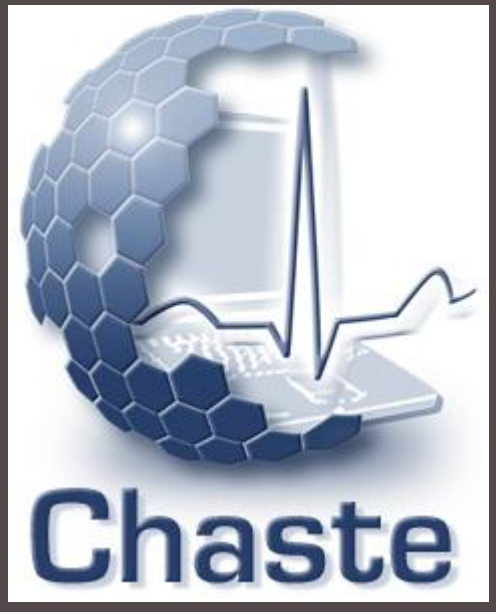
A TEST-DRIVEN APPROACH TO SOFTWARE DEVELOPMENT FOR BIOLOGICAL MODELLING - CHASTE



Firefox

Grand challen... | http://...b8c41a6 | Resultados da ... | Calls - Researc... | Healthcare Sys... | Chaste - Canc... | Chaste - Ca... | Chaste - Canc... | Chaste : Projec...

www.cs.ox.ac.uk/chaste/index.html

chaste

UNIVERSITY OF OXFORD

DEPARTMENT OF COMPUTER SCIENCE

Chaste

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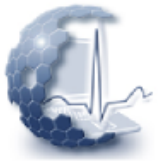
Chaste

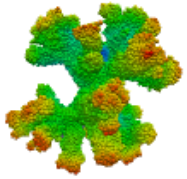
Chaste (**C**ancer, **H**eart **a**nd **S**oft **T**issue **E**nvironment) is a general purpose simulation package aimed at multi-scale, computationally demanding problems arising in biology and physiology. Current functionality includes tissue and cell level electrophysiology, discrete tissue modelling, and soft tissue modelling. The package is being developed by a team mainly based in the Computational Biology Group at the Department of Computer Science, University of Oxford, and development draws on expertise from software engineering, high performance computing, mathematical modelling and scientific computing. Read more...

To get started with Chaste, download the code and browse the documentation.

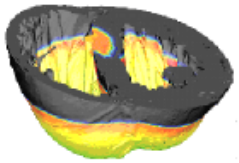
What is Chaste?



