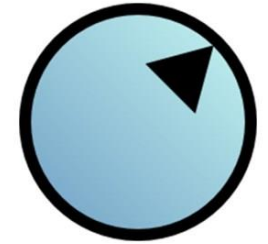


Tutorial: Connecting Aircraft Concept Development to Systems Simulation

Let's give it a try!

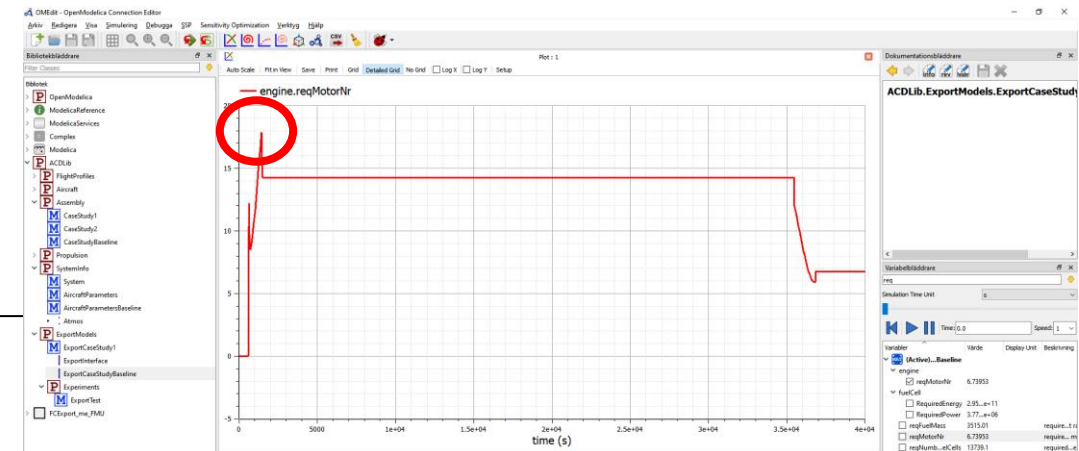
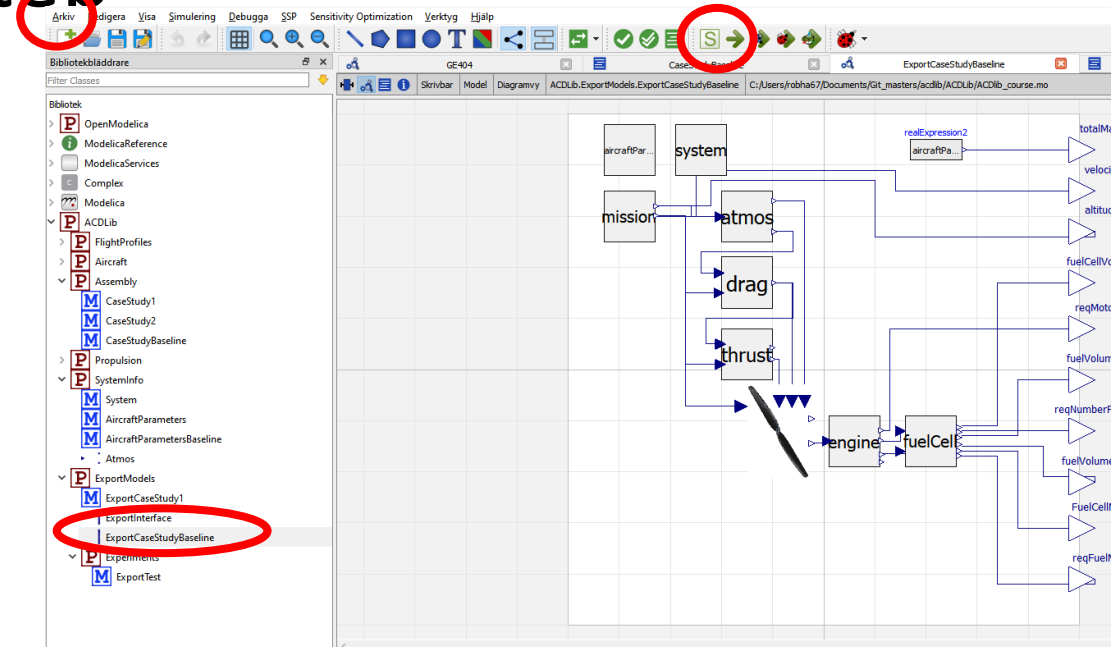
Tools

