VISUALISATION IN SCIENTIFIC COMPUTING

1992

(SLIDES)

"VISUALISATION ENTAILS MODELLING PHYSICAL PHENOMENA"

(1)

Analogies	between **physics**	and **computer science**
declarative	equational description of system behaviour mathematical theories	mathematical specification abstract computation functional / logic program
state-based + correlated to external world	heuristic models to aid interpretation of eqns	meaning of program how is connected to the real world
	Feynman: "completely unmathematical, imprecise and inexact nature of physical understanding"	Brian-Cantwell Smith: non-logicist view of computation: content relations aren't computed cf traditional PL semantics
modelling	describe state-transitions in physical systems	programming = modelling cf Simula philosophy

Issues for modelling in

	physics	and **computer science**
preconceptions	(classical physics) mechanical models	(current CS) object-oriented modelling
orthogonal views	modelling all aspects of physical phenomena inconsistent with single mechanical model	revision of requirements may => object redesign respecting locality of state-change problematic
faithfulness	how far is mechanism interpretable? how elaborate is the interpretation process?	how much of the object model refers to application? how does model describe how changes synchronise across object boundaries?

⇒ NEED A CONCEPT OF INTERPRETABLE PROGRAM STATE

SUMMARY

modern CS and classical physics have common themes and problems

- mathematically abstract aspect
- complementary interpretative state-based heuristics
- models that have similar qualities and limitations

Modern physics addresses the question

how is a physical phenomena correlated to the heuristic model?

	physics and	**computer science**
model environment and definition What is observable?	define observations identify variables whose values are monitored in describing behaviour	identify parameters to be monitored to specify operation of program in relation to its environment

⇒ NEED TO IDENTIFY WHAT STATE-CHANGING AGENTS CAN OBSERVE.

experimental context for the model How is it observed?	decide conventions for simultaneous observation	accuracy of observation granularity, how state-changes synchronise

⇒ NEED TO CONSIDER ACCURACY OF OBSERVATION, HOW ACTIONS AFFECT OBSERVATIONS

How is state changed?	change solely driven by experimentor: "what if?" e.g. Hooke's law	program state changed solely by user e.g. database, spreadsheet

⇒ NEED TO IDENTIFY PRIVILEGES OF AGENTS TO CHANGE STATE.

	change involving autonomous activity e.g. observation of planetary motion	program state is altered under program control and / or by independent agents cf reactive system

	physics	**and computer science**
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validation of model confirmation of experiment	correlation between simultaneous observation in change correctly predicted	program manipulates relevant parameters appropriately in relation to state of system