Cell-based Simulations



Cardiac Simulations

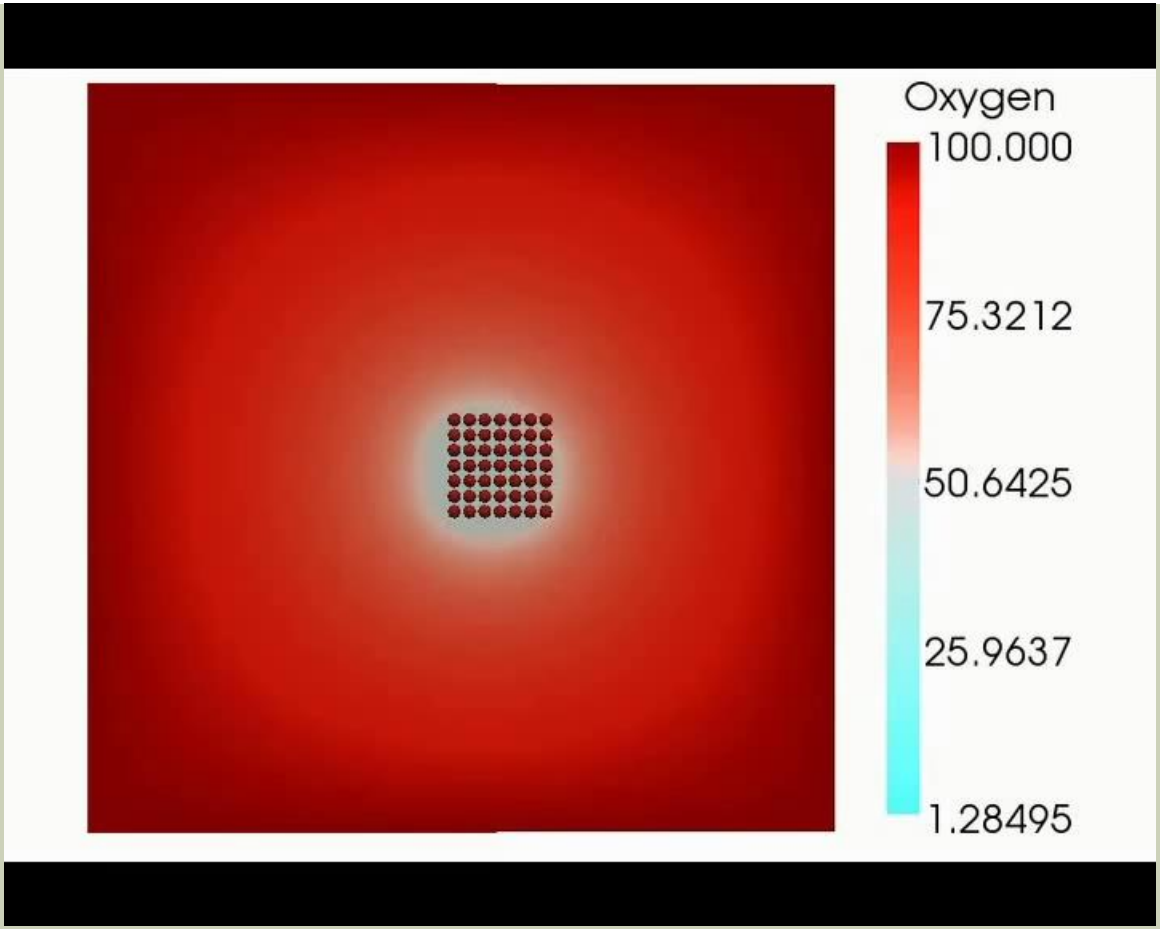


Getting Started

- Chaste home
- Cardiac Chaste
- Cell-based Chaste
- About Chaste
- Latest news
- Download
- Getting started
- Methodology
- Functionality
- The team
- Publications
- Google+

Chaste

CELL GROWTH AND HYPOXIA



CHARACTERISTICS

- Open-source
  - Can be modified
  - Adaptable
  - Can be extended
- Programers are researchers from different backgrounds
- Researchers come and go (contract ends, promotions, change in research interests)
- Used mainly for research (as any sw, needs to be reliable and consistent)
- Currently, over 180,000 lines of code
- Over hundreds of classes
- Being developed (adapted, modified) since 2005
- So far over 54 programmers

Class Index

A | B | C | D | E | F | G | H | I | K | L | M | N | O | P | Q | R | S | T | V | W | X | Z

A

AbstractAlgebraicContractionModel
AbstractAssemblerSolverHybrid
AbstractBackwardEulerCardiacCell
AbstractBackwardEulerCardiacCell< 0u >
AbstractBidomainSolver
AbstractBoundaryCondition
AbstractBoundaryConditionsContainer
AbstractCachedMeshReader
AbstractCardiacCell
AbstractCardiacCellFactory
AbstractCardiacCellInterface
AbstractCardiacCellWithModifiers
AbstractCardiacFeVolumeIntegralAssembler
AbstractCardiacMechanicsSolver
AbstractCardiacMechanicsSolverInterface
AbstractCardiacProblem
AbstractCardiacTissue
AbstractCellBasedSimulation
AbstractCellBasedSimulationModifier
AbstractCellBasedTestSuite
AbstractCellBasedWriter
AbstractCellCycleModel
AbstractCellCycleModelOdeSolver
AbstractCellDivisionRule
AbstractCellKiller
AbstractCellMutationState
AbstractCellPopulation
AbstractCellPopulationBoundaryCondition
AbstractCellPopulationWriter
AbstractCellProliferativeType
AbstractCellProperty
AbstractCellWriter
AbstractCentreBasedCellPopulation
AbstractChasteRegion
AbstractCompressibleMaterialLaw
AbstractConductivityModifier
AbstractConductivityTensors
AbstractContinuumMechanicsAssembler
AbstractContinuumMechanicsSolver
AbstractContractionCellFactory
AbstractContractionModel
AbstractConvergenceTester
AbstractCorrectionTermAssembler
AbstractCryptStatistics
AbstractCvodeCell
AbstractCvodeSystem
AdhesionPottsUpdateRule
Alarcon2004OxygenBasedCellCycleModel
Alarcon2004OxygenBasedCellCycleOdeSystem
ApcOneHitCellMutationState
ApcTwoHitCellMutationState
ApoptoticCellKiller
ApoptoticCellProperty
ArchiveLocationInfo
ArchiveOpener
AveragedSourcePde
AxisymmetricConductivityTensors