- You can download the tools needed for the tutorial via the links below.
- Hopsan
 - <https://github.com/Hopsan/hopsan/releases>
Hopsan-2.16-win64-with_compiler.zip
- OpenModelica
 - <https://openmodelica.org/download/download-windows>
- OpenVSP
 - <http://openvsp.org/>



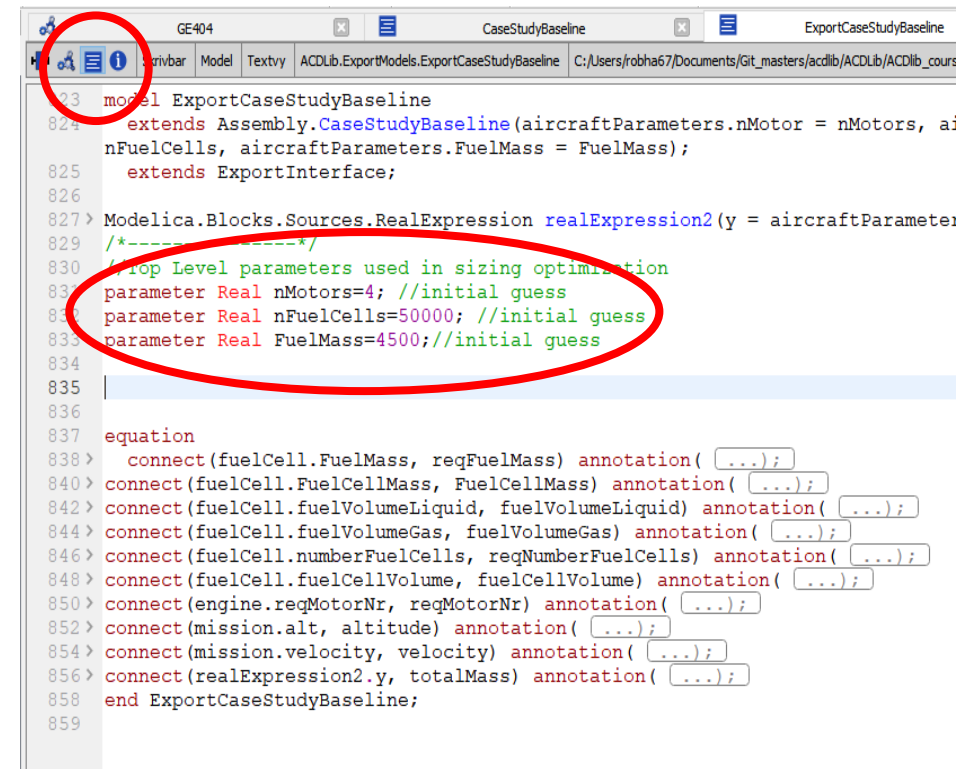
Tutorial: OpenModelica step-by-step

- Open ACDLib
 - Arkiv->Öppna Modell-/Biblioteks-fil(er)
- Navigate to model
 - ACDLib->ExportModels->ExportCaseStudyBaseline
- Simulate(for 37000s)
- Investigate results
 - For example, plot reqMotorNr



Tutorial: OpenModelica step-by-step

- Inspect “code-layer” of model
- Sizing parameters
 - The specified values serve as initial guess values for the sizing optimization
 - These are the parameters that are determined during the sizing optimization; provided a given aircraft geometry
 - Change “initial guess” values

