ISS0031 Modeling and Identification

Practical Work #5*: Global Optimization

These exercises are meant to be completed in the MATLAB environment. A report must be submitted within 2 weeks from the date the practical work took place. It must contain the details related to the work and answers to corresponding questions.

Global Optimiziation in MATLAB

Go to the `GO` subfolder. We shall use the `GODLIKE` function to solve the first set of tasks below. Learn the call sequence by typing the following in MATLAB command line

```
>> help GODLIKE
```

In the subfolder `single-objective-unc`, there are multiple benchmark functions for optimization. Start by adding the functions to MATLAB path by running in the command line

```
>> addpath(genpath('single-objective-unc'))
```

Now, take any two functions and provide a three-dimensional graph of each one. For this, use the provided `ezimage` MATLAB function in the following way (as an example, we graph the bird() function):

```
>> ezimage(@bird)
```

Multi-objective Optimization

Provide the Pareto Front for 2-objective optimization using your pair of functions combined together.

1. Try different sizes of the population and optimization algorithms. NB! Some optimization algorithms do not provide the solution. In that case, try to find which one can be used to solve the problem.
2. Which algorithm is better for the current problem?

In the report, provide the answers to the above questions.

Symbolic Regression

Go to the `SR` subfolder. Today, we will quickly learn how to use GPTIPS2F toolbox for solving function estimation problems using symbolic regression. For this purpose, we shall use the script file provided in the downloaded folder (`symreg.m`).

This exercise is based on Dominic Searson's GPTIPS tutorial[1]. The goal is to fit a symbolic model to data generated by the following function:

$$y = \frac{1}{(1 + x_1^{-4})} + \frac{1}{(1 + x_2^{-4})},$$

where $(x_1, x_2) \in [-5, 5]$ with $\Delta x_1 = \Delta x_2 = 0.4$.

Follow two steps:

1. Add all GPTIPS2F toolbox functions to path by typing in the command line
   >> `addpath(genpath('gptips2f'))`
2. Open the file `symreg.m` and execute the sections one by one. Take note of the results.

In the report, provide the benchmark problem description, the graph of the data used for fitting the function, and the resulting equation. Run the fitting algorithm at least three times. How different are the results? Provide comments about the applicability of the obtained model.

Compile the Report

1. Provide the analysis of the solution of the given task and answers to questions.
2. Draw conclusions based on the results of the work.
3. Compile your individual report and present it no later than **December 12, 2017** via electronic submission—as a PDF file—to aleksei.tepljakov@ttu.ee.

[1] `https://sites.google.com/site/gptips4matlab/gptips-2-tutorial-examples/tutorial1`, last retrieved Nov 27, 2017.