MODEL ORDER REDUCTION OF ELECTRO-THERMAL ACTUATOR USING ANSYS AND SIMPLORER

Atul Singh

216100191

Guide:

Prof Dr-Ing Tamara Bechtold

Tasks-

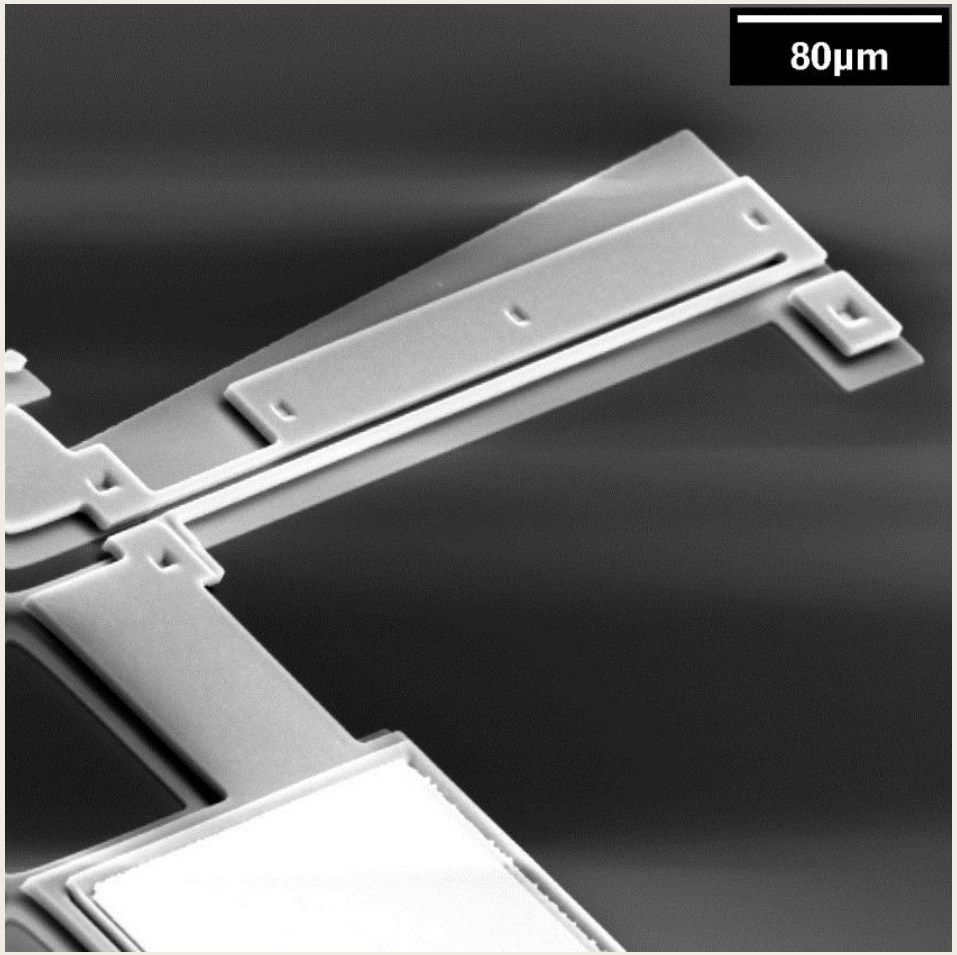
- Reduce the full-scale ANSYS model with MORACT (two inputs, extra output: max actuator temperature) and export the model to Simplorer.
- Compare the results of reduced model integrated in Simplorer with ANSYS transient solution using the expansion result button in ANSYS workbench.
- Compare the results of full and reduced model in Simplorer
- Develop a temperature control (operation at fixed temperature), using the PI controller library element in Simplorer
- Goal: Maximum actuator temperature should quickly increase to 300 ℃ and show minimum overshoot (use ***optimization*** for controller parametrization in Simplorer 2017) Temperature-Control for

Electro- Thermal Actuator – What is it?

Theses devices provide a robust actuation method in surface-micro machined MEMS processes .

Their higher output force on lower input voltages makes them a more feasible option for electrostatic actuation methods.

