

Sketcher 2D context

- Create geometry
- Propagate
- Translate a geometry
- Rotate a geometry
- Make a blend
- Make a chamfer

- Tools Display/View
 - Add symmetry
 - Add linear repetition
 - Add linear repetition
 - Add circular repetition
 - New beveled edge
 - New cong
 - Scaling
- Translation
- Rotation
- Adjust
- Fractionate
- Merge lines
- Simplify lines
- Extend lines
- Correct intersections
- Correct superpositions
- Simplify geometry automatically
- Heal geometry automatically
- Measure
- Check geometry

Using Workflow Automation Tools for the Multi-physics Optimization of Traction Motors

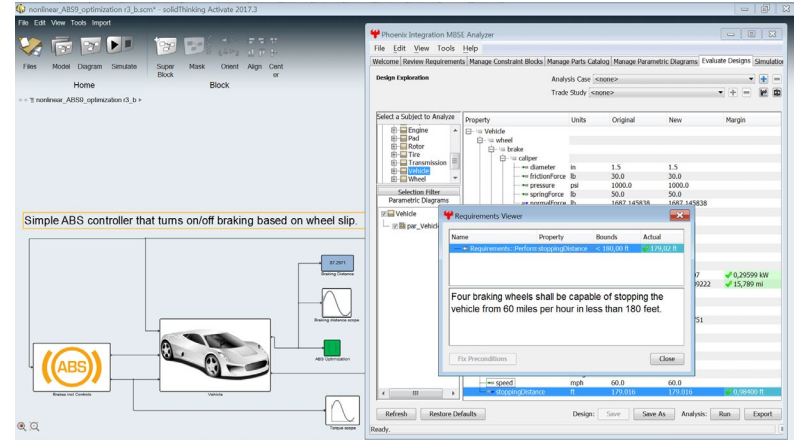
Jean-Baptiste Mouillet – Director – April 2019



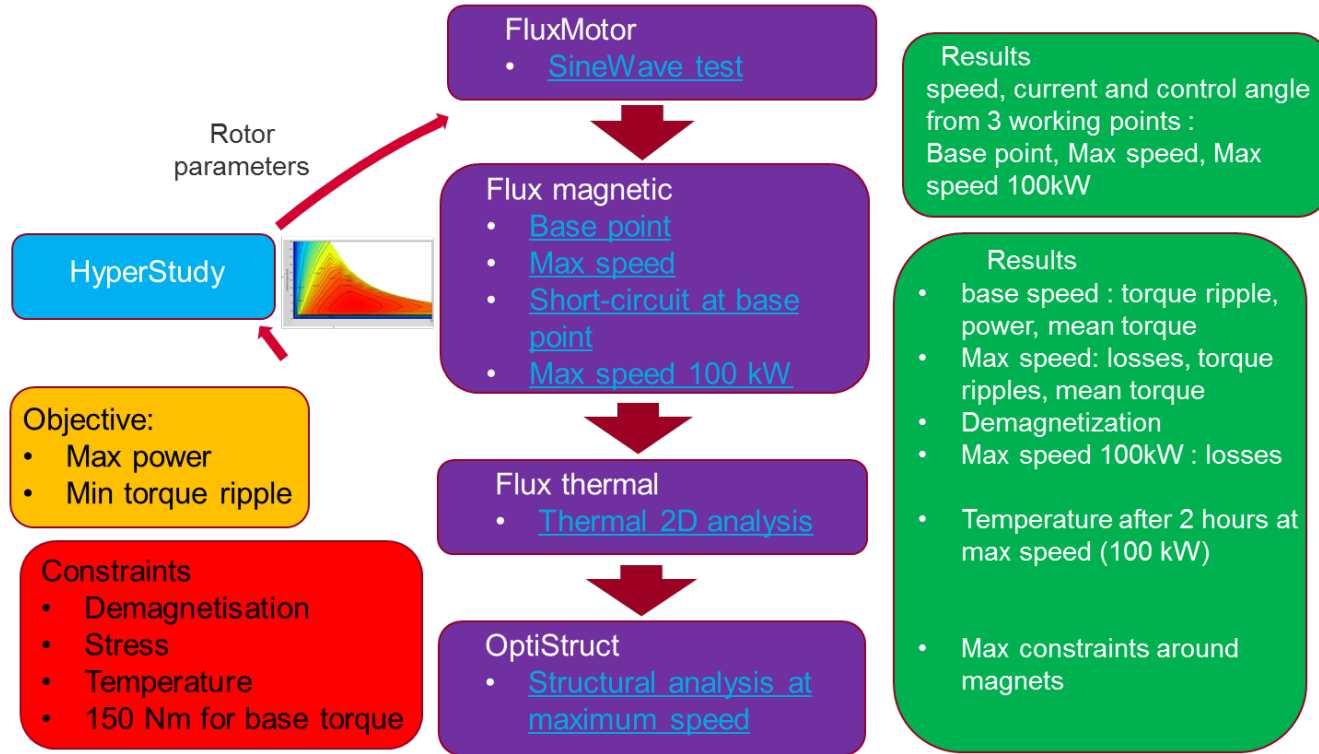
Altair

PLAN

- Introduction
- ModelCenter presentation
- Workflow automation
- Connexion of the workflow with HyperStudy
- Conclusion

