



because good research needs good data

Lost in Translation

Technological Views on Preserving CAD

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Supported by



Outline

Introduction

3D geometric representations

Advanced modelling techniques

Use cases

Possible solutions

Introduction

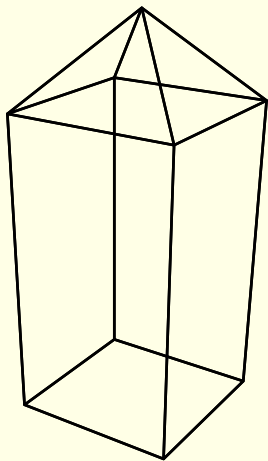
Key message

The main technological barrier to preserving CAD is variety

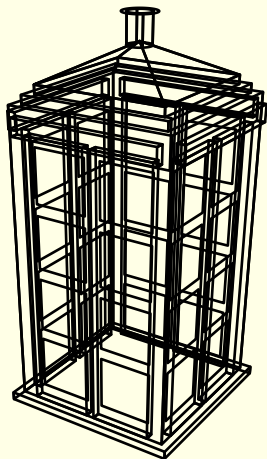
- ▶ of 3D geometric representations
- ▶ of advanced modelling techniques
- ▶ of use cases

3D geometric representations

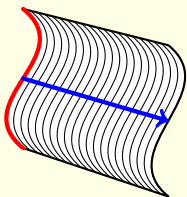
Wire-frame modelling



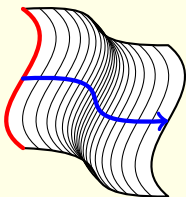
Wire-frame modelling



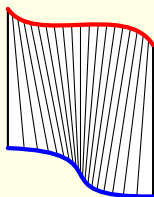
Surface modelling



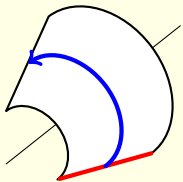
Extruding



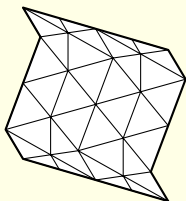
Sweeping



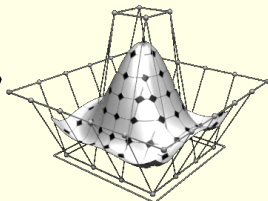
Lofting



Revolving



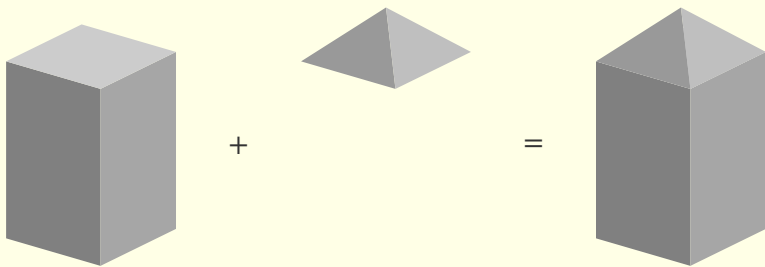
Triangular mesh



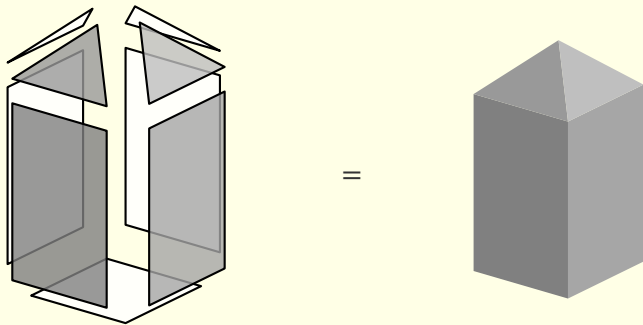
NURBS

© Greg A L

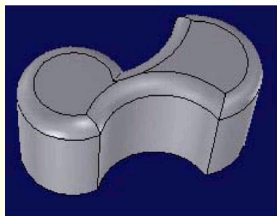
Constructive Solid Geometry



Boundary representation

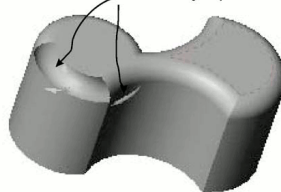


Mistranslation and misinterpretation

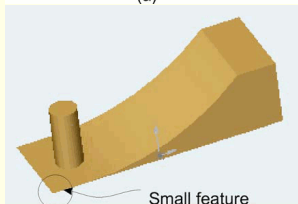


(a)

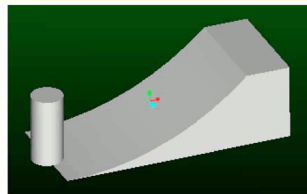
Cracks after healing algorithm fails to reconstruct a valid boundary representation



(b)



(a)



(b)

© Jianchang Qi, Vadim Shapiro

Modelling techniques: summary

- ▶ There are many incompatible ways of modelling 3D geometry.
- ▶ There are many incompatible ways of interpreting 3D models.

