Simulations in Use

CHANCES AND THREATS IN HIGH COMPLEX SYSTEMS

10.12.2012

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Structure

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- Discrete vs. Continuous Events
- History
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- Book presentation

Description

- Simulation is the imitation of the operation of a real-world process or system over time.

  J. Banks, J. Carson, B. Nelson, D. Nicol (2001). *Discrete-Event System Simulation*. Prentice Hall. p. 3. ISBN 0-13-088702-1.

- The use of a mathematical model to recreate a situation, often repeatedly, so that the likelihood of various outcomes can be more accurately estimated.

  http://www.investorwords.com

Static- vs. Dynamic Simulation

Static simulation:

- Representation of a system at a particular point in time

Dynamic simulation:

- Representation of a system as it evolves over time

Discrete vs. Continuous Events

Discrete event:

- System changes only at discrete points in time(events)
- In programming:

• Look at system only when events occur; time is sectional from event to event

Discrete vs. Continuous Events

Continuous event:

- State of system changes continuously over time
- In programming:

- Time is divided in small interval
- Use of differential equations to represent flows

History

- Paper reference about the historically overview

A History of Discrete Event Simulation Programming Languages

By Richard E. Nance

Department of Computer Science
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

June 11, 1993

History

- The Geneolical Tree for Simulation Programming Langues

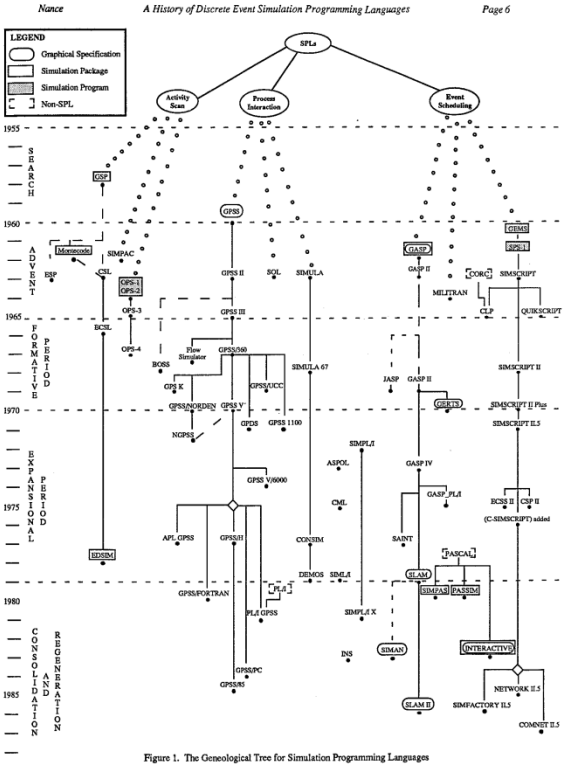


Figure 1. The Geneological Tree for Simulation Programming Languages

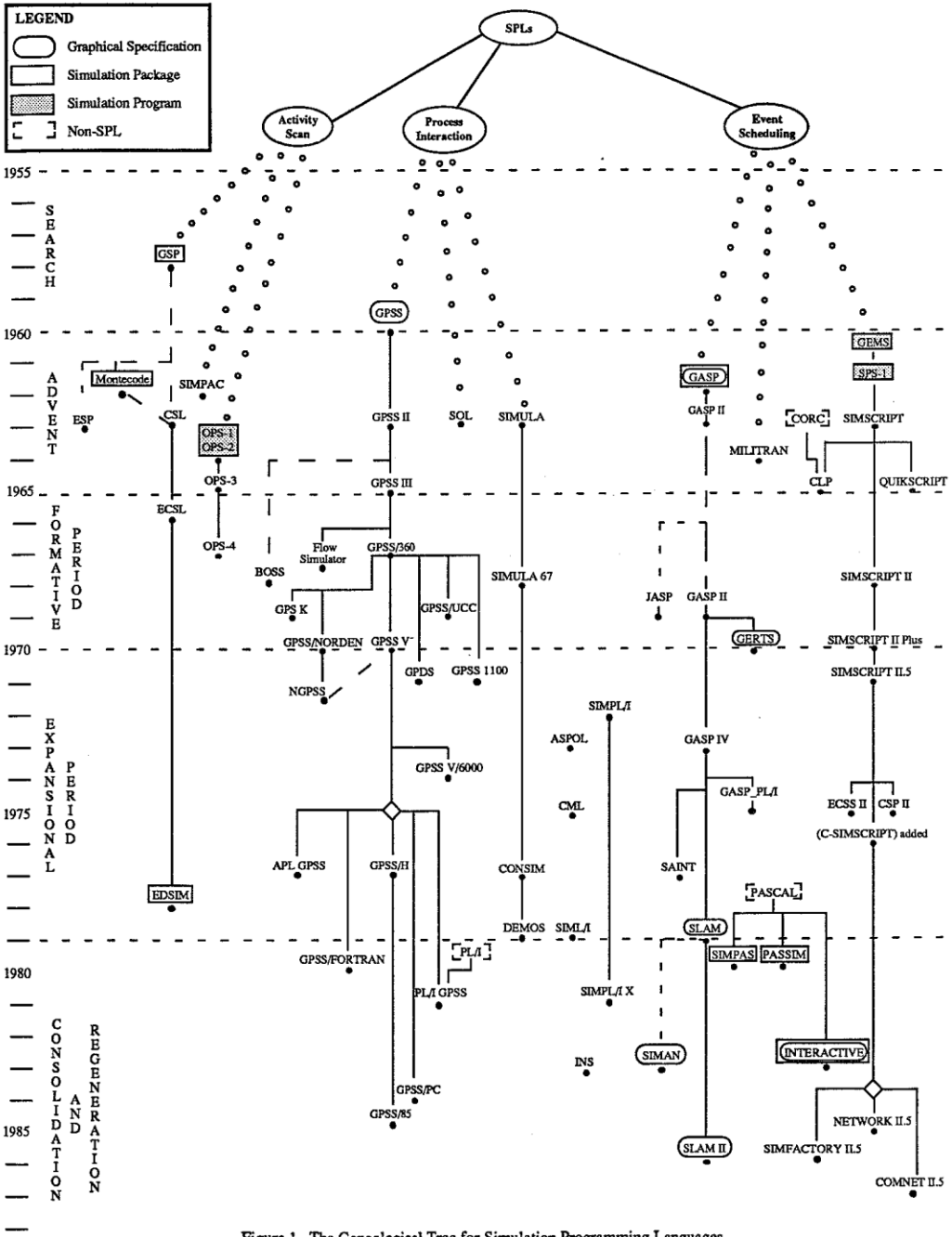
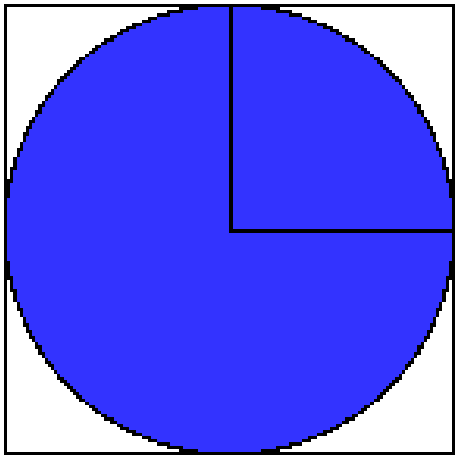
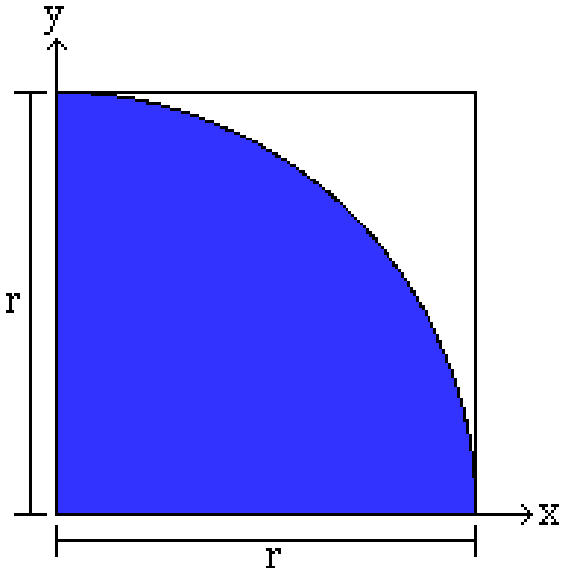


