

# ISS0031 Modeling and Identification

## Practical Work #1\*: Identification by Linear Models

These exercises are meant to be completed in the MATLAB environment. You are given two identification datasets along with corresponding validation data. To load them into MATLAB, locate the file `lab4_datasets.mat` and in the corresponding directory type:

```
>> load lab4_datasets
```

The datasets are represented by MATLAB structures, where `#` denotes the number of the dataset, which contain the following entries:

- `id#.y`, `id#.u`, and `id#.t` contain the experimentally collected system output, input, and time vector, respectively;
- `id#.valid.y`, `id#.valid.u`, and `id#.valid.t` contain the experimentally collected validation signals corresponding to system output, input, and time vector, respectively.

**Example:** when you type

```
>> id2.valid.y
```

you get the output signal vector for the second dataset.

## Identification by Transfer Function Models

The task is to identify a linear model given the datasets and validate them using the provided data. Exercise numbers correspond to those of the datasets.

1. (Dataset `id1`). Observe the provided signals. How much noise is present in the collected data? Is there any offset in the output signal? If so, remove it. Then choose a transfer function model structure to fit the data. Use the `optimize()` function to estimate its parameters. Start with a low-order poles-only model. Once a model parameter set is obtained, validate the resulting model. Now increase the order of the model. Did the results of identification improve?
2. (Dataset `id2`). Proceed in the same way as in the previous exercise. Will a poles-only model structure provide a sufficiently accurate model in this case? How does the output signal offset affect the identification results?

## Identification using `ident` Tool in MATLAB

The System Identification Toolbox™ offers a graphical tool for solving the system identification problems. In order to launch it, type

```
>> ident
```

in the MATLAB command prompt. The graphical interface is shown in Figure 1 with relevant comments.

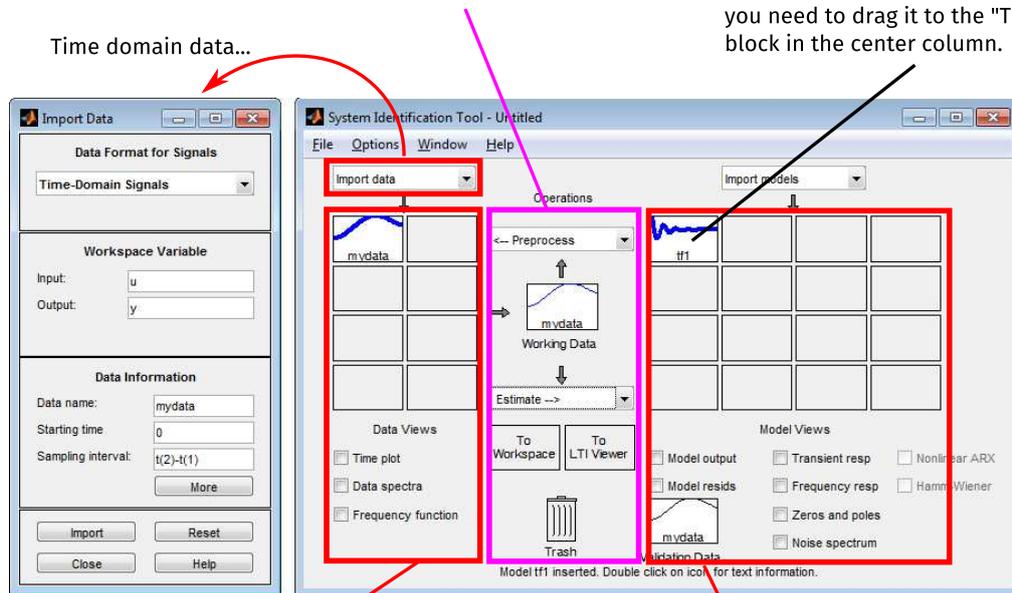
You have the following assignments:

1. Use dataset `id2` to estimate at least four different models. Preprocess data if needed. Choose an appropriate model order. Validate the resulting model. Consider the following categories of models:
  - (a) Transfer function models;
  - (b) State space models;
  - (c) Process models;
  - (d) Polynomial models (ARX, ARMAX, OE, BJ).
2. Present the results on a single plot. Which model structure gives you the best fit? The worst fit (if applicable)?
3. Present the model that gives the best fit as a mathematical equation (e.g., transfer function).
4. Draw conclusions based on the results of the work.

Compile your individual report and present it no later than **October 24, 2017**. The report should be electronically submitted—as a PDF file—to [aleksei.tepljakov@ttu.ee](mailto:aleksei.tepljakov@ttu.ee).

This part of the interface is used to:  
 (a) Preprocess data—remove trends, apply filters, etc.  
 (b) Run the identification process—estimate the parameters of a particular model.  
 (c) Export the obtained model to either MATLAB workspace or LTI Viewer tool.

Obtained models (and identification data) are draggable. For instance, to save a model to the MATLAB workspace you need to drag it to the "To Workspace" block in the center column.



Working identification data. Highlighted data may be analyzed using a selection of analysis tools below (check the correct box to get a plot) and preprocessed using a variety of methods—choose the desired preprocessing method from the drop-down list in the center column.

Placeholder for identified models. Highlighted models may be analyzed and compared by using the checkboxes below that provide specific characteristics of the selected system model. Validation data is stored in the bottom left of the placeholder.

Figure 1: The `ident` tool explained