Advanced modelling techniques

Construction history modelling

1. Insert cylinder $l = 20$ $r = 1.0$

← Change cylinder $l = 40$ $r = 0.5$

2. Insert sprocket $r = 3.0$

3. Fit sprocket to cylinder

4. Group cylinder and sprocket

5. Scale group by $1.75\times$

...

Procedural modelling

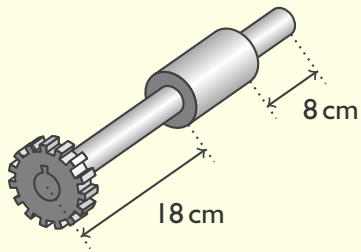
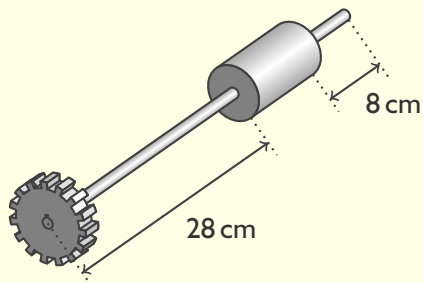


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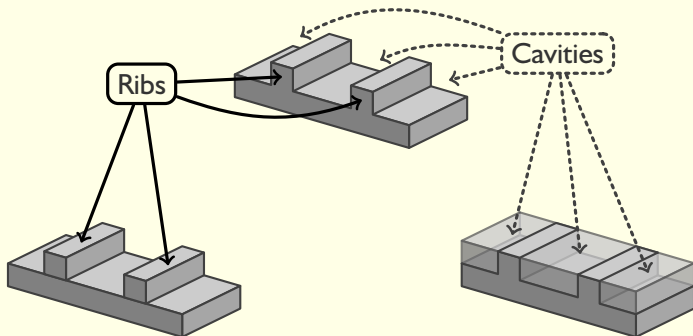


© Barbara M. Cutler

Parametric modelling



Feature-based modelling

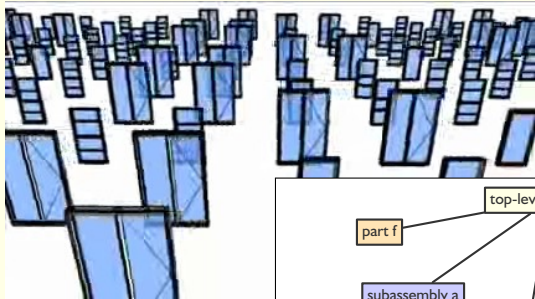


Advanced modelling techniques

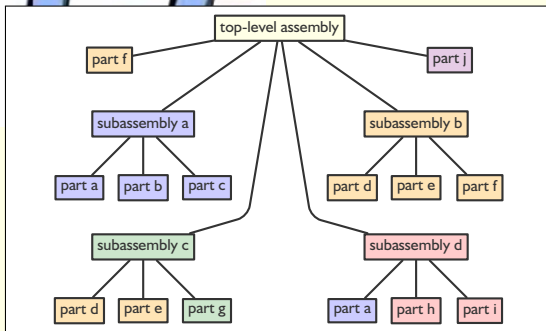
- ▶ CAD models contain much more than just geometry.
- ▶ The geometry might be useless without the extra information.