Figure 1. The Geneological Tree for Simulation Programming Languages

History

- "*Monte Carlo*" simulation (stochastic technique)
- For example: **Monte Carlo Calculation of Pi**





History

$$\frac{\#\ \text{darts hitting shaded area}}{\#\ \text{darts hitting inside square}} = \frac{\frac{1}{4}\pi r^2}{r^2} = \frac{1}{4}\pi$$

or

$$\pi = 4\,\frac{\#\ \text{darts hitting shaded area}}{\#\ \text{darts hitting inside square}}$$

History

Late '50s, early '60s

- First Simulation languages: SIMSCRIPT, SIMULA, GPSS (IBM)
- Simulation as the only remaining option

Late '60s, early '70s

- GASP (milestone of simulation)
- Mainframes: limited accessibility and interaction

History

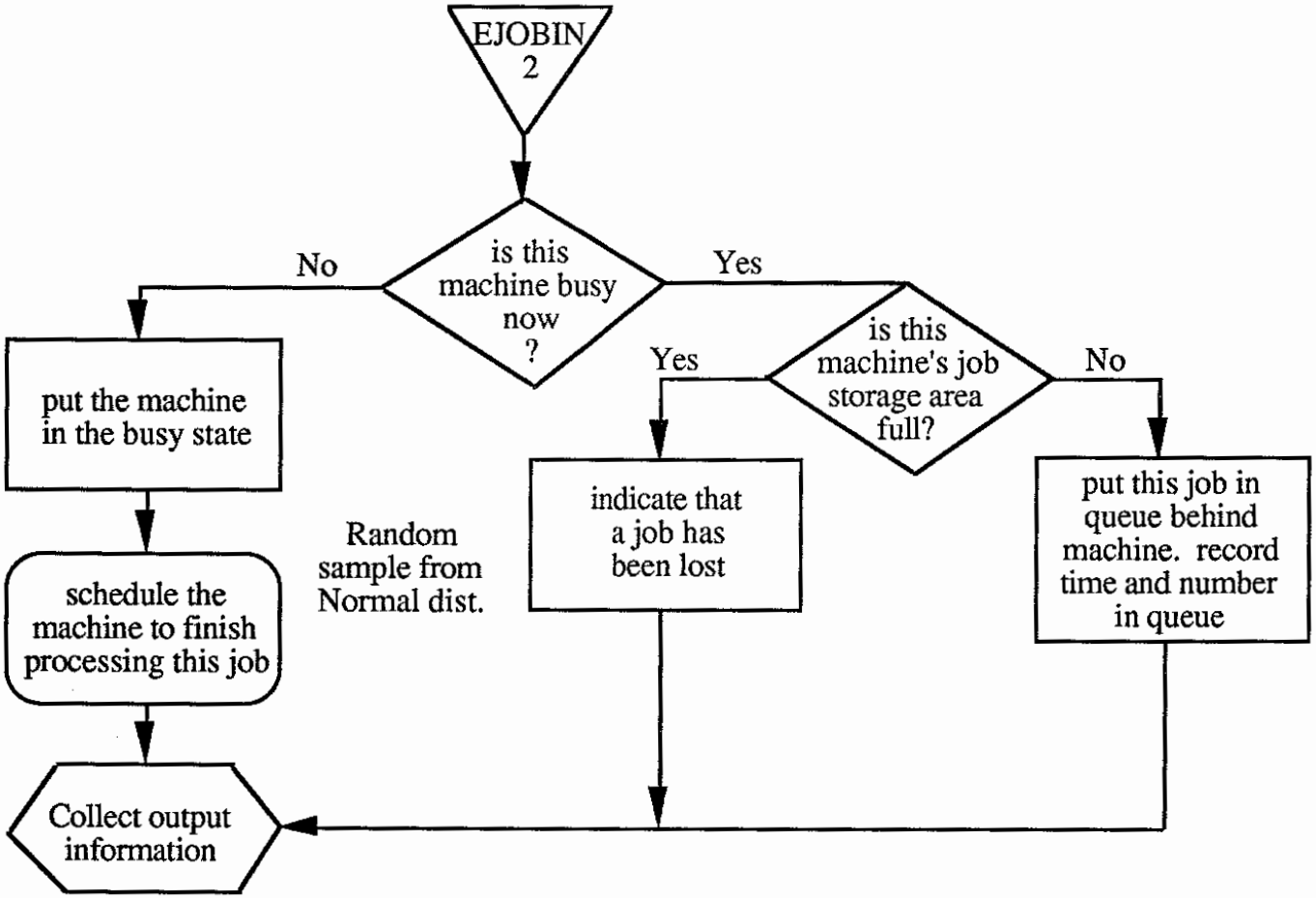


Figure 9. The Flow-Chart Representation of an Event (EJOBIN) in GASP

History

Late '70s, early '80s

- SLAM (Pritsker & Pegden)
- Models more realistc because of sophisticated technologie
- SIMAN (Pegden)
- First language which runs on both a mainframe as well as a microcomputer

History

Late '80s through present

- Powerful PCs
- Languages are very sophisticated (market almost saturated)

Some Used Cases

- Contrasting 1984 and Today

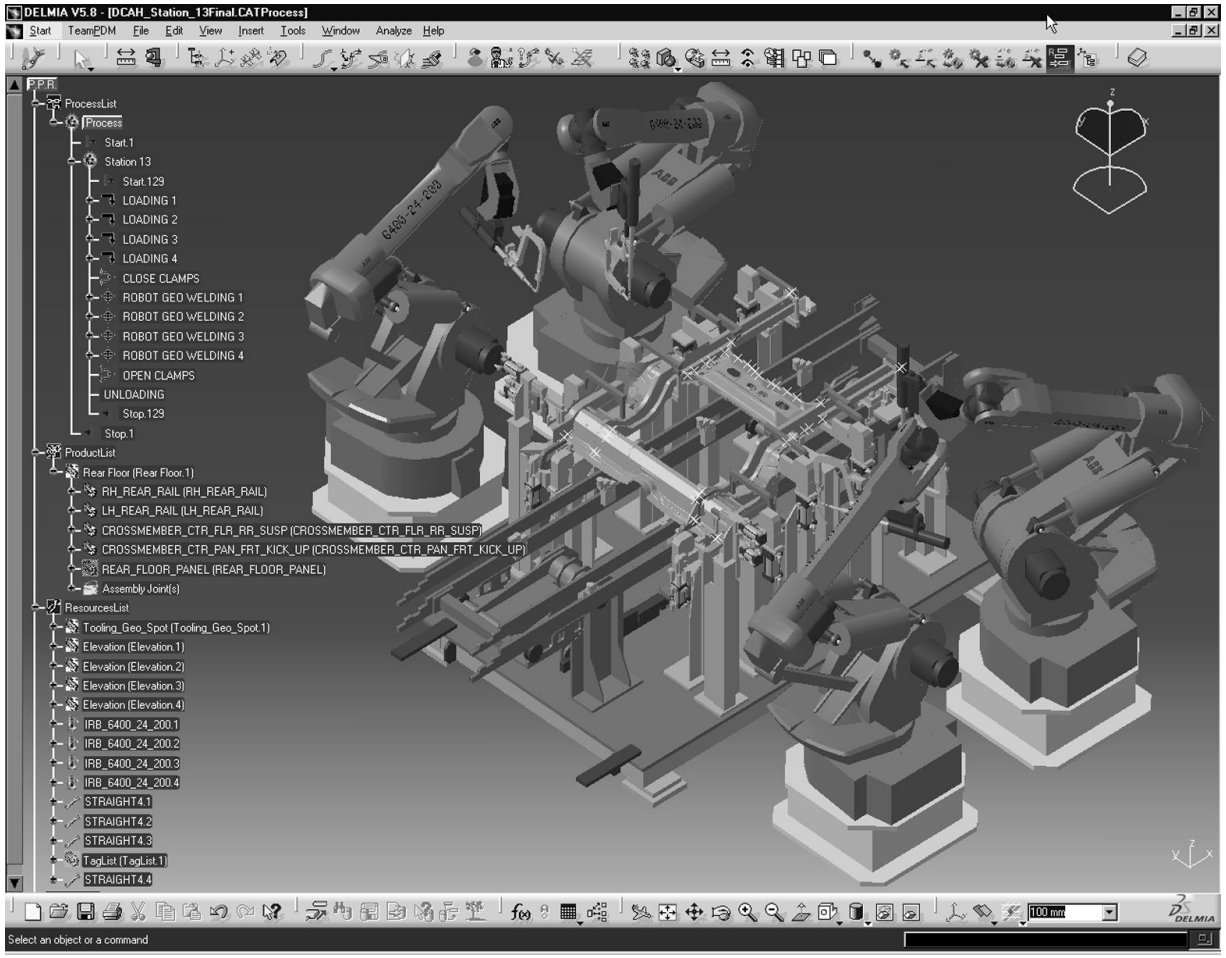
http://www.youtube.com/watch?v=jdA4e14pTa8