Works on the principle of Joules Heating



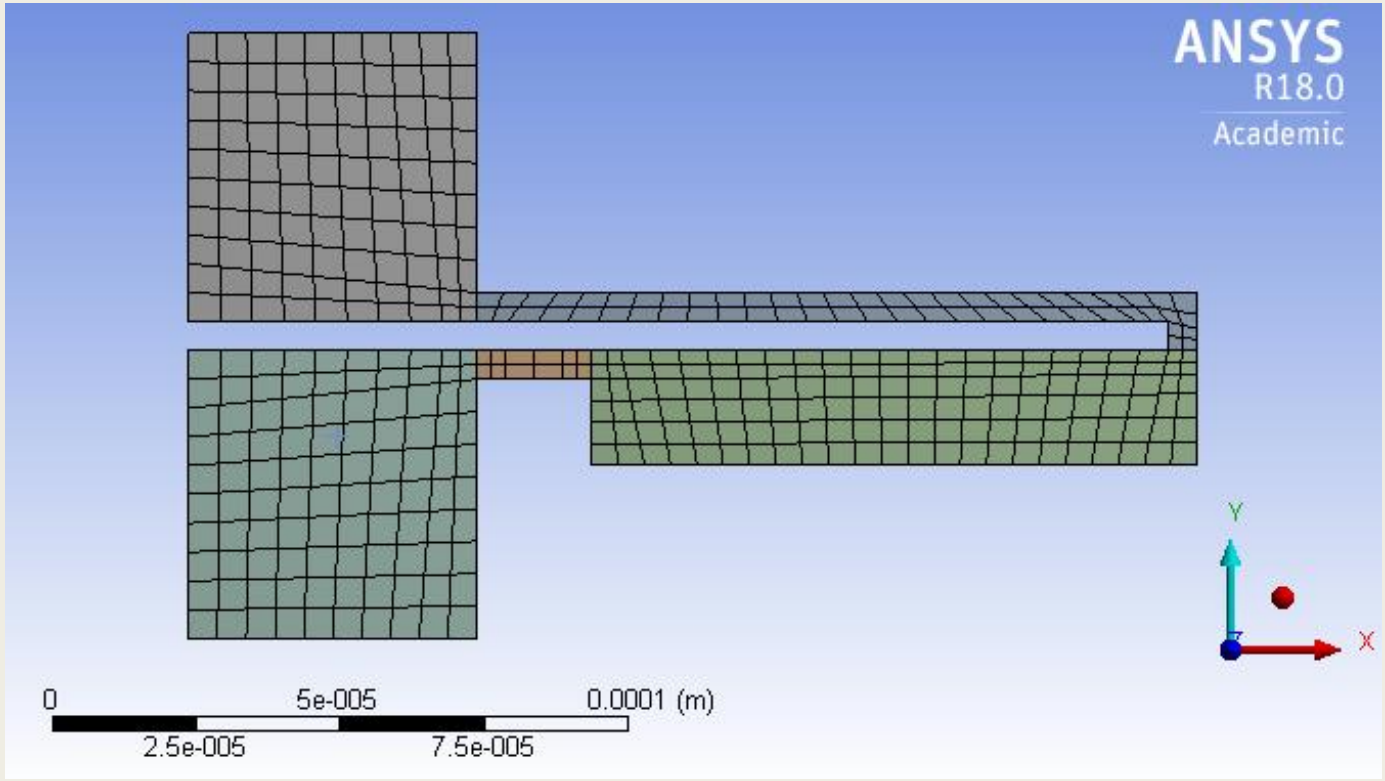
APPLICATIONS

1) Temperature control devices
2) Stepper motors
3) Electromechanical Switches

Ansys Case setup

Meshing

- No. of nodes:- 5455
- No. of elements :- 844
- Coarse
- Hexahedral



Input details

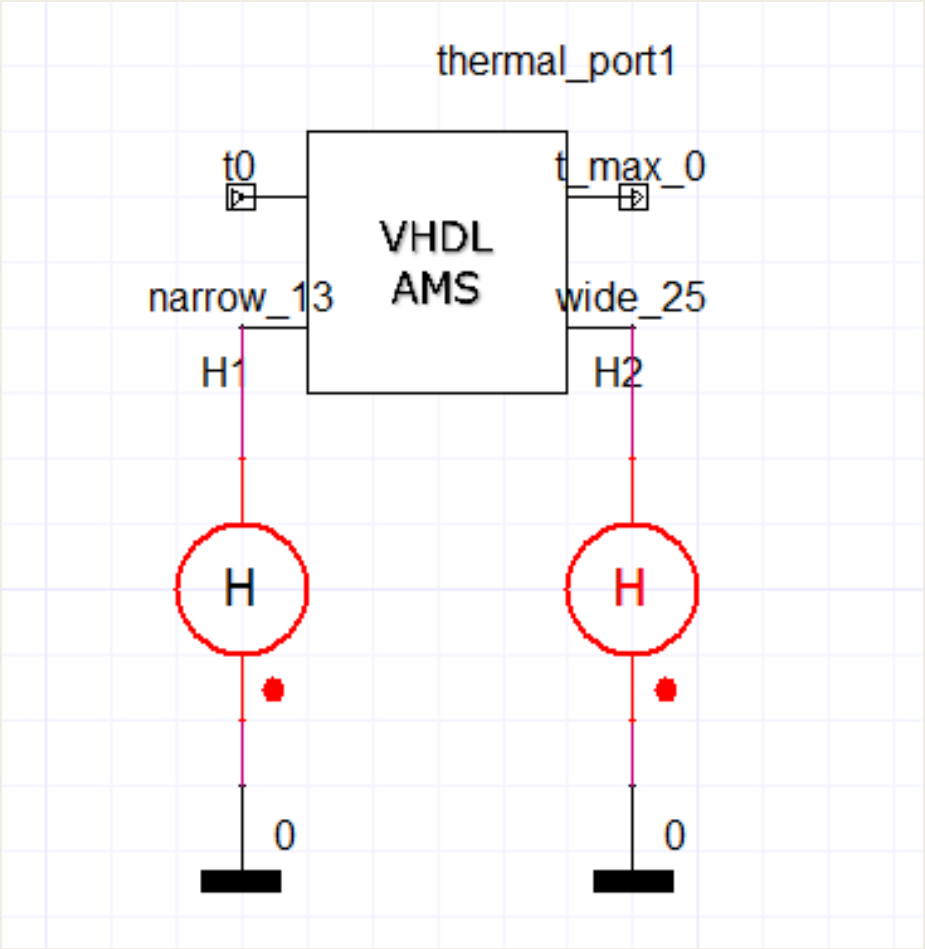
Internal heat generation

Narrow regions :- $10^{13}\ W/m^3$

Wide Region : - $2.5 * 10^{12}\ \frac{W}{m^3}$

Simplorer model

Boundary condition indicating 0 K at the two bottom pads



Max temperature at a node

Heat source to indicate heat flow in narrow region

Heat source to indicate heat flow in wide region.

Task 2

Comparision between Ansys Full order and Reduced order expanded result from simplorer inside Ansys

