Architecture of a Tangible Interface for Modeling Plant Cell Cycle

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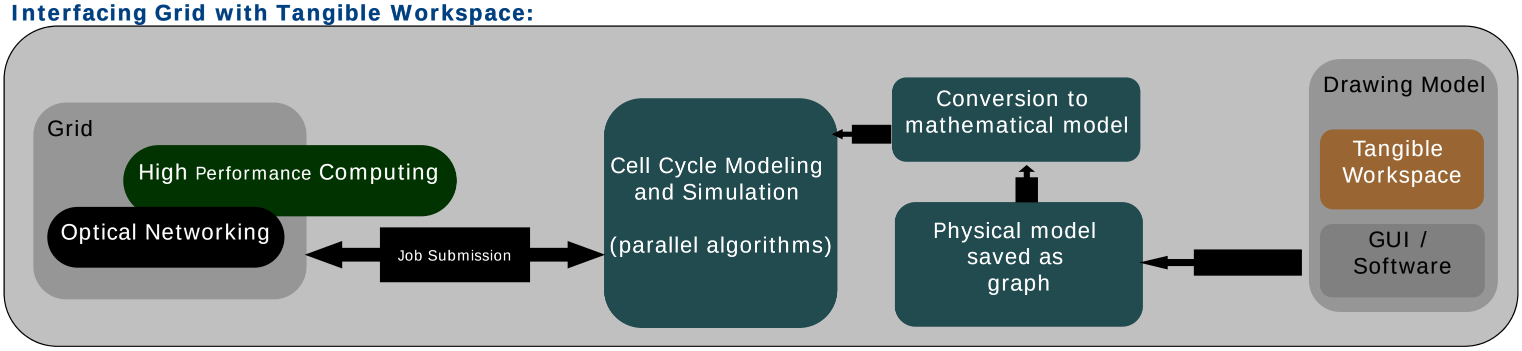
Motivation:

Cell cycle simulation using HPC techniques had been successfully done using supercomputers [2]. The existing techniques used to model cell cycle is not user-friendly for biologists. Also, there is no way in which a schematic diagram of a part of the model can be converted to corresponding mathematical model for simulation purposes. We seek prospects of interfacing supercomputers with tangible interfaces to serve this purpose.

Interfacing Grid with Tangible Workspace:



Tangible Workspace (TW)	Back-end Software GUI	Design considerations for TW	Handling simulations, Computational Issues, back-end grid-connectivity
▪ Includes both visual+physical components ▪ Easy for human manipulation ▪ Maintains back-end connectivity with cluster computers, and grid resources for simulation.	▪ needs to save the physical model drawn on the tangible workspace ▪ needs to retrieve a saved model for further editing ▪ needs to create new models, if necessary, and save it.	• the material for the workspace area • how the objects will hold on to the workspace • how the objects will sense presence of each other	• comparing results of mathematical model and experimental data • very hard to set numerical values of the “parameters” in the mathematical model equations to create more accurate representations of steps in each cell cycle

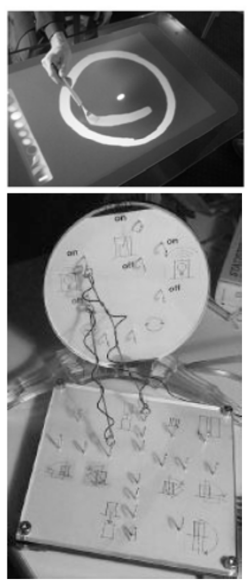


Fig. 1: (Some existing tangible interfaces): (left top) Graphical, actuated workbench for cell tower placement [Patten et al. 2007]; (left bottom) PostIt-based web layout [Klemmer et al. 2001]; (middle top/bottom) collaborative visualization using viz tangibles [Ullmer et al. 2008]; (left top) Microsoft Surface Technology; (left bottom) String-based interface;

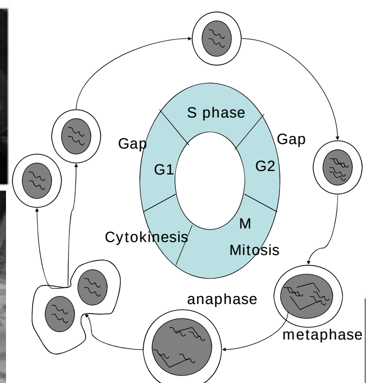


Fig. 2: Phases of cell division

Fig. 3: Existing physical workspace for cell-cycle modeling, without any computer connectivity

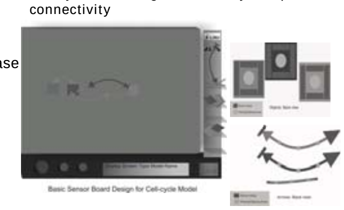


Fig. 4: Preliminary sketches of Tangible workspace, objects, and connectors

Basic Workflow

(1) Actual physical design of a cell-cycle model on the tangible interface workspace;

(2) Saving of the physical model as a softcopy for future retrieval, using controls available on the workspace;

(3) Editing the saved model in a GUI, if needed;

(4) Choosing a cell-cycle model as input to the parallel algorithm for simulation and verification of the model's correctness;

(5) Submitting the resulting compute job description to the grid;

(6) Collecting the output from the compute resources for further analysis and archiving.

References

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