Some Used Cases

- Contrasting 1984 and Today

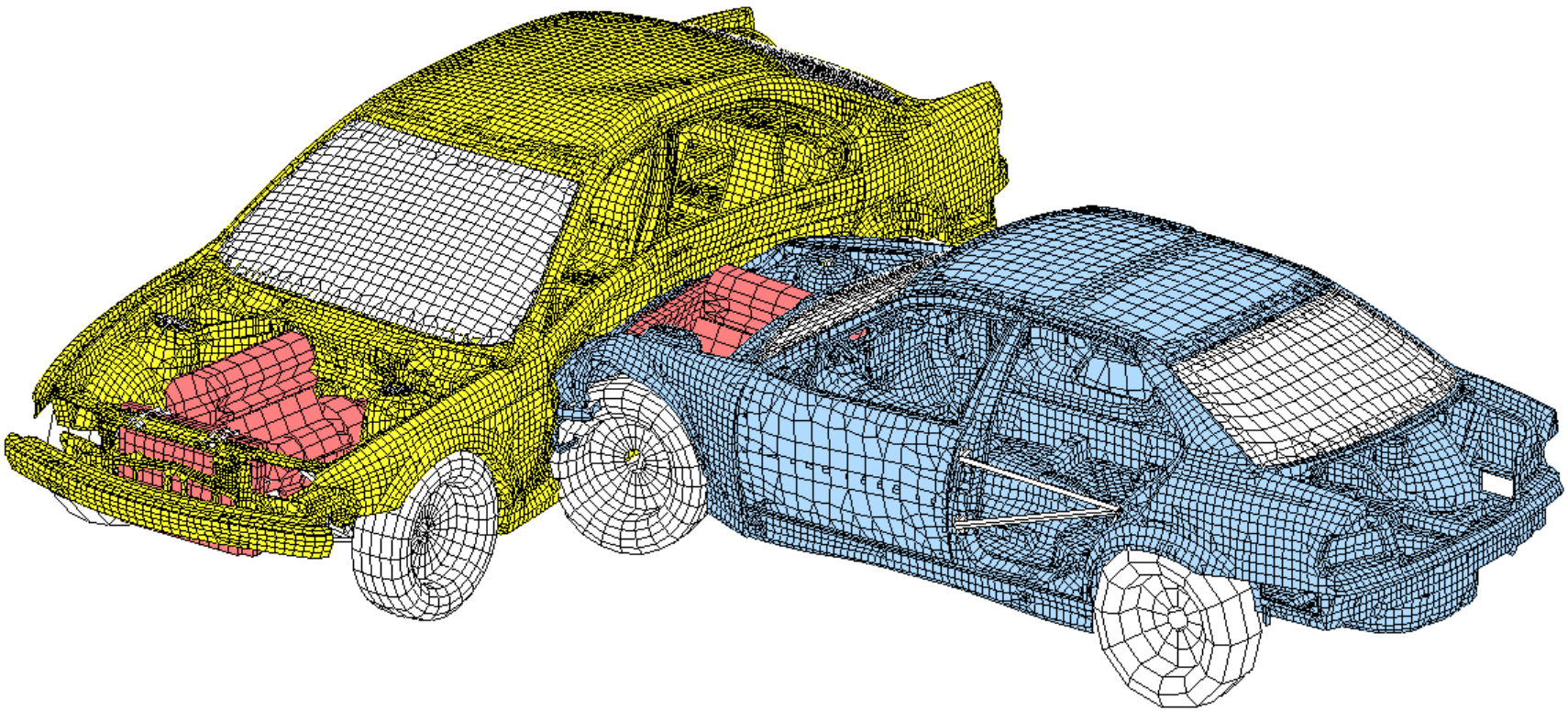
http://www.youtube.com/watch?v=wIWZ3WIQIII