Use cases

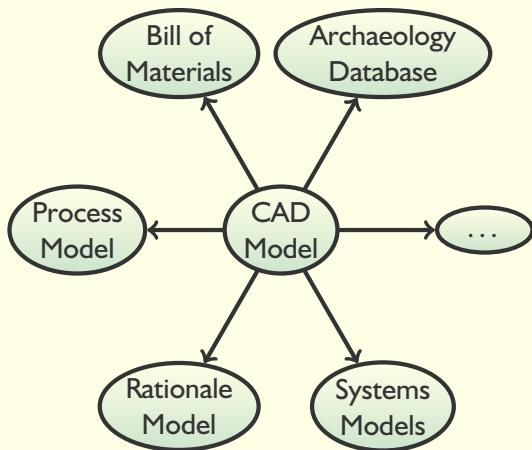
Reusing standard parts



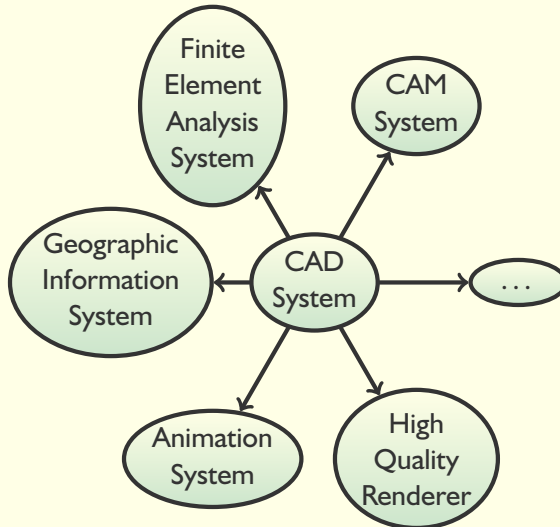
© Koray Pekerici



Relationship with other documents



Integration with other systems



Use cases

- ▶ You might need to coordinate CAD models with many other types of information.
- ▶ You might need to mimic whole systems.

Possible solutions

Standards: IGES

IGES

(ANSI Y14.26M-1981, ...
ANS US/PRO/IPO-100-1996)

2D drawing

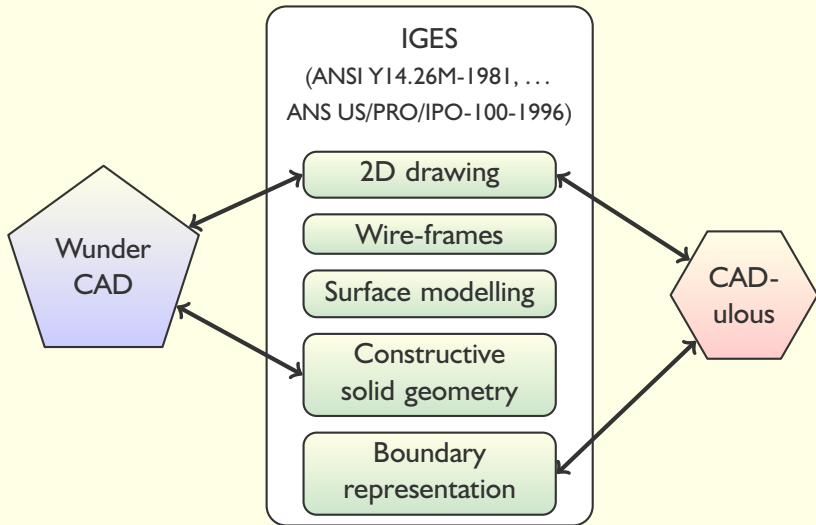
Wire-frames

Surface modelling

Constructive
solid geometry

Boundary
representation

Standards: IGES



Standards: STEP



Standards: STEP

STEP
ISO 10303



LOTAR
(NAS 9300/EN 9300)

Standards for BIM, CAD style conventions

BIM

- ▶ ISO 16739:2013 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries
- ▶ National BIM Standard – United States (NBIMS-US)
- ▶ AEC (UK) BIM Protocol
- ▶ (BSI) PAS 1192-2 Information management for the capital/delivery phase of construction projects

CAD style

- ▶ United States National CAD Standard
- ▶ AEC (UK) CAD Standards For Layer Naming

Recommendations

- ▶ Establish why a CAD model will be kept, then target the required properties for preservation.
- ▶ Create tests that can prove whether these properties have survived.
- ▶ Keep native CAD models for as long as they can be read.
- ▶ Normalise to STEP/IFC and a geometry-only standard (or two).
- ▶ Don't forget supporting documentation, especially local conventions and 'house style'.
- ▶ Campaign for better support for standard formats in CAD systems!



DPC Technology Watch Report

Preserving Computer-Aided Design (CAD)

Alex Ball

<http://dx.doi.org/10.7207/twr13-02>

DPC Technology Watch Report 13-02 April 2013





because good research needs good data

Thank you for your attention

DCC Website: <http://www.dcc.ac.uk/>

'Preserving CAD' report:
<http://dx.doi.org/10.7207/twr13-02>