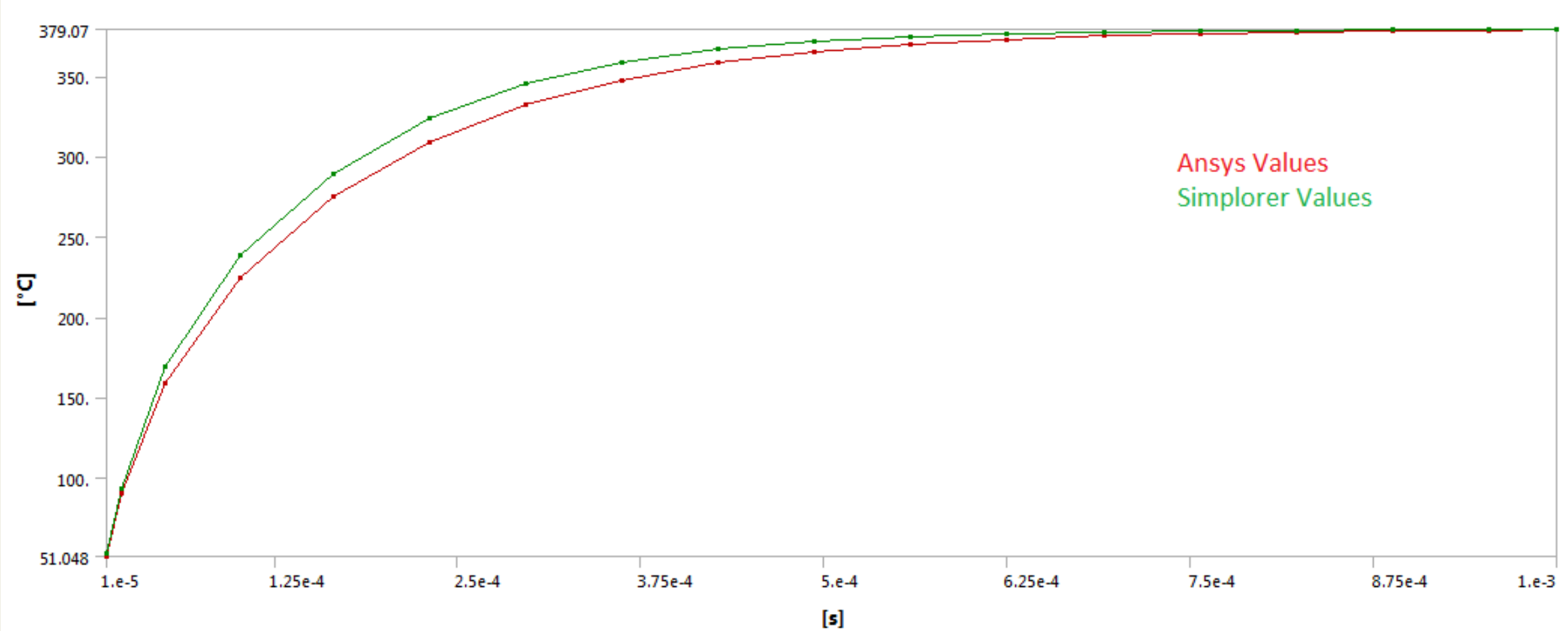


Fig 4:- Temperature curves

Model in Simplorer

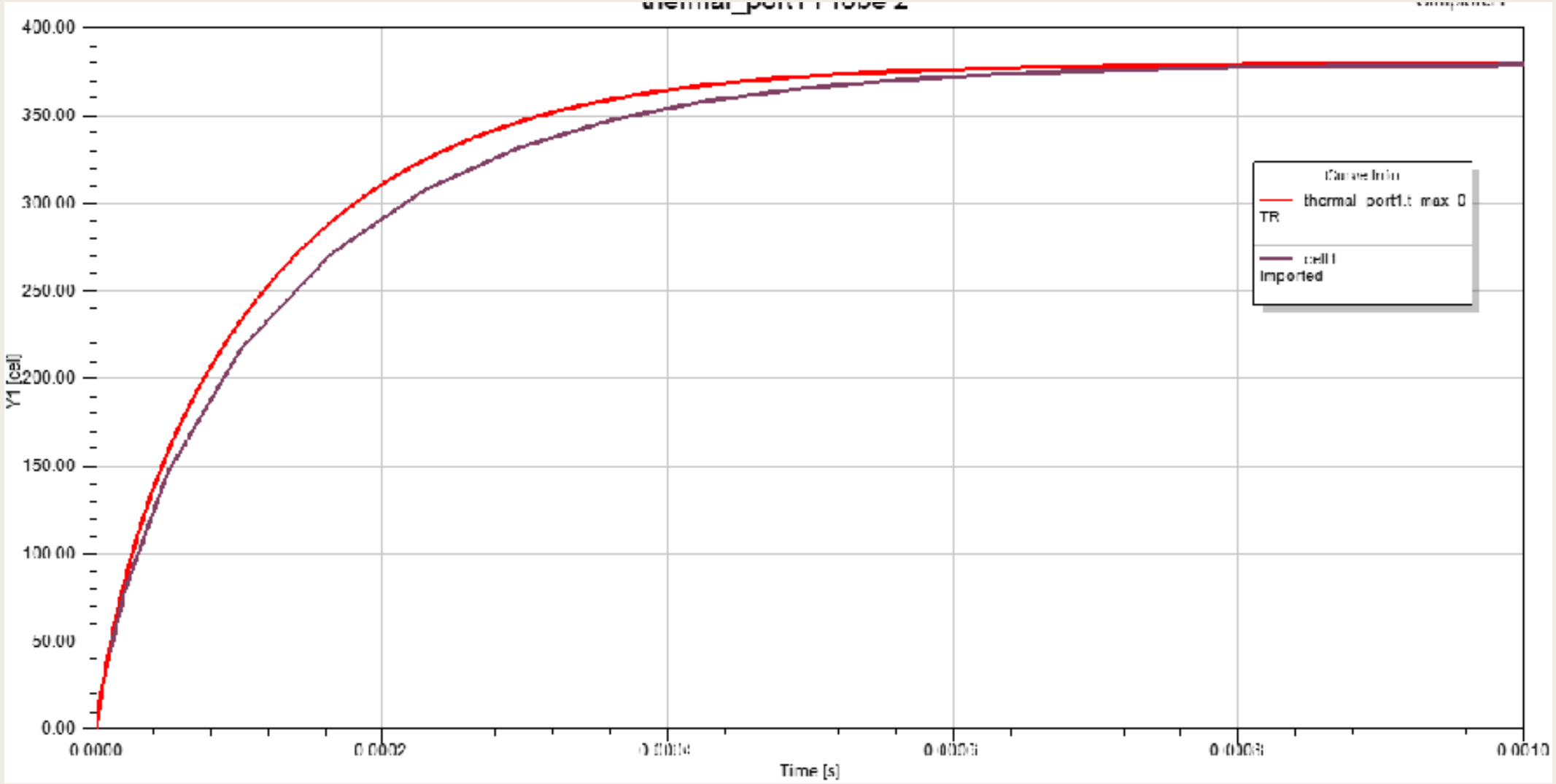


Fig 5:- Comparision between Simplorer Reduced model and Ansys Fullscale model inside Simplorer

