BOPTEST Tutorial #1

An Introduction to BOPTEST Software for Test Case Development and Interaction

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Introduction

The Building Optimization Test Framework (BOPTEST) is developed to enable the fair comparison and benchmarking of advanced control strategies in buildings. The framework is composed of three main parts:

1. Test Cases
2. Key Performance Indicators
3. Software Runtime Environment

Test Cases are complete building emulators. They not only include detailed physical models of buildings and their systems, but also all boundary condition data necessary to test a controller for the building. This includes weather, schedules, energy and fuel prices, occupant comfort definitions, and documentation. A test case is ultimately represented by a Functional Mockup Unit (FMU). This is known as the test case FMU.

Key Performance Indicators (KPI) are metrics to evaluate controller performance. A set of core KPIs have been identified and defined by the IBPSA Project WP1.2 team, which will get calculated for every tested controller for each test case.

The Software Runtime Environment is designed to create a controlled testing environment that is efficiently deployed. It makes use of Docker containerization to create a well-defined simulation environment which contains Python modules to manage simulation of the test case FMU, deliver boundary condition forecasts, store results, calculate KPIs, and deliver information about the test case. This functionality is accessed by a user through a RESTful HTTP API.

The purpose of this tutorial is to provide a basic introduction of the BOPTEST framework and associated software components to potential test case developers and controller testers. Therefore, the tutorial is split into three main parts, I) Software Requirements, II) Test Case Development and III) Test Case Interaction.

More information at https://github.com/ibpsa/project1-boptest and in [1].

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[1] D. H. Blum, F. Jorissen, S. Huang, Y. Chen, J. Arroyo, K. Benne, Y. Li, V. Gavan, L. Rivalin, L. Helsen, D. Vrabie, M. Wetter, and M. Sofos. (2019). "Prototyping the BOPTEST framework for simulation-based testing of advanced control strategies in buildings." In Proc. of the 16th International Conference of IBPSA, Sep 2 – 4. Rome, Italy.

Part I: Software Requirements

The following is a list of software needed for this tutorial. Note that items 1-3 are only needed for test case development, and not for test case interaction or controller testing.

1. Modelica IBPSA Library
2. Modelica Buildings Library
3. Dymola
4. Python 2.7
5. Docker
6. BOPTEST Repository Software
7. Cygwin (for Windows only).

Please follow the steps below to obtain links for downloading and installing the proper versions.

A. Download the Modelica IBPSA Library master branch from https://github.com/ibpsa/modelica-ibpsa. Extract the zip file to a directory location of your choice.

B. Download the Modelica Buildings Library master branch from https://github.com/lbl-srg/modelica-buildings. Extract the zip file to a directory location of your choice.

C. Install Dymola from https://www.3ds.com/products-services/catia/products/dymola/. A demo version will suffice for this tutorial.

D. Install Python 2.7 from https://www.python.org/downloads/. If other versions of Python are on the system, create an environment to run Python 2.7.

E. Install Docker by following the instructions for your system:

   Windows:
   https://docs.docker.com/docker-for-windows/install/

Ubuntu or Other Linux (see side panel at link):
https://docs.docker.com/install/linux/docker-ce/ubuntu/
MacOS:
https://docs.docker.com/docker-for-mac/install/

Be sure to test your Docker installation by opening a terminal and running a test example container stored in an image on the Docker Hub (For Windows, try PowerShell. For Linux and MacOS, you may need to add sudo permission):

$ docker run hello-world

If you are using Windows and getting a permission error, you may have to add yourself to the "docker-users" group in computer management. See here for more information and how to resolve:
https://icij.gitbook.io/datashare/faq/you-are-not-allowed-to-use-docker-you-must-be-in-the-docker-users-group-.-what-should-i-do

F. Download the BOPTEST Repository Software issue85 branch from https://github.com/ibpsa/project1-boptest/tree/issue85_testcaseBestestAir. Extract the zip file to a directory location of your choice and add the root directory for the repository to your PYTHONPATH environmental variable.

G. For Windows users only, install Cygwin from http://www.cygwin.com/.