cbcbeat Documentation

Release 1.0

cbcbeat-authors

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Contents

cbcbeat is a Python-based software collection targeting computational cardiac electrophysiology problems. cbcbeat contains solvers of varying complexity and performance for the classical monodomain and bidomain equations coupled with cardiac cell models. The cbcbeat solvers are based on algorithms described in Sundnes et al (2006) and the core FEniCS Project software (Logg et al, 2012). All cbcbeat solvers allow for automated derivation and computation of adjoint and tangent linear solutions, functional derivatives and Hessians via the dolfin-adjoint software (Farrell et al, 2013). The computation of functional derivatives in turn allows for automated and efficient solution of optimization problems such as those encountered in data assimillation or other inverse problems.

cbcbeat is based on the finite element functionality provided by the FEniCS Project software, the automated derivation and computation of adjoints offered by the dolfin-adjoint software and cardiac cell models from the CellML repository.

cbcbeat originates from the Center for Biomedical Computing, a Norwegian Centre of Excellence, hosted by Simula Research Laboratory, Oslo, Norway.

CHAPTER 1

Installation and dependencies:

The cbcbeat source code is hosted on Bitbucket:

> https://bitbucket.org/meg/cbcbeat

The cbcbeat solvers are based on the FEniCS Project finite element library and its extension dolfin-adjoint. Any type of build of FEniCS and dolfin-adjoint should work, but cbcbeat has mainly been developed using native source builds and is mainly tested via Docker images.

See the separate file INSTALL in the root directory of the cbcbeat source for a complete list of dependencies and installation instructions.

CHAPTER 2

Main authors:

See the separate file AUTHORS in the root directory of the cbcbeat source for the list of authors and contributors.

CHAPTER 3

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CHAPTER 4

Testing and verification:

The cbcbeat test suite is based on pytest and available in the test/ directory of the cbcbeat source. See the INSTALL file in the root directory of the cbcbeat source for how to run the tests.

cbcbeat uses Bitbucket Pipelines for automated and continuous testing, see the current test status of cbcbeat here:

https://bitbucket.org/meg/cbcbeat/addon/pipelines/home

CHAPTER 5

Contributions:

Contributions to cbcbeat are very welcome. If you are interested in improving or extending the software please contact us via the issues or pull requests on Bitbucket. Similarly, please report issues via Bitbucket.

CHAPTER 6

Documentation:

The cbcbeat solvers are based on the Python interface of the FEniCS Project finite element library and its extension dolfin-adjoint. We recommend users of cbcbeat to first familiarize with these libraries. The FEniCS tutorial and the dolfin-adjoint documentation are good starting points for new users.

6.1 Examples and demos:

A collection of examples on how to use cbcbeat is available in the demo/ directory of the cbcbeat source. We also recommend looking at the test suite for examples of how to use the cbcbeat solvers.

6.2 API documentation:

6.2.1 cbcbeat package

Subpackages

cbcbeat.cellmodels package

Submodules

cbcbeat.cellmodels.beeler_reuter_1977 module

cbcbeat.cellmodels.cardiaccellmodel module

cbcbeat.cellmodels.fenton_karma_1998_BR_altered module

cbcbeat.cellmodels.fenton_karma_1998_MLR1_altered module

CHAPTER 7

Indices and tables

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