

Ethics and the Complexity of Technology

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Ethics in technology: reductionist views

- Ethics is for users, not for engineers
 - Until its use, technology is neutral
- Ethics should be taken away from users and built into the technology
 - Cars do not start when the driver does not wear seat belts, cars can not drive faster than the speed limit, etc.; more modest: scripts in artifacts
- Ethics in technology is just a matter of calculating risks
 - This is a double reduction!

Another reduction of ethics in technology

- Ethics is a matter of analysing moral dilemmas
 - Examples
 - Challenger accident: loyalty to company versus care for safety of people
 - Ford Pinto: same dilemma
 - Environmental issues: loyalty to company versus care for the environment

An alternative vision, inspired by technology itself

- Technology is not just a matter of choosing between alternatives in dilemmas, but of creating new solutions that overcome the dilemma
 - Designing a new iron: dilemma between low weight (women must be able to handle) versus high weight (iron must press on the cloth)
 - Solution: an iron with vibrating sole, etc.
- Caroline Whitbeck: treat ethical problems as design problems

That brings in the full complexity of reality

- Designing has become much more complex than in the 1950s and 1960s
 - Economics are less favorable
 - Customers have become more critical
 - Governments want to have influence
 - Environmental problems have emerged
 - Globalisation has developed
- Engineers increasingly face the challenge of dealing with the full complexity of reality

Technology is never neutral

- Values are in the motives for doing technology
- Values are in the knowledge
 - Knowledge of functions (what the artifact *should* do): normative component
 - Knowledge of the relationship between the physical and the functional nature of an artifact (x is *suitable* for y): another normative component
 - Knowledge of standards and *norms*: again a normative component

Here reformational philosophy comes in

- Reality makes sense
 - Therefore: so can technology (but this means no neutrality)
- Reality is complex
 - Therefore: so is technology
- Reality shows regularity
 - Therefore: technology can use that

Two matters of design

- The development of the artefact is itself a design process
- Dealing with the ethical issues in that process can also be treated as a design problem

Analysing the complexity of technology

- Two reductions for the sake of gaining insight
 - Systems reduction (sociotechnical system, technical system, components of technical system)
 - Aspect reduction (Dooyeweerd's 15 aspects)
- Analysis to create order
 - Essential functions (founding, qualifying, subject and object functions)
 - e.g. living versus non-living 'artifact'
 - Laws (descriptive, prescriptive)

Aspecten (Dooyeweerd)

Aspect	Zin-kern
Aritmetisch	Discrete kwantiteit
Ruimtelijk	Continue uitgebreidheid
Kinematisch	Beweging
Fysisch	Oorzaak-gevolg
Biotisch	Leven
Psychisch	Bewustzijn
Analytisch/Logisch	Onderscheiding
Historisch/Vormig	Ontwikkelingsvermogen
Linguïstisch/Symbolisch	Symbolische betekening
Sociaal	Omgang
Economisch	Waardenafwegend beheer
Esthetisch	Harmonie
Juridisch	Vergelding
Ethisch	Liefde
Piëtisch	Geloof

Analyse van artefacten

Artefact	"Kwalificerende" functie	Hoogste subjectfunctie
Computermuis	Sensitief	Fysisch
Beeldscherm	Linguïstisch	Fysisch
Silicium-IC	Logisch	Fysisch
Bio-chip	Logisch	Biotisch
Elektromotor	Kinematisch	Fysisch

Ethics and the laws of reality

- The three 'classical' approaches can have a place here
 - Virtue ethics
 - Prescriptive law related to the human heart and the good life
 - Consequentialist ethics
 - Prescriptive law related to effects in time
 - Deontic ethics
 - God-given universal prescriptive laws
- Integration: ethics of responsibility (Schuurman)

And then back to the integral perspective on reality

- Not only analysis, but also synthesis
 - Integration of insights based on the analysis of complexity and order
- Analysis and synthesis are not sequential but alternate

What does that mean for ethics?

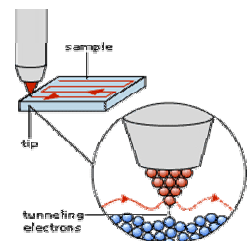
- Ethical issues pervade all aspects (universality)
- Ethical issues need to be integrated with other aspects ("trade-offs")
- Elements of all three 'classical' approaches can feature in a christian ethics of technology

Case study: nanotechnology

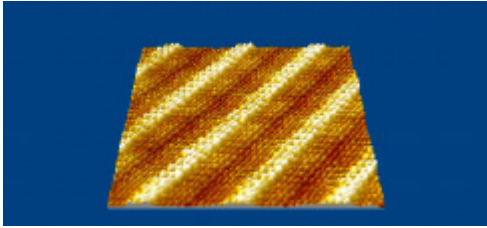
- 1 nanometer = 0,000000001 meter
- Manipulating individual atoms and molecules
- In production phase: coatings
- In laboratory stage: buckyballs, buckytubes
- In forecasts: miniature selfreproducing machines
- Applications: medicine and electronics
- Billion dollar issue

Scanning Tunneling Microscope

- Belangrijk gebied binnen nanotechnologie: waarnemen op nano-schaal
- Scanning Tunneling Microscope (IBM Zürich 1981)



Visualisering van atomen



Hoe ver is men al?