Task4 :- Temperature Control for Actuator

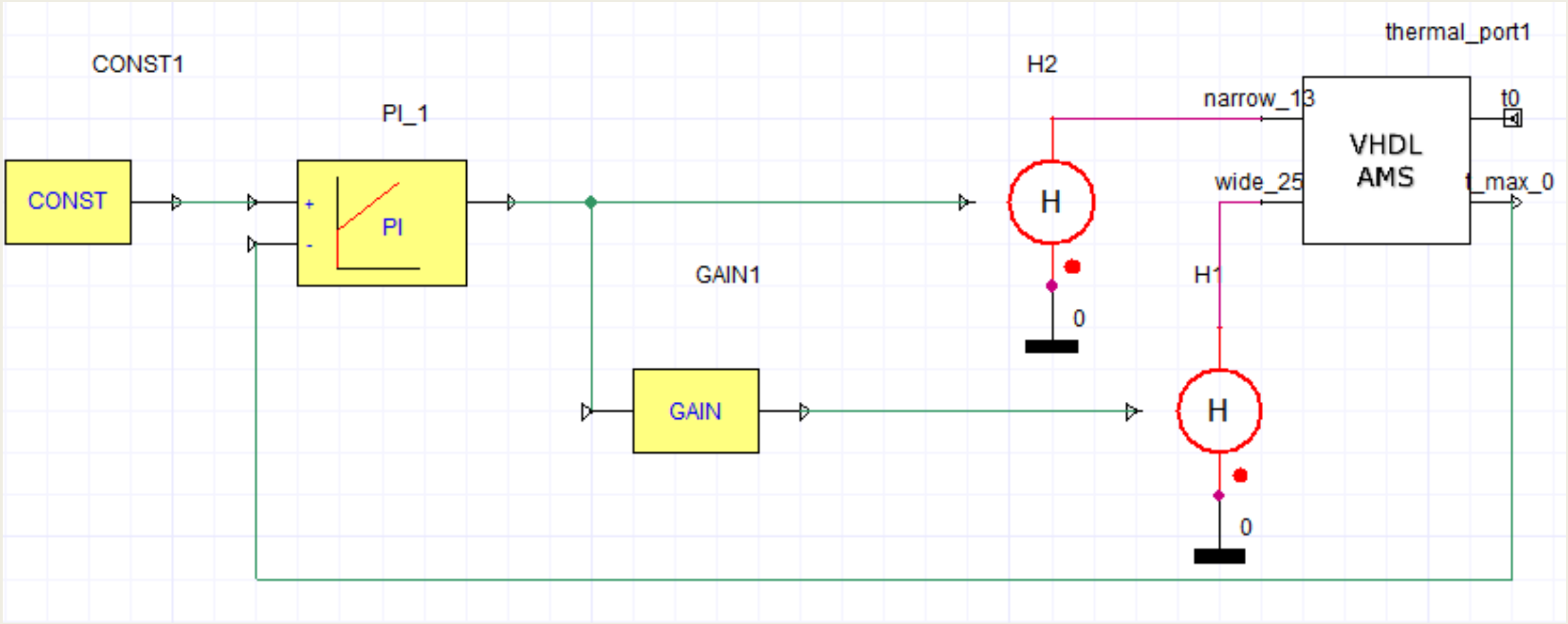


Fig 6:- PI Controller model in Simplorer

Optimization Graphs

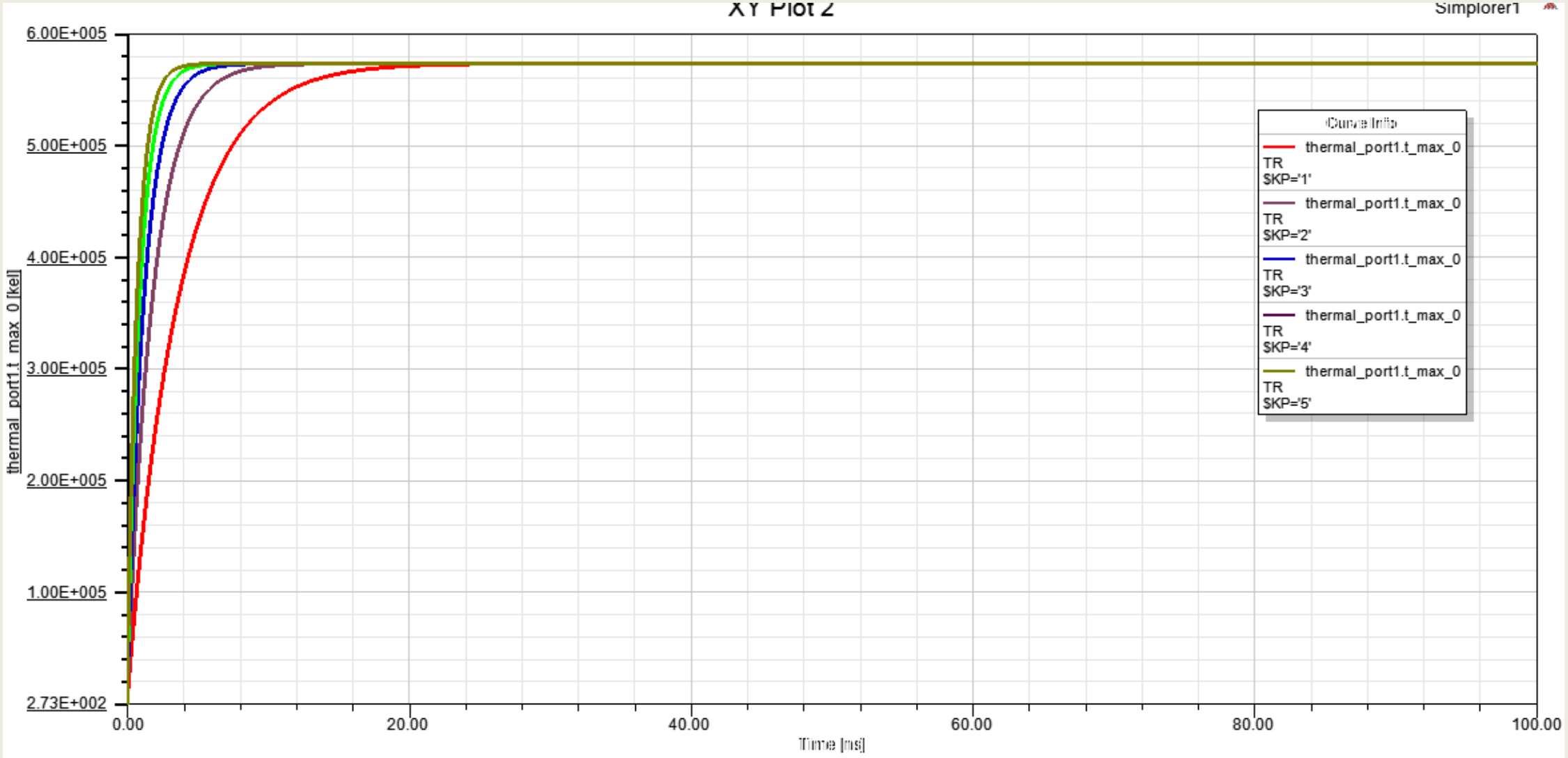


Fig 7

Conclusion

- Nature of graphs and their results of temperature distributions indicate the similarity in both of the models. i.e Reduced and Full order models.
- Hence Model Order Reduction method can be employed to simulate models with less compute power without loosing accuracy.

Thank you