B

BackwardEulerIvpOdeSolver
BathCellFactory
BetaCateninOneHitCellMutationState
BidomainAssembler
BidomainCorrectionTermAssembler
BidomainMassMatrixAssembler
BidomainNeumannSurfaceTermAssembler
BidomainProblem
BidomainSolver
BidomainTissue
BidomainWithBathAssembler
BidomainWithBathProblem
BoundaryConditionsContainer
BoundaryElement
BoundaryNodeWriter
Box
BoxCollection
BuskeAdhesiveForce
BuskeCompressionForce
BuskeElasticForce

C

CardiacElectroMechanicsProblem
CardiacElectroMechProbRegularGeom
CardiacNewtonSolver
CardiacSimulation
CardiacSimulationArchiver
Cell
CellAgesWriter
CellAncestor
CellAncestorWriter
CellBasedEventHandler
CellBasedPdeHandler
CellBasedPdeHandlerOnCuboid
CellBasedPdeSolver
CellBasedSimulationArchiver
CryptSimulationBoundaryCondition
CryptStatistics
CuboidMeshConstructor
CvodeAdaptor
CvodeData_
Cylindrical2dMesh
Cylindrical2dNodesOnlyMesh
Cylindrical2dVertexMesh
CylindricalHoneycombMeshGenerator
CylindricalHoneycombVertexMeshGenerator

D

DataAtQuadraturePoint_
DataWriterVariable
DefaultCellProliferativeType
DeltaNotchCellCycleModel
DeltaNotchOdeSystem
DeltaNotchTrackingModifier
DifferentialAdhesionPottsUpdateRule
DifferentiatedCellProliferativeType
DiffusionForce
DiffusionMultipleCaUpdateRule
DiscreteSystemForceCalculator
DistanceMapCalculator
DistributedBoxCollection
DistributedQuadraticMesh
DistributedTetrahedralMesh
DistributedTetrahedralMeshPartitionType
DistributedVector
DistributedVectorException
DistributedVectorFactory
DummyModifier
DynamicCellModelLoader
DynamicModelLoaderRegistry

E

TetrahedralMesh::EdgeIterator
Electrodes
ElectrodesStimulusFactory
ElectroMechanicsProblemDefinition
Element
ElementAndWeights
ElementData
AbstractTetrahedralMesh::ElementIterator
AbstractMeshReader::ElementIterator
EulerIvpOdeSolver
AbstractLookupTableCollection::EventHandler
Exception
ExecutableSupport
LinearParabolicPdeSystemWithCoupled
LinearSpringWithVariableSpringConstar
LinearSystem
LogFile
LuoRudySpiralWaveCellFactory

M

MassMatrixAssembler
MechanicsEventHandler
MemfemMeshReader
MeshalyzerMeshWriter
MeshBasedCellPopulation
MeshBasedCellPopulationWithGhostNod
MeshEventHandler
MeshPottsWriterIterators
MeshWriterIterators
Mirams2010WntOdeSystem
MixedDimensionMesh
MockEulerIvpOdeSolver
MonodomainAssembler
MonodomainCorrectionTermAssembler
MonodomainProblem
MonodomainSolver
MonodomainStiffnessMatrixAssembler
MonodomainTissue
MooneyRivlinMaterialLaw
MultipleCaBasedCellPopulation
MultiStimulus
MutableElement
MutableElement< 1, SPACE_DIM >
MutableMesh
MutableVertexMesh