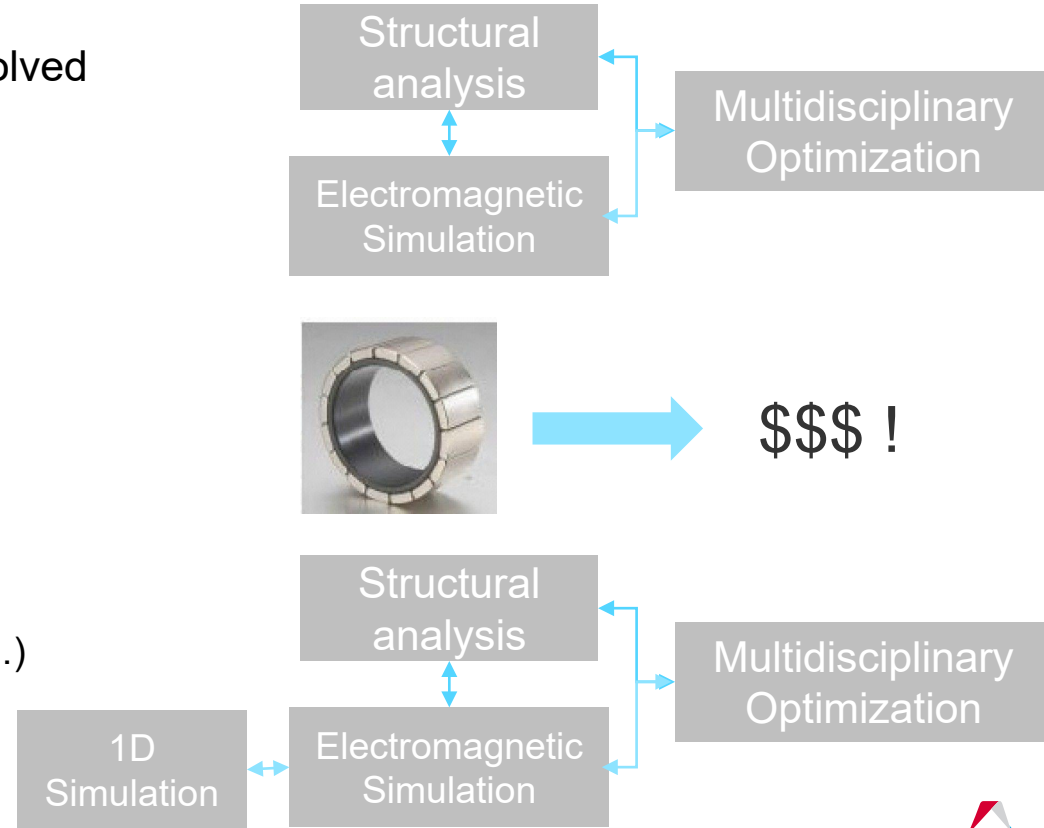


MULTIPHYSIC OPTIMIZATION OF AN E-MOTOR WORKFLOW



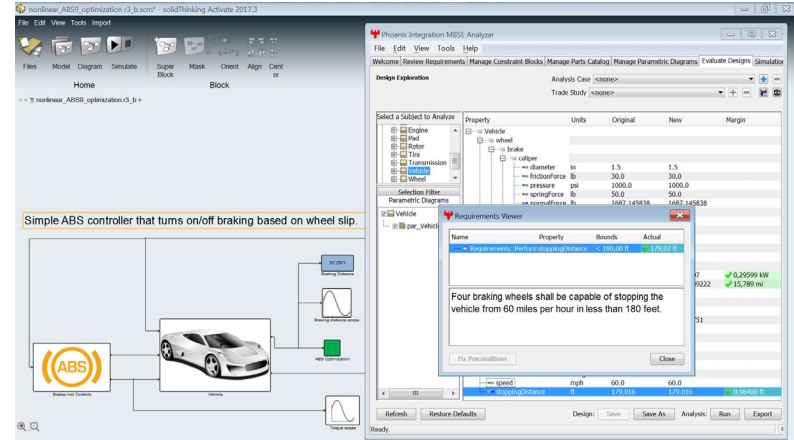
MOTIVATION FOR AUTOMATING THE WORKFLOW

- Multiple Altair Hyperwork softwares involved
 - FluxMotor, Flux, Hypermesh, OptiStruct
 - + HyperStudy
- Connected to other processes
 - Cost estimates
 - Ex : Magnet weight and cost
 - Manufacturing constraints
- Possible modifications of the process
 - Improvement (add inverter, NVH, cooling ...)
 - Adaptation to another project



