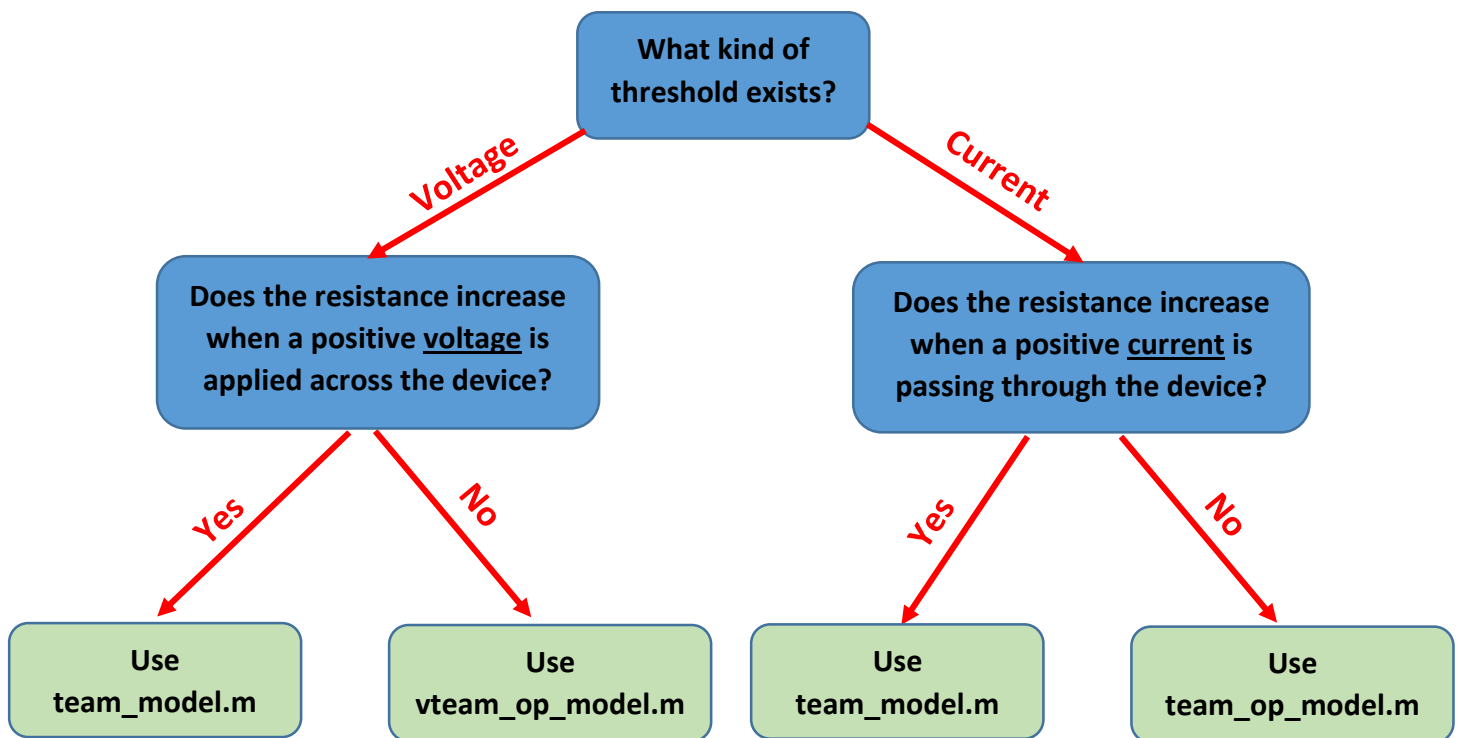Misbah Ramadan
Misba7.90@gmail.com

Model Fitting Manual

This is a manual that will help you setup the fitting environment, and perform the right configurations in order to optimize your model according to a reference data.

Step 1: Choose your model

First of all you need to choose which model you want to work with. To do that, you need to observe and characterize the behavior of the reference data and ask the following questions:

Step 2: Choose what parameters you wish to optimize

After choosing the model, you'll need to decide what parameters of the model you want to tune. Generally some of the parameters can be extracted manually from the graph such as R_{on} and R_{off}, or negative / positive voltage / current thresholds ($v_{off}, v_{on}, i_{off}, i_{on}$). But, for the other parameters you will need to slightly change the code for your model.

Here, I'll show an example for tuning only three parameters of the team_op_model, in order to fit the model to RESET switching if HfO2-based device. The three parameters are, i_{off}, k_{off}, and α_{off}.

1. In the model file, add the vector "input_parameters" as an input to the function in the first line of the model.

2. In the main script, "run.m", insert the initial values for the vector input parameters, as well as, defining the lower and upper bound for parameters. Follow the comments in the file "run.m"

Step 3: Setting up other parameters

After choosing the parameters you wish to optimize, you'll need to set up other parameters, such as the input voltage, time vector, initial value for the state variable, and the I-V relationship.

Voltage input – v_input – is the vector holding the voltage values at each time step (corresponding to the time steps in t_vec). Make sure that this is the same vector as the reference data voltage input (v_ref) since you want to fit your model to the same behavior of the physical measurements under the aforementioned voltage vector.

Time steps – t_vec – is the time step vector, which might include constant time steps or varying time steps. This should be extracted also from the reference data and should be identical to t_ref, which is the time steps used in the measurements of the physical device. Note that in the model files each dt is calculated according to the appropriate index of t_vec.

I-V relationship – choose 1 for exponential relationship, and 0 for linear relationship.

X_init – initial value for the state variable – this must be chosen according to the initial value measured in the reference data.

Fill in the parameters in the run.m and mse.m files.

Step 4: Run the optimization procedure

After running the optimization procedure from the main script (run.m) two optimization results (optres1 and optres2) are achieved and plotted against the physical measurements in order to verify visual similarity.
Note: sometimes the results might be very unrealistic or far away from optimized. This could be as a results of converging to a local minimum! Try to change your initial values of the input_parameters, and run the optimization procedure again.