Some Used Cases



http://www.emeraldinsight.com

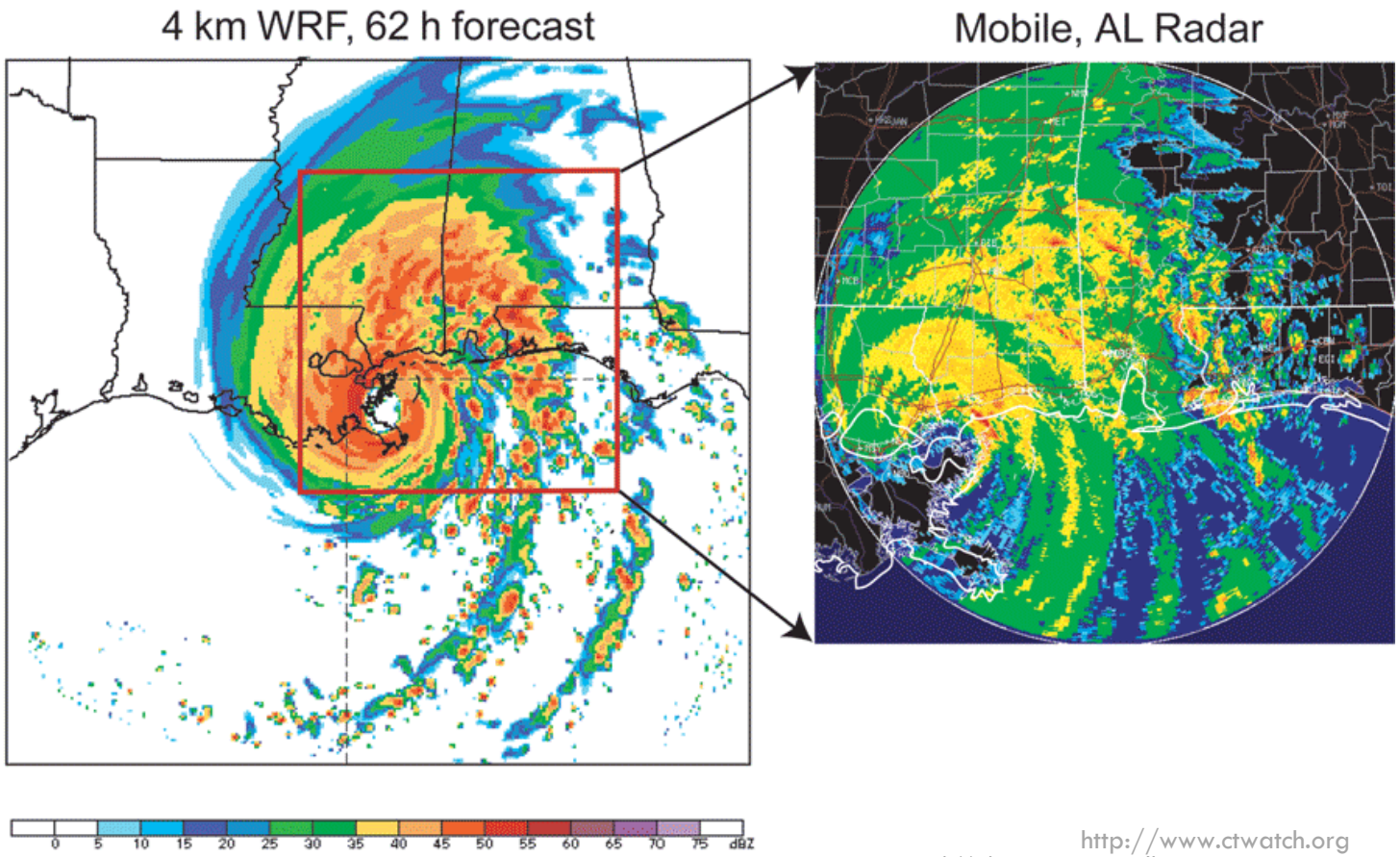
Some Used Cases



