Modelling at the tissue scale: a concurrent approach

Adam Sampson and Alexey Goltsov
CRISP
University of Abertay Dundee
measure, model → cell
measure, model

replicate
measure, model → cell → replicate

not practical: insufficient computational resources
measure, model

cell
measure, model

discard emergent properties?

tissue
measure, model → cell → tissue

coarse-grain, simplify

replicate

cell  cell  cell

cell  cell  cell

cell  cell  cell
cell
measure, model
coarse-grain, simplify
replicate
cell
cell
cell
cell

cell
cell
cell

cell
cell
cell

cell
cell
cell

validate
tissue
cell

measure, model

coarse-grain, simplify

replicate

validate

greatest practical scale

cell
cell
cell
cell
cell
cell
cell
cell
measure, model

coarse-grain, simplify

replicate, parallelise

validate

greatest practical scale
Concurrent programming

- Design and write software in terms of **concurrent activities** and how they interact
  - Uses include: network servers, robotic control systems, multiplayer games, media processing...
Concurrence to parallelism

- The **runtime system** divides activities dynamically among the available processors
  - ... so it exploits the **natural concurrency** of the system you're modelling to execute in **parallel**

- Modern runtime systems (CCSP, TBB...) look at the **interactions** to decide how best to do this
  - ... giving you better **locality** of execution
Distributed simulation

- Building your program out of **interacting processes** makes it relatively simple to **distribute** across a cluster of machines
  - Developed techniques to minimise latency effects
Playing games with space

- Spatial interactions are key to our applications
  - Needs to be **accurate** and **fast**
- We use techniques developed for real-time **collision detection** in computer games
  - ... and plan to make our runtime system aware of space for even better scheduling
tissue
tissue

parallelise

tissue  tissue

tissue  tissue
Thanks to...

- **CoSMoS**
  www.cosmos-research.org
  esp. Paul Andrews,
  Carl Ritson, Peter Welch

- **CRISP**
  Abertay/Edinburgh/St. Andrews
  esp. Jim Bown, Dana Faratian,
  Simon Langdon, David Harrison

- Any questions?