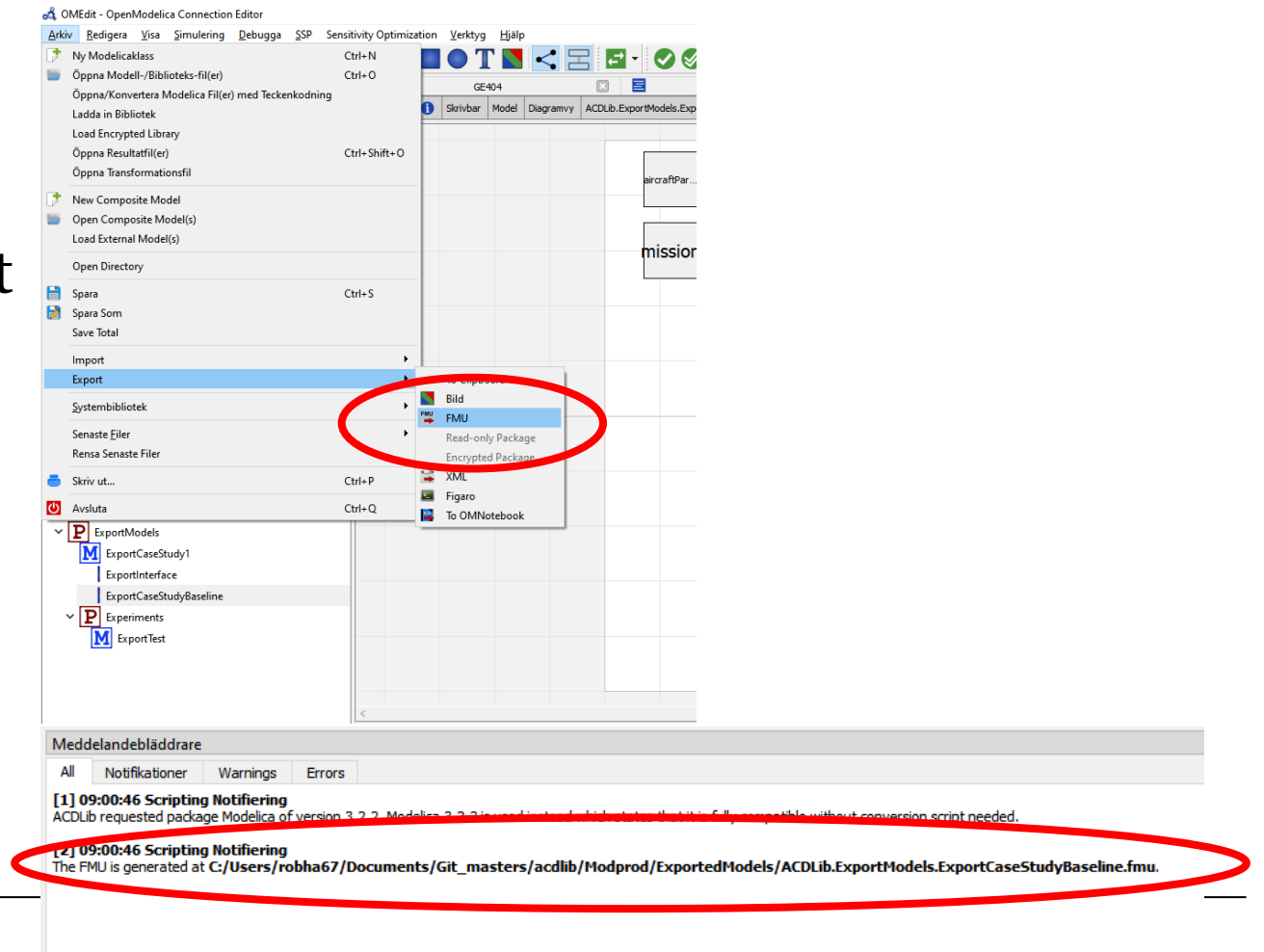


```
GE404 CaseStudyBaseline ExportCaseStudyBaseline
ACLib.ExportModels.ExportCaseStudyBaseline C:/Users/roha67/Documents/Git_masters/acdlib/ACDlib_cours

823 model ExportCaseStudyBaseline
824   extends Assembly.CaseStudyBaseline(aircraftParameters.nMotor = nMotors, ai
nFuelCells, aircraftParameters.FuelMass = FuelMass);
825   extends ExportInterface;
826
827 > Modelica.Blocks.Sources.RealExpression realExpression2(y = aircraftParameter
/*-----*/
830 /* Top Level parameters used in sizing optimization
parameter Real nMotors=4; //initial guess
831 parameter Real nFuelCells=50000; //initial guess
832 parameter Real FuelMass=4500; //initial guess
833
834
835
836
837 equation
838 >   connect(fuelCell.FuelMass, reqFuelMass) annotation( (..) );
840 > connect(fuelCell.FuelCellMass, FuelCellMass) annotation( (..) );
842 > connect(fuelCell.fuelVolumeLiquid, fuelVolumeLiquid) annotation( (..) );
844 > connect(fuelCell.fuelVolumeGas, fuelVolumeGas) annotation( (..) );
846 > connect(fuelCell.numberFuelCells, reqNumberFuelCells) annotation( (..) );
848 > connect(fuelCell.fuelCellVolume, fuelCellVolume) annotation( (..) );
850 > connect(engine.reqMotorNr, reqMotorNr) annotation( (..) );
852 > connect(mission.alt, altitude) annotation( (..) );
854 > connect(mission.velocity, velocity) annotation( (..) );
856 > connect(realExpression2.y, totalMass) annotation( (..) );
858 end ExportCaseStudyBaseline;
859
```