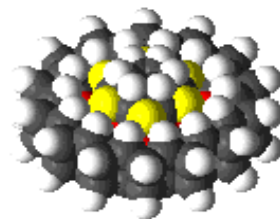
- Al in productie:
 - toepassingen met dunne laagjes, coating zonnebril, zonnebrand-olie, waterafstotende kleding
- In laboratoriumfase:
 - Buckyballs (C_{60}), nanotubes, moleculaire electronica (met DNA), lab-on-chip



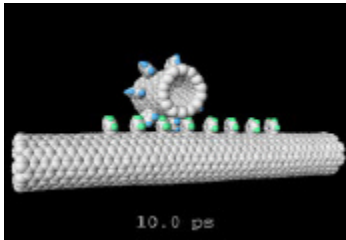
De lange termijn?

- Lange-termijn scenario's (b.v. Foresight Instituut):
 - Replicators maken assemblers, die afzonderlijke atomen en moleculen kunnen manipuleren
 - Mechanieken en apparaten van nano-afmeting
 - Alle objecten op macroniveau maken door manipulatie van afzonderlijke atomen en moleculen

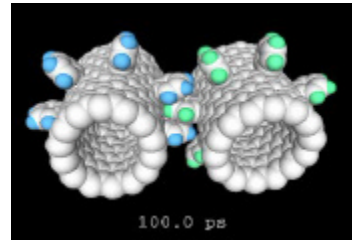
Miniatuur-mechanieken (1)



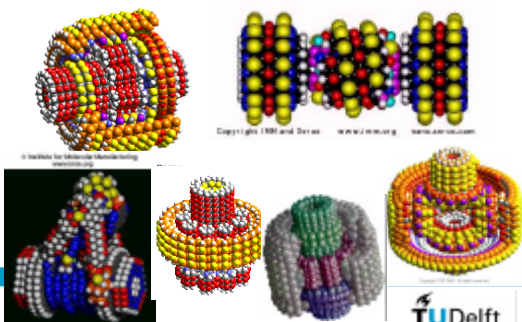
Miniatuur-mechanieken (2)



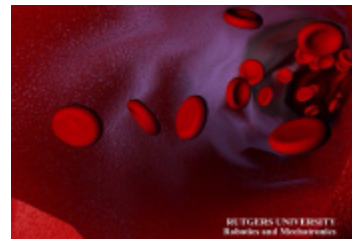
Miniatuur-mechanieken (3)



Miniatuur-mechanieken (4)



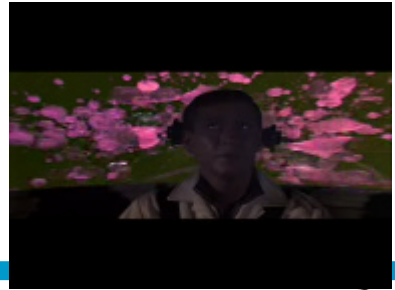
Miniatuur-machines (1)



Miniatuur-machines (2)

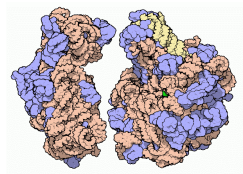


Nieuw idee? Toch niet! (1) Fantastic Voyage (1966)



Nieuw idee? Toch niet (2)

- De natuur doet het allang
- Ribosomen in cellen



Nanotechnologie: toepassingen

- Medisch
 - Medicijnen, protheses en implantaten
- Informatie- en Communicatie
 - IC's op nanoschaal, zeer kleine apparatuur

Nanotechnologie: initiatieven

- USA
 - 21st Century Nanotechnology Research and Development Act (Congress, 07-01-2003)
 - National Science Foundation: workshop over maatschappelijke aspecten
 - Ong. 1.000 miljoen dollar per jaar
- EC
 - 6th Framework Programme
 - Ong. 500 miljoen Euro per jaar
- Nederland
 - TUDelft, TU Eindhoven: technisch-wetenschappelijk onderzoek
 - Rathenau Instituut: Technology Assessment studie

Ethics and the aspects of reality

- | | |
|-----------------|--|
| •1 Numerical | •Can we deal with an enormous amount of nanobots? |
| •2 Spatial | •Privacy issues when things get really small |
| •3 Kinematical | •) Nanodevices have quantum behavior that we do not yet fully grasp: |
| •4 Physical | •) Is it responsible to produce things we do not understand yet? |
| •5 Biotic | •What do nanomachines do to life? |
| •6 Psychical | •Will nanodevices change our perception of reality for the better? |
| •7 Analytical | •Boundaries between living and non-living disappear? |
| •8 Cultural | •Is it good to put so much power in human hands? |
| •9 Symbolic | •Is the guru-language realistic or does it fool people? |
| •10 Social | •New social divide between haves and have-nots? |
| •11 Economic | •Is it a good thing to invest so much in what is still uncertain? |
| •12 Aesthetical | •Will there be harmony between nanodevices and other devices? |
| •13 Juridical | •Is it possible to turn ethics into laws in such an early stage? |
| •14 Ethical | •Will nanotech really be in service of care? |
| •15 Pistic | •Is it a good thing to put so much belief in this technology? |

In summary

- Christian ethics of technology does justice to the complexity of reality
- Christian ethics of technology does justice to the law-like character of reality
- Christian ethics of technology uses the God-given creative powers of humans