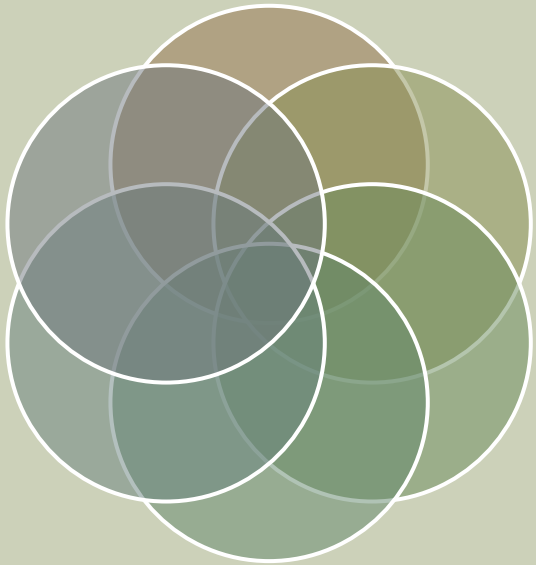
N

NagaiHondaDifferentialAdhesionForce
NagaiHondaForce
Nash2004ContractionModel
NashHunterPoleZeroLaw
NaturalNeumannSurfaceTermAssemble
NhsContractionModel
NhsModelWithBackwardSolver
Node
NodeAttributes
NodeBasedCellPopulation
NodeBasedCellPopulationWithBuskeUp
NodeBasedCellPopulationWithParticles
AbstractMeshReader::NodeIterator
AbstractMesh::NodeIterator
NodeLocationWriter

CHALLENGES

Documentation

Comunication between members



Testing

Patterns and consistency

Adaptability

Dissemination, etc...

CHASTE METHODOLOGY

Ideas taken from agile programming:

- Developers work together in pairs and produce new code in short iterative bursts with frequent planning and retrospective meetings.
- Development of any code is preceded by the creation of one or more test cases to thoroughly check that the code to be written meets our requirements.
- Ideally, core tests are included in our continuous test pack, which is run frequently - every time a check-in is performed.
- Test result summaries for every revision are automatically published to a web page.
- Longer tests are divided between the nightly and weekly test packs, depending on how long they take to complete.

FACTS

Mature, well-established codebase

- First lines of source code were added to in 2005
- Attract long-term commitment
- Mature and relatively bug-free code base