http://www.pclaunches.com

Some Used Cases

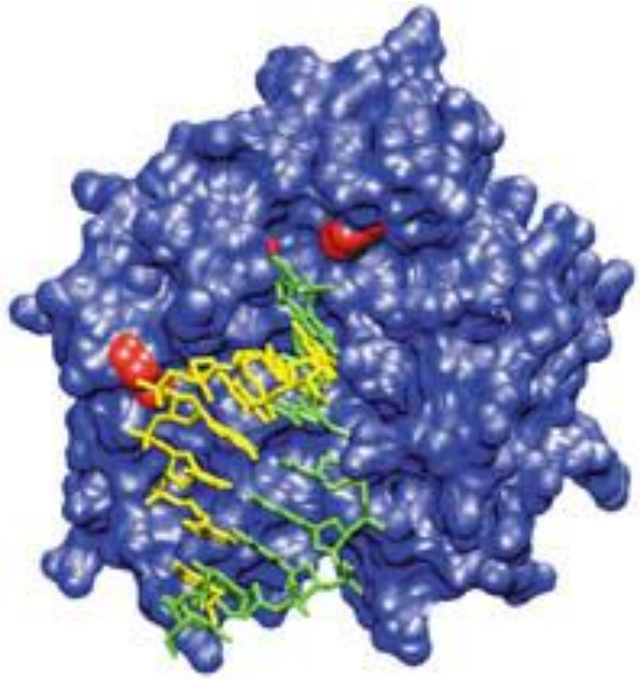
Computer simulation of hurricane katrina



