

Solid Modelling for Heritage Documentation

Eric Mngumi

Heinz Rüther

University of Cape Town

Computer Models

- Engineering Design
- Education
- Tourism

- Cheaper to build
- Easy to store & retrieve
- Easy to modify

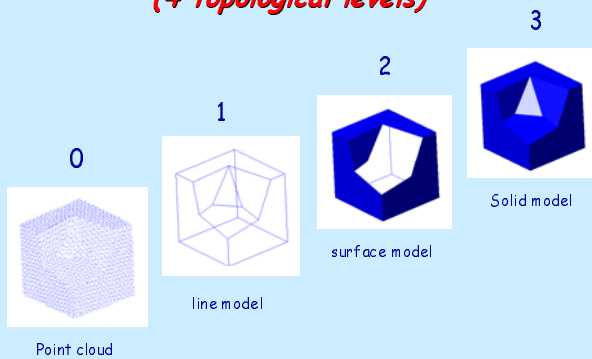
Application to Historical sites:

A virtual model shop : creation, study, & experimental reconstruction of partly ruined/extinct monuments.

Reverse/Forward Engineering

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Main Types of Computer Models (4 topological levels)



Criteria for the Choice of Representation

Choice of model: purpose of the representation

- wire frames - edges connecting vertices
- surface models - surfaces spanning edges
- solid models - boundary info. & interior info.

Heritage Documentation: wire frames /surface: economical

Solid Modelling :

Modelling by combining individual parts (primitives) into a single object

- primitives : e.g. cones, torus, cylinder, sphere



- or swept (extrude), lofted, rotated forms

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The Power of Solid Modelling.

- Ability to combine individual objects to create desired shapes :
 - intersection, union, subtraction (Boolean operations)
- A well defined topology: database with connectivity info : allows modelling functions not possible with wireframes / surface models

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Kilwa in Tanzania



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Kilwa Kisiwani

Important medieval trade centre on the coast of East African



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Kilwa Kisiwani



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Modelling Kilwa's Monuments

Solid Modelling - suitable representation for Kilwa's monuments

Buildings :

- built of Coral & lime mortar (badly eroded walls, rough edges)
- open, roofless
- freestanding walls

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Modelling Process

Data Acquisition :

Photogrammetry - line model

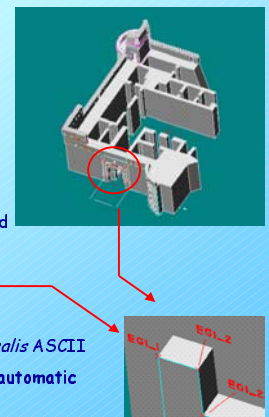
Laser Scanning - detailed model (surface/solid)

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Data Structure

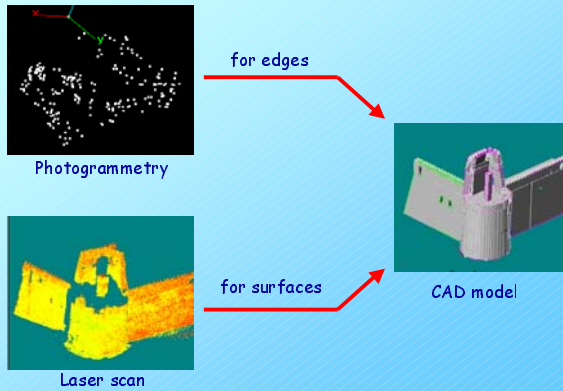
For automated photogrammetry - CAD transfer

- An approx.(working) CAD model
- In *Australis*, labels (codes) assigned to every measured feature point, e.g E61_1
- *Aus2Lisp* used to "translate" *Australis* ASCII file into AutoLisp feature files for automatic line drawing on CAD.



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CAD Modelling from Hybrid Processing



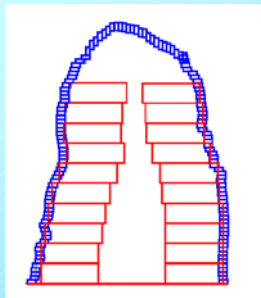
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Solid Modelling of Complex Walls

1. In CAD a laser scan point cloud is displayed as dxf
2. A segment of the point cloud is saved as a file
3. A DTM is created from the point cloud (kriging algorithms - Surfer)

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Solid Modelling of Complex Walls



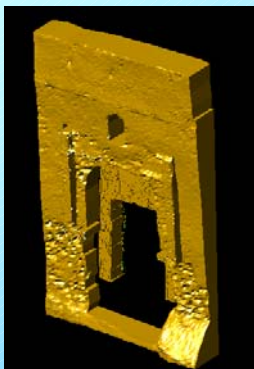
- 4. Triangular discs (cells of the DTM) are extruded to create unit solids

Units are combined (Boolean union) to form one solid object.

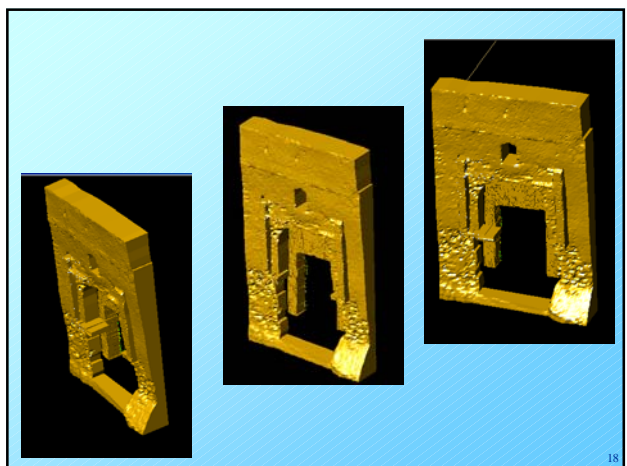
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Deriving Other Products From Solid Models

- **Slicing (Sectioning) :**
Deriving 2D abstractions from
3D models - (sections, elevations)
often for technical reports
- **Digital Reconstruction:**
CSG supports Boolean operations -
useful in extending existing models.

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Conclusion

Solid modeling of complex objects:

- Still a challenge :
 - * expensive computing
 - * time consuming
- Nevertheless :
 - * the advantages of solid modelling as a computer representation
 - * advancement in hardware, software & algorithms

predict an increased use of SM for heritage documentation in the near future.

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