Large, active development team

- Over the entire history of the project, 54 developers

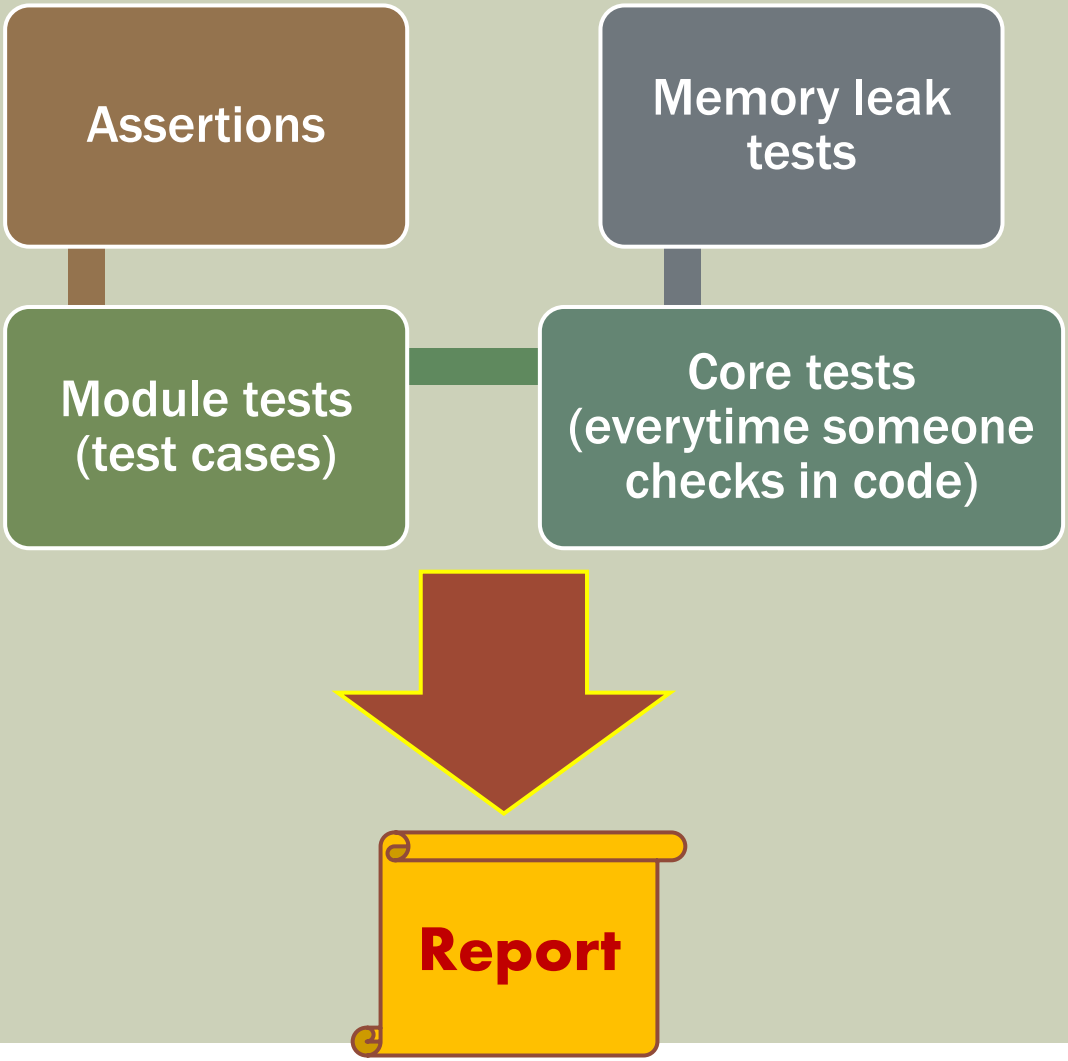
Very well-commented source code

- 36%

DEVELOPER FUNCTIONALITY

- Source released under 3-clause BSD license. (Note that versions 3.0 and earlier used LGPL.)
- Fully tested codebase (~185,000 code lines and ~100,000 test lines as of Oct 2012):
  - Immediate detection of newly broken functionality.
  - Tests help in obtaining details on available functionality.
- Web-based automatic testing and integration framework.
- Two development strategies:
  - To develop functionality that links against Chaste libraries.
  - To modify and extend the current implementations.

LAYERS OF TESTING



Chaste Tests

This is the funky interface to Chaste's testing suite.

- Recent continuous builds.
- Old continuous builds.
- Recent nightly builds.
- Old nightly builds.

Branch/project builds: (toggle visibility)

Run time variation of profiled tests.
Run time variation of weekly tests.

Latest continuous build

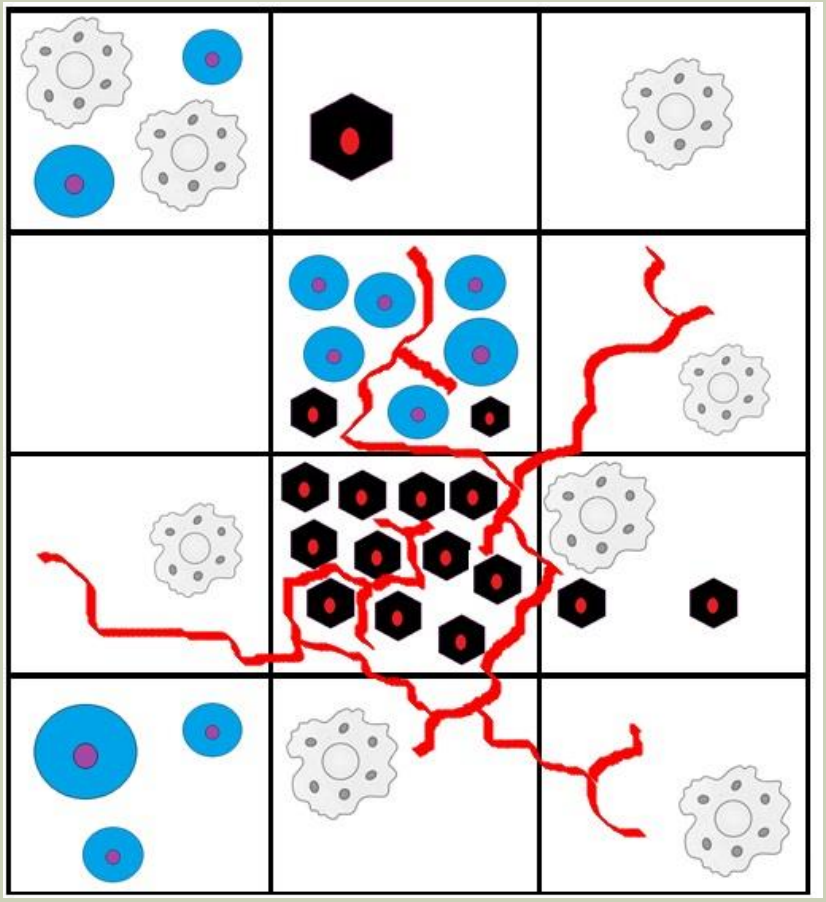
Revision: 21258 [changes]
Date and time: 18/03/2014 18:37:33
Overall status: All 353 tests run passed
Build type: Intel
Machine: userpc60.cs.ox.ac.uk
Targets:
Build log: /out/continuous/21258