http://www.ctwatch.org

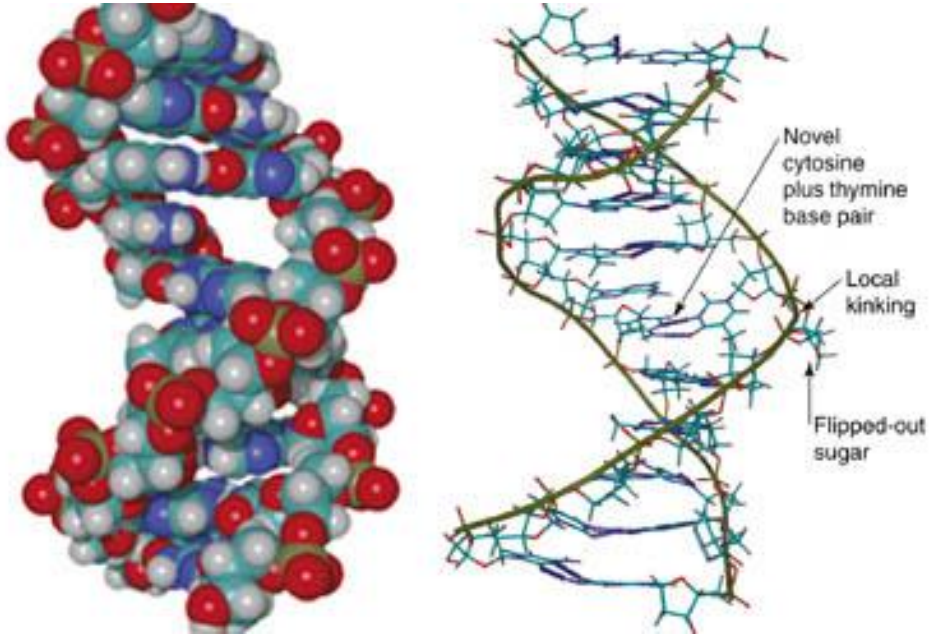
Some Used Cases

DNA-repair protein



www.llnl.gov

a DNA molecule missing one of its bases



www.llnl.gov

Some Used Cases

Evakuierungssimulation

ib-riesener.de

www.llnl.gov

Advantages

- Astraction of complex systems
- Solving high complex problems
- Describe the behavior of systems
- Can be used to study existing systems without disrupting the ongoing operations
- Representing, handling, understanding sets of data
- Construct theories or hypotheses
- Gaining predictions about the future
- “what if” questions...

Disadvantage:

- Lose of realism
- Validity
- Sometimes just an interpretation

Discontent & Risks

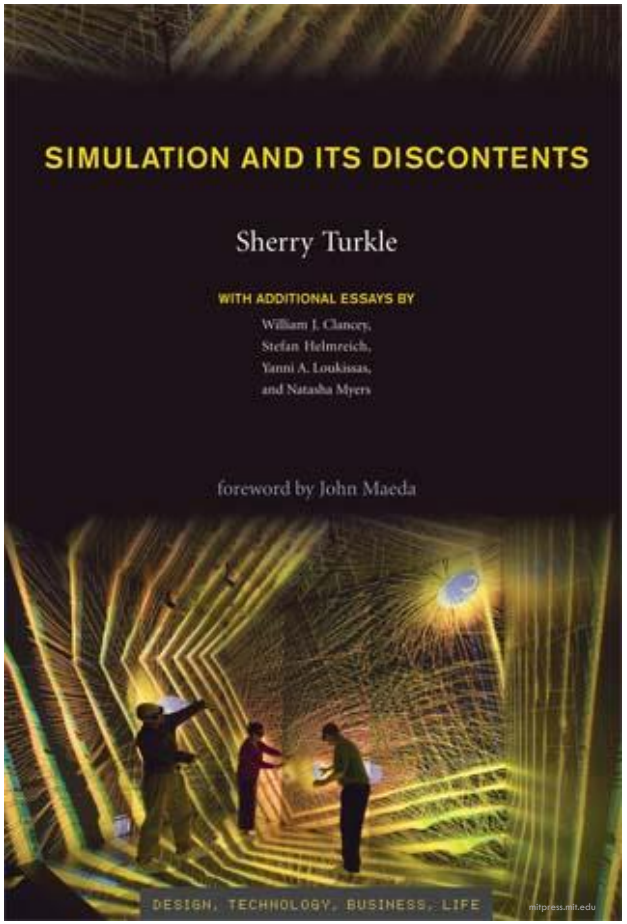
- “People has to learn “to do” and “to doubt”
- Loosing capability of deep understanding
- Losing transparency
- Black box system
- Growing addiction

Discontent & Risks

- Winston Churchill once said:

"We make our buildings and after-wards they make us. They regulate the course of our lives."

Book presentation



Sherry Turkle

Professor of the Social Studies of Science and Technology at MIT

Founder and Director of the MIT Initiative on Technology and Self

Licensed clinical psychologist

Sources

- Sherry Turkle – Simulation and it's discontent
- www.chem.unl.edu
- *www.engr.sjsu.edu*
- *pcsostres.ac.upc.edu*