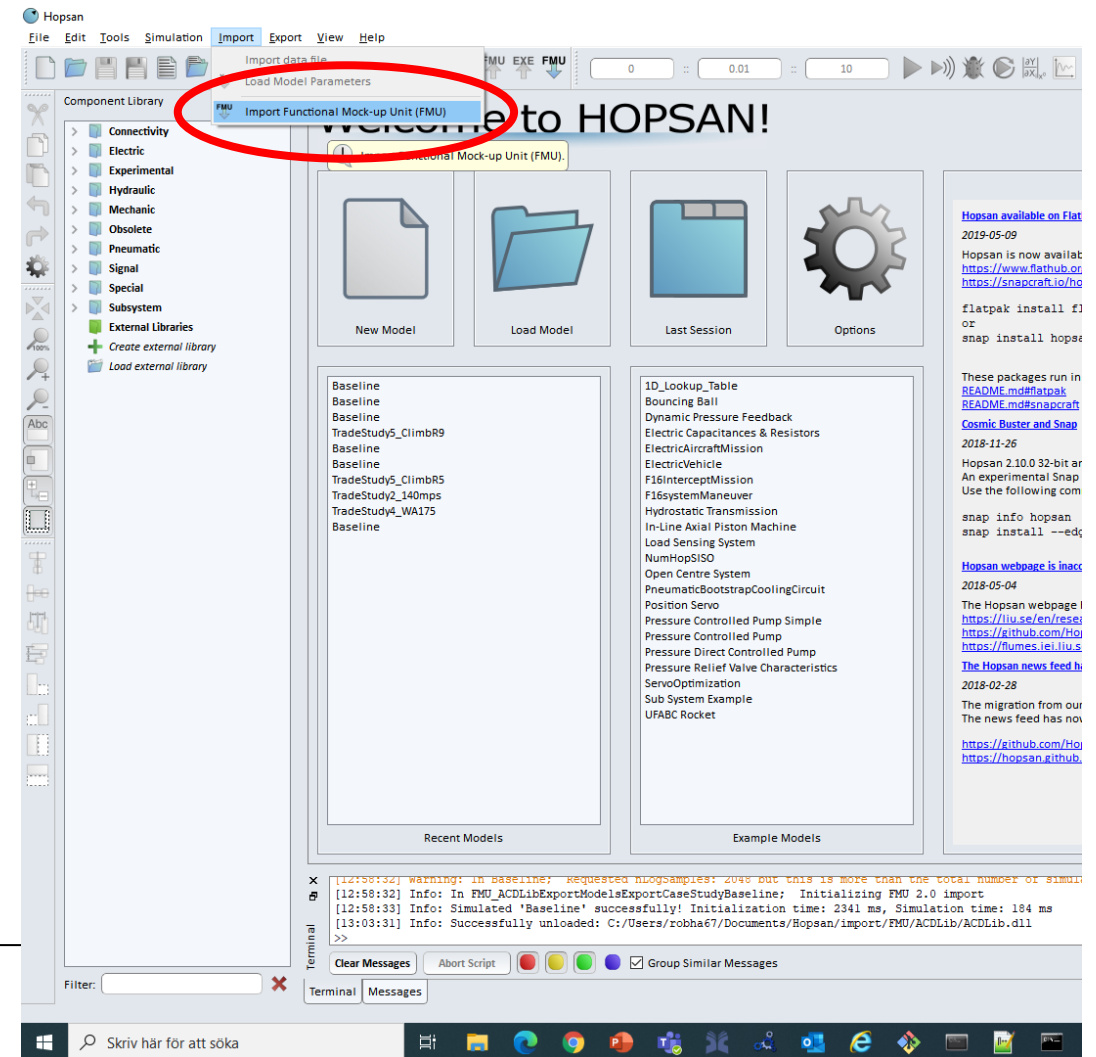
Tutorial: OpenModelica step-by-step

- Export Model
 - Arkiv->Export->FMU
- The exported FMU is