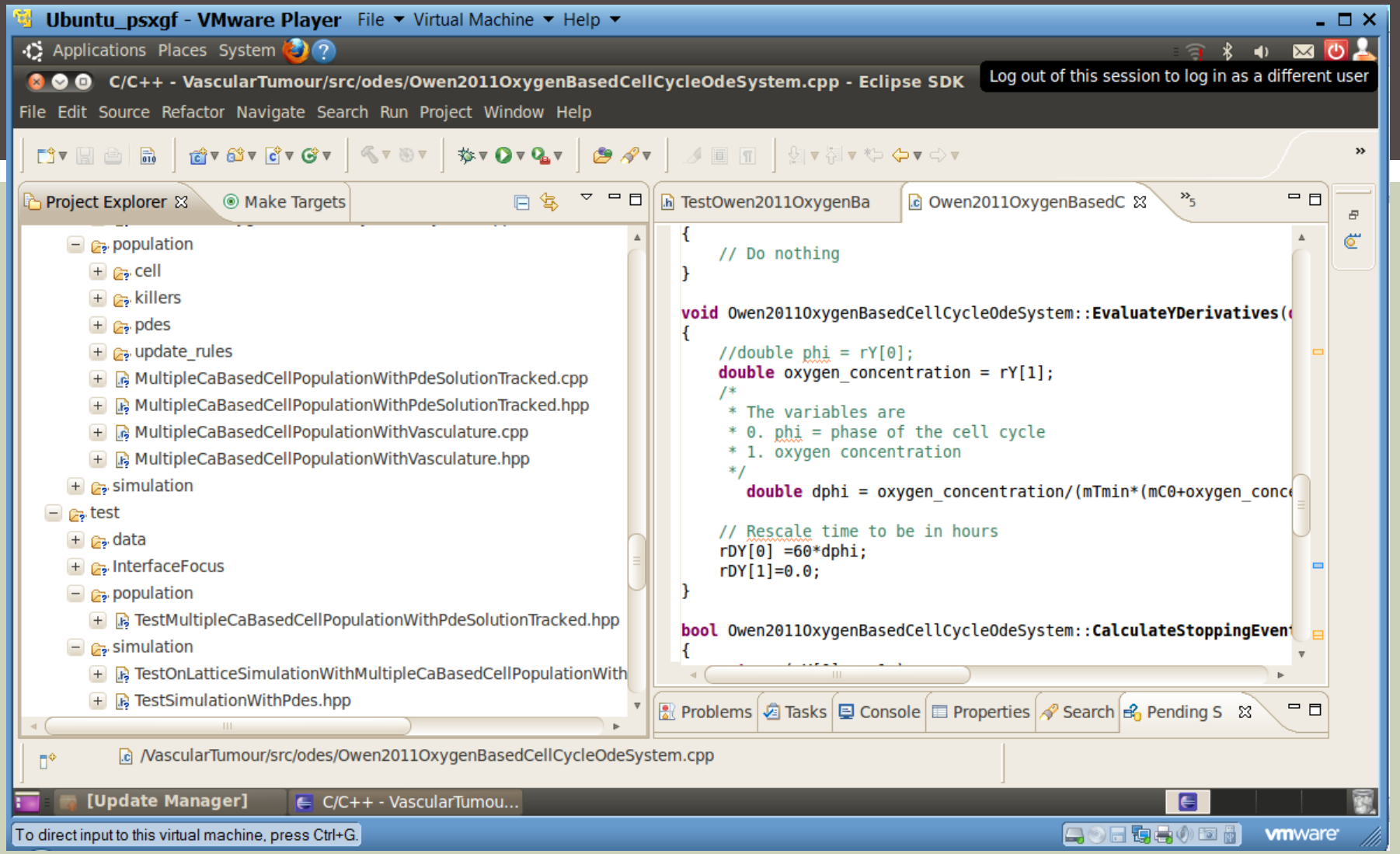
Timings (for entire build log):