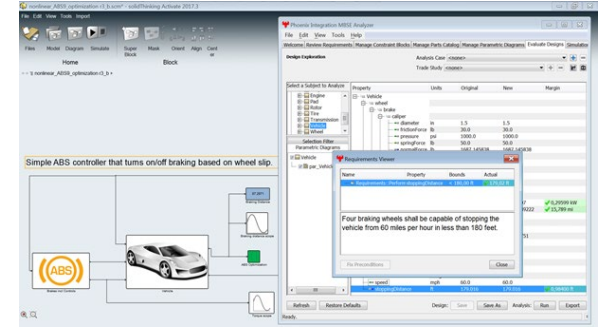
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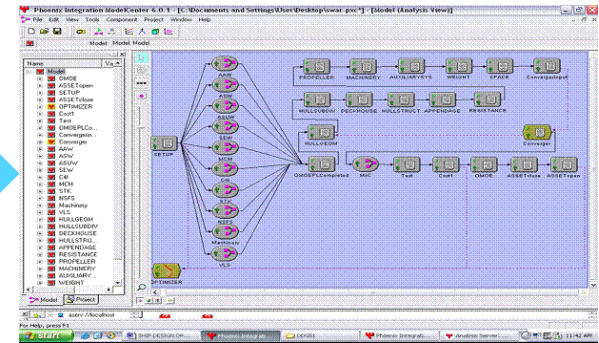
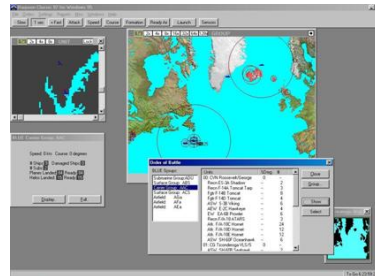


MODEL CENTER

- Developed by Phoenix Integration (member of APA)
 - ➔ Available through APA
- User friendly workflow builder
 - Automatic variable links
 - Tests
 - Loops
 - Activation / deactivation
- Software connexion with wrappers
 - CAD modellers (design variables)
 - 0D , 1D, 3D solvers
 - Other softwares
 - Scripts:
 - Python / Java / VB ...



ABS system simulation (Activate)

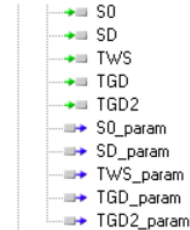


Military vessel effectiveness model (cost / effectiveness / risk)

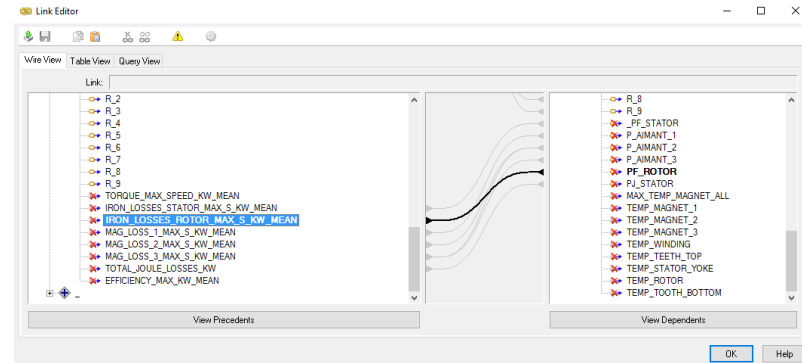


CREATE A WORKFLOW WITH MODELCENTER

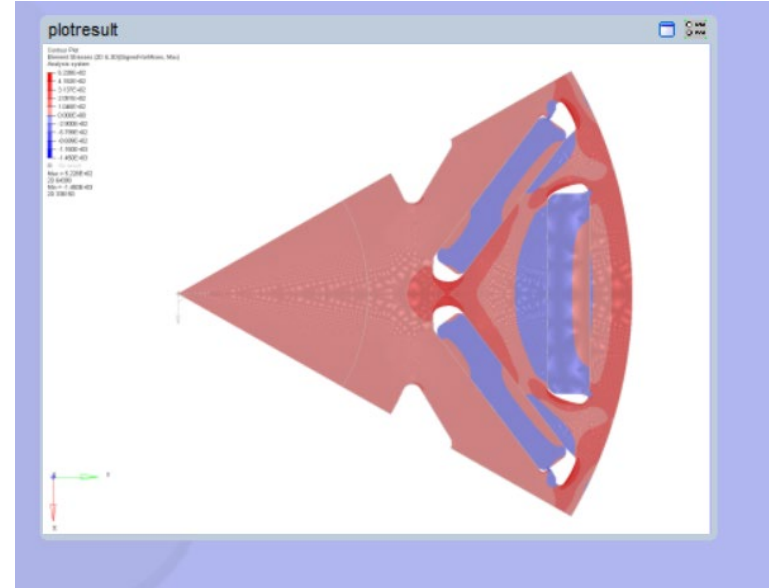