located at the path presented in the message browser



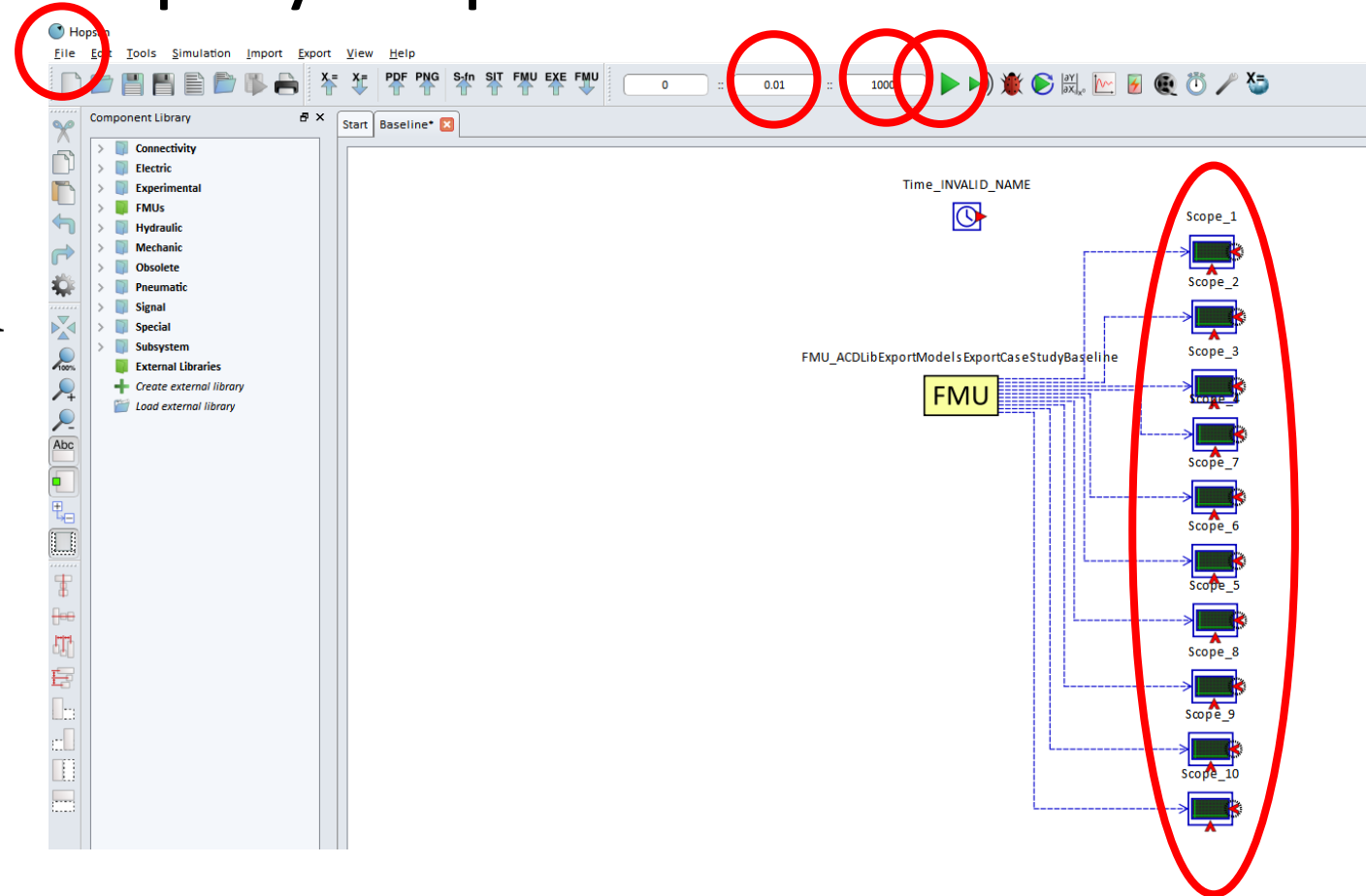
Tutorial: Sizing in Hopsan. Step-by-step

- Open HOPSAN
- Import the generated FMU
 - Import->Import Functional Mock-up Unit (FMU)



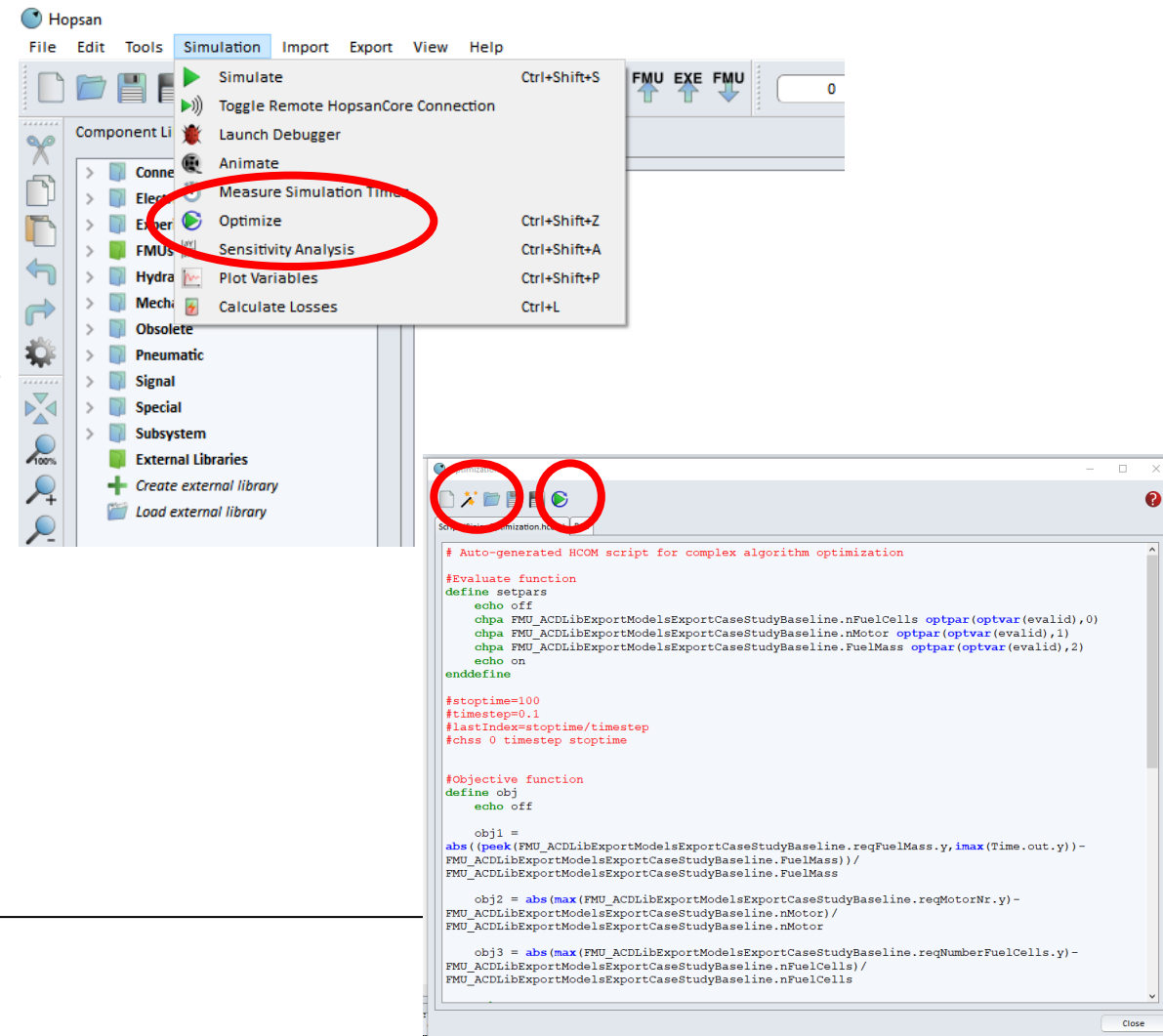
Tutorial: Sizing in Hopsan. Step-by-step

- Open “Baseline.hmf”:
 - File-Open
- Set simulation time (mission length~37000s)
- Specify step length (1-10s suggested)
- Simulate
- Check results



Tutorial: Sizing in Hopsan. Step-by-step

- Optimization
 - Simulate->Optimize
- Load Script File
 - Select “SizingOptimization.hcom” or make your own using the script wizard
- Start optimization



Tutorial: Sizing in Hopsan. Step-by-step

- Optimization takes 10-15min with 10s step length
- Finished when parameter values have converged
- Sizing iteration completed!!
 - Apply found parameter values to FMU
 - Simulate with new parameter values

The image displays three screenshots from the Hopsan software interface. The top screenshot shows a plot of parameter values over time, with a legend indicating 'parameter 1' (blue), 'parameter 2' (red), and 'parameter 3' (green). The middle screenshot shows a plot of parameter values over evaluations, with a legend indicating 'parameter 1' (blue), 'parameter 2' (red), and 'parameter 3' (green). The bottom screenshot shows the 'Optimization' window with a table of parameter values and a progress bar. The table has a red circle around the 'Apply' column. The progress bar shows 55% completion. The bottom screenshot also shows a log window with the following text:

```
Assigning scalar totalObj with 0.0746622
[13:23:58] Info: In FMU_ACQLibExportModelExportCaseStudyBaseline: Initializing FMU 2.0 import
[13:24:00] Info: Simulated 'Baseline' successfully! Initialization time: 1892 ms, Simulation time: 766 ms
Assigning scalar totalObj with 0.0289506
[13:24:01] Info: In FMU_ACQLibExportModelExportCaseStudyBaseline: Initializing FMU 2.0 import
[13:24:03] Info: Simulated 'Baseline' successfully! Initialization time: 1893 ms, Simulation time: 732 ms
Assigning scalar totalObj with 0.0599823
[13:24:04] Info: In FMU_ACQLibExportModelExportCaseStudyBaseline: Initializing FMU 2.0 import
[13:24:06] Info: Simulated 'Baseline' successfully! Initialization time: 1650 ms, Simulation time: 808 ms
Assigning scalar totalObj with 0.0409813
[13:24:08] Info: Optimization finished!
Defined function: setpars
Defined function: obj
Defined function: evalworst
Defined function: evalall
[13:50:12] Info: In FMU_ACQLibExportModelExportCaseStudyBaseline: Initializing FMU 2.0 import
>>
```

Thank you!

Questions?