Activity	Time (minutes)
Total	174:0.455488
Compile	133:45.388959
Test running	28:0.080168
PyCml execution	9:24.600799
Other	2:50.206269
CxxTest generation	0:0.179293
Object dependency analysis	0:0.000000

Test Suite	Status	Run Time
Copyrights	All tests passed	1s
DuplicateFileNames	All tests passed	0s
OrphanedTests	All tests passed	0s
Schemas	All tests passed	1s
cell_based-test-cell-TestArchiveCell	All tests passed	0s
cell_based-test-cell-TestCell	All tests passed	7s
cell_based-test-cell-TestCellBasedCellProperties	All tests passed	0s
cell_based-test-cell-TestCellCycleModelOdeSolver	All tests passed	0s
cell_based-test-cell-TestCellMutationStates	All tests passed	0s
cell_based-test-cell-TestCellProliferativeTypes	All tests passed	0s
cell_based-test-cell-TestCellPropertyCollection	All tests passed	0s
cell_based-test-cell-TestCellPropertyRegistry	All tests passed	0s
cell_based-test-cell-TestCellsGenerator	All tests passed	0s
cell_based-test-cell-TestDeltaNotchCellCycleModel	All tests passed	0s
cell_based-test-cell-TestOdeBasedCellCycleModels	All tests passed	5s

EXEMPLAR MODEL




Ubuntu_psxgf - VMware Player File Virtual Machine Help
Applications Places System
C/C++ - VascularTumour/src/odes/Owen2011OxygenBasedCellCycleOdeSystem.cpp - Eclipse SDK
Log out of this session to log in as a different user
File Edit Source Refactor Navigate Search Run Project Window Help
Project Explorer
Make Targets
population
cell
killers
pdes
update_rules
MultipleCaBasedCellPopulationWithPdeSolutionTracked.cpp
MultipleCaBasedCellPopulationWithPdeSolutionTracked.hpp
MultipleCaBasedCellPopulationWithVasculature.cpp
MultipleCaBasedCellPopulationWithVasculature.hpp
simulation
test
data
InterfaceFocus
population
TestMultipleCaBasedCellPopulationWithPdeSolutionTracked.hpp
simulation
TestOnLatticeSimulationWithMultipleCaBasedCellPopulationWith
TestSimulationWithPdes.hpp
TestOwen2011OxygenBa
Owen2011OxygenBasedC
{
// Do nothing
}
void Owen2011OxygenBasedCellCycleOdeSystem::EvaluateYDerivatives(
{
//double phi = rY[0];
double oxygen_concentration = rY[1];
/*
* The variables are
* 0. phi = phase of the cell cycle
* 1. oxygen concentration
*/
double dphi = oxygen_concentration/(mTmin*(mC0+oxygen_conc
// Rescale time to be in hours
rDY[0] =60*dphi;
rDY[1]=0.0;
}
bool Owen2011OxygenBasedCellCycleOdeSystem::CalculateStoppingEven
{
Problems
Tasks
Console
Properties
Search
Pending S
/VascularTumour/src/odes/Owen2011OxygenBasedCellCycleOdeSystem.cpp
[Update Manager]
C/C++ - VascularTumou...
To direct input to this virtual machine, press Ctrl+G.
vmware