The use of VR for teaching in mechanical engineering and material science

Tuesday 27 October, 15.15-16.00

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Daniel Wikell, David Olsson, Niklas Scherp, Mikael Ringman

Participants from Cairo and Nottingham

Tempus, general (Gert)

Preconditions (Gert)

VR, general comments (Lasse)

Teaching with VR (Lasse)

Four master theses

- 3D structures and material science (Daniel)
- 3D interaction for mechanical construction (David)
- Use of haptics (Niklas)
- Other tools for interaction, Wii (Mikael)

Summing up, tests to come, experiences from Cairo (Lasse)

Demo

VRLAB a Tempus Project

- Tempus program
  - To develop education in countries nabouring the European Community
  - Idea is to have more exchange with those countries
- VRLAB
  - To develop education in mechanical engineering by using Virtual Reality

VRLAB

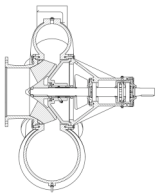
- Partners
  - KTH
  - Univ. Nottingham
  - Ain Shams University, Cairo
  - Helwan University, Cairo
- General rules
  - Equipment grant to the foreign university
  - Limited support for development

The laboratory

- A VR theater with around 30 persons
  - A stereo projector with Infitec technology and glasses
- 4-6 work stations a $600
  - NVIDIA 3D Vision Bundle: Samsung Syncmaster 3D 22” Gaming LCD Monitor and NVIDIA 3D Vision Stereoscopic Glasses

Laborations/demos in VR

- assembling mechanical parts
- work study
- acoustic simulation
- vibration investigation
- material experiments



VR, general comments

VR or virtual environments may mean different things.

Immersion may vary

Reality versus virtuality may vary

Equipment may hence vary from a simple screen to a CAVE with different interaction devices

Application areas

Problems

Teaching with VR

• You learn more when being able to use and interact with the environment and also discuss it with others

• The VR world is more flexible than the real world and can be adjusted to your needs.

• Close cooperation with teachers is important when developing prototypes for teaching purposes.

Teaching with VR

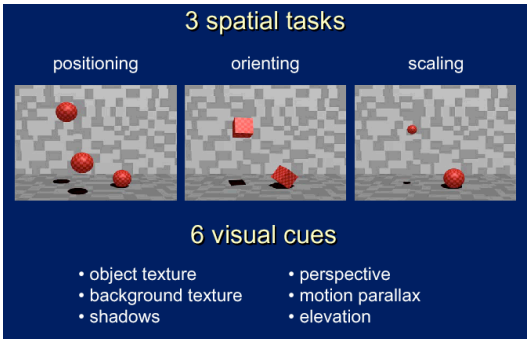
The importance of understanding and using 3D.

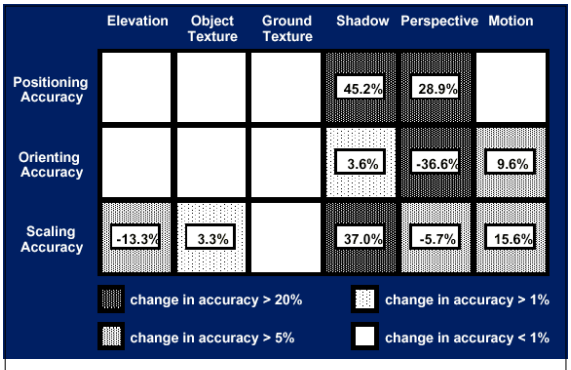
• Bob Parslow traveled around showing simple 3D-tests illustrating that people are rather bad at understanding 3D (he used a cube as example).

• 3D computer generated models are being used.

• Simple spatial abilities consist of three parts: spatial relations, visualization tests, spatial orientation

• The use of VR is one way of achieving better 3D understanding. Other methods may be sketching, using different projections, building real models





from Ferwerda

Teaching with VR

• In the future 3D graphics and VR/AR systems may create completely different processes for construction of 3D objects as used in mechanics, architecture, chemistry etc

3D structures and material science (Daniel)

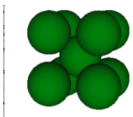


Figure 6a: A correct BCC structure

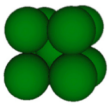


Figure 6b: An incorrect BCC structure, the way several students try to build it

- BCC (Body-Centered Cubic), cubic with one in the center
- FCC (Face-Centered Cubic), cubic but an atom in every cubic face
- HCP (Hexagonal Close-Packed), hexagonal cell with atoms In each of the 12 corners of the hexagon

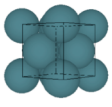


Figure 4a: Unit cell for a FCC structure (outlined)

