

Benchmarking optimization methods for parameter estimation in large kinetic models: DOCUMENTATION SUPPLEMENT

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1 Software requirements and installation

1.1 Requirements

- Operating system: Linux, Windows, or OSX.
- MATLAB 64-bit (<https://www.mathworks.com/products/matlab.html>).
- AMICI toolbox (<https://github.com/FFroehlich/AMICI>).
- MEIGO64 toolbox (https://bitbucket.org/jrbanga_/meigo64).

1.2 Installation

1. Install MATLAB 64-bit (if it is not already present in the system) by following the instructions in its documentation.
2. Install AMICI by following the instructions in its documentation.
3. Install MEIGO64 by opening a MATLAB session and running the file `install_MEIGO.m`, which can be found in the MEIGO root folder.

2 Plotting the results

The results reported in the paper are provided in MAT-files included in the `results` and `results_stats` folders. Using these MAT-files, it is possible to generate the figures and tables included in the aforementioned paper using the scripts included in the `plot_results` folder. These scripts can also be used to visualize new results. The main scripts for this purpose are:

- **main_plot_convergence_curves**
This file can be used for:
 - Calculating and saving the statistics (success ratio, mean time, etc) of the results obtained with the hybrid methodology, eSS.
For this purpose, set `calculate_flag = 1`.
 - Displaying the 'horizontal' and 'vertical' view statistics, as in the supplementary information Tables S3–S20.
For this purpose, set `display_flag = 1`.
 - Plotting the colormaps summarizing the results of the horizontal and vertical views, as in supplementary information Figs. S65–S82.
For this purpose, set `colormap_flag = 1`.
 - Plotting the convergence curves of the optimizations with the hybrid methodology, eSS, as in Figs. 2A and S15–S28.
For this purpose, set `plot_flag = 1`.
- **main_plot_convergence_curves_eSS_FWD_vs_ADJ**
This file can be used for:
 - Plotting the convergence curves of the optimizations with eSS-FMINCON-ADJ-LOG and eSS-FMINCON-FWD-LOG, as in Fig. S83.
- **main_plot_Fig2**
(note that the statistics must have been previously computed with the aforementioned files). This file can be used for:
 - Plotting Figure 2 in the manuscript.
- **main_plot_MS_histograms_and_dispersion_plots**
This file can be used for:
 - Calculating and saving the statistics (success ratio, mean time, etc) of the results obtained with the multistarts of local searches, MS.
For this purpose, set `calculate_flag = 0`,
 - Plotting the figures that summarize the results of the multistarts of local searches, as in Figs. S1–S14.
- **main_plot_OE_ratios**
This file can be used for:
 - Plotting Table S21.
- **main_plot_SR_and_OE**
(note that the statistics must have been previously computed with the aforementioned files). This file can be used for:
 - Plotting the 'Success vs CPU time' figure that compares the performance of all the methods (MS and eSS), as in Figs. 2B and S29–S46.
 - Plotting the overall efficiency (OE) for each method in a stacked bar figure, as in Figs. 2C and S47–S64.

3 Obtaining new optimization results

The code provided in the Software Supplement can be used to run new optimizations, thus obtaining new results for the problems reported in the main text and in the Results Supplement or for modifications of them. Running new implementations may require recompiling the benchmark models first. The necessary steps are described in the next subsections.

3.1 Model compilation

MEX files of the models used in the benchmarks are provided as part of this software. However, depending on the machine it may be necessary to generate (i.e. compile) them again. To recompile the models and obtain new MEX files, open a MATLAB session and run the `compileModels` script included in the `inputs/intermediate_models/project/models` folder. The `compileModels` function uses AMICI's `amiwrap` function to compile the models; in case of errors during the compilation, please refer to the AMICI documentation.

3.2 Running the benchmarks

The `inputs` folder contains scripts that estimate the parameters of the models using the MEIGO toolbox. They are called `launch_meigo_MODELNAME.m` (e.g. `launch_meigo_B2.m`). They contain a number of options about the optimization method, which can be edited by the user. Typically, one may want to modify the following options:

- The `optim_algorithm` variable, which selects the optimization method. To perform a multistart of local searches, set it to `'multistart'`. To run the hybrid optimization method, set it to `'ess'`.
- The settings of the optimization method can be tuned in the `'MEIGO OPTIONS *'` section of the m-file. The most common ones are in section `'MEIGO OPTIONS I'`.

For further information about these options, please refer to the MEIGO documentation.