine & Shape (IMA)
- Develop suitable methods
- Compatibility with parametric design
- Fields of application

(*) Cuong, V., Hellström, M., "Aircraft Surface Modeling with Subdivision Surfaces", Master Thesis LIU-IEI-TEK-A--15/02202--SE, Linköping University, 2015



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WHAT ARE **SUB-DIVISION** SURFACES?

First proposed in 1978 by Catmull and Clarck(*) and Doo and Sabin(**):

- Approximate arbitrary bodies using recursively refined polygonal meshes (i.e. sub-division surfaces)
- C² continuous everywhere but in a limited number of extraordinary points where the surface is C¹ continuous
- "Digital clay"

(*) Catmull, E.; Clark, J., "Recursively generated B-spline surfaces on arbitrary topological meshes", Computer-Aided Design 10 (6): 350. doi:10.1016/0010-4485(78)90110-0, 1978

(**) Doo, D., Sabin, M., "Analysis of the behaviour of recursive division surfaces", Computer Aided Design, Vol.10, No.6, pp.356-360, 1978



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MORE ABOUT SUB-DIVISION SURFACES...

- Consumer products
- Automotive industry
- 3D computer graphics
- Why not aircraft?



DESIGN FEATURES MODELLED IN IMA



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FLAT MODEL STRUCTURE



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MODELLING EXAMPLES



PROS AND **CONS**



- Quick and easy to create complex surfaces
- Time savings
- No patchwork
- Watertight surface
- Robustness
- Ease of modification
- Not parametric



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INDIRECT PARAMETERIZATION?



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MASTER THESIS OUTCOME

The thesis project was **successful** and provided good insight in the workbench

With support from Dassault Systémes, the students were able to demonstrate how to create surfaces with the **desired features**

Based on the thesis results it was decided to **acquire two IMA licenses** and to introduce the workbench in the daily work at Advanced Design group



CONCLUSION

SAAB invested in IMA after master thesis results

- Time saving
- Robustness of surfaces
- Direct manipulation "digital clay"
- Easy to use for non CAD educated personnel

Still in the process to full implementation Possible benefits:

Reduction of meshing time

Positive on-going dialogue with DS on future steps for surface modelling in aircraft conceptual design





QUESTIONS?