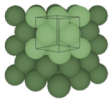


Figure 4b: Aggregate of atoms based on the atoms participating in a FCC unit cell (highlighted)

Figure 5a: The BCC structure

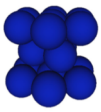


Figure 5b: The HCP structure

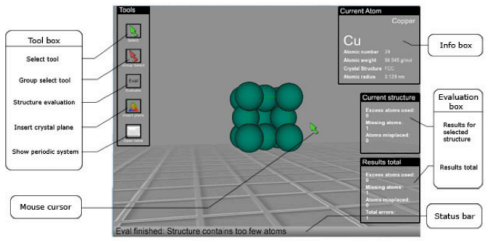


Figure 8: Components of the Graphical User Interface

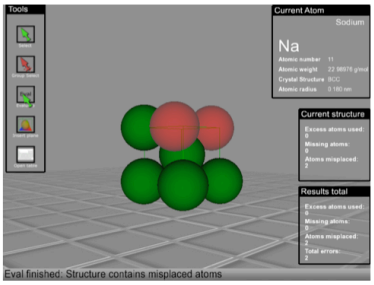


Figure 15: Evaluation results of a structure indicating two misplaced atoms (highlighted in a bright color)

Tests have been been prepared with questions etc
and will hopefully be performed in Cairo within the near future

Do you have any previous experience using a 3D program? If so, which programs have you used?

Describe your general reactions to the Materials Engineering Application

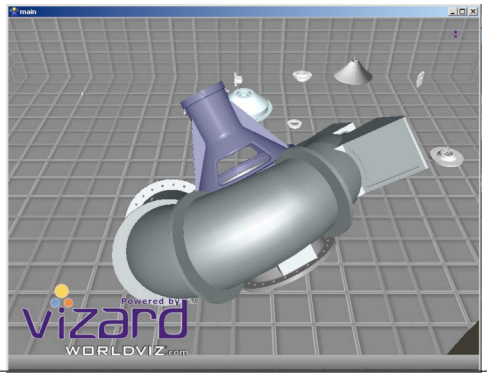
Which of the methods (pen and paper, the Materials Engineering Application) did you find easiest to use for solving the exercises? Explain your choice.

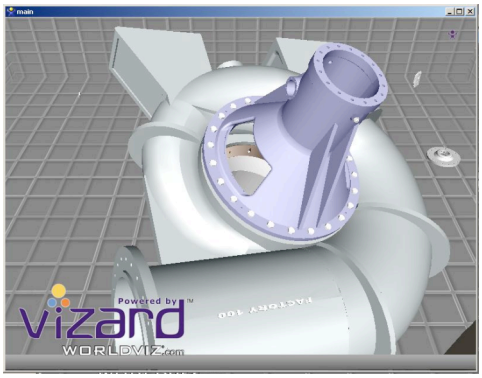
Which of the methods (pen and paper, the Materials Engineering Application) gave you the most insight to the basic concepts of Materials Engineering? Explain your choice.

What changes would you want to make to the Materials Engineering Application?

3D interaction for mechanical construction (David)
Placement of machine (pump) components:

Putting the components together:





The use of haptics (Niklas)


Bild 1: En phantom Omni (från www.sensable.com)

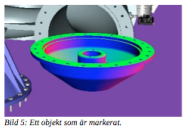


Bild 5: Ett objekt som är markerat.

- Investigation of 3D interaction, especially when using haptics
- Implementation of prototype
- Interaction/manipulation of machine components
- Time measurements

Other tools for interaction, Wii (Mikael)

Tests with the use of the IR camera in the Wii device is ongoing and we can say:

- Wii is supported by the software we use and can rather easily be used in e.g. Windows.
- Movements in depth can be calculated using some assumptions using IR nodes and then be used to modify the object.
- The keyboard and the ergonomic design of the device seems to be suitable to control the camera and pointer (2D/3D) together using only one hand (which is important).

Other tools for interaction, Wii

Some more things to be investigated:

- How can the Wii be used together with the software with the education software implemented so far (for manipulation of mechanical objects in a VR environment)
- The 3D interaction methods with Wii has to be further developed and tested with users.
- Can rotation of objects be performed in some intuitive way for practical use?

User tests will be done in Cairo according to plans (probably in December).

Summing up, tests to come, experiences from Cairo

Tests: mainly discussions with teachers and some students so far

Future: More tests and then more regular use in education

Cultural differences with ASU

Experiences as a tourist

Result from the project will be

- Report to EU
- Four master thesis reports (two exist now)
- Paper to journal/conference
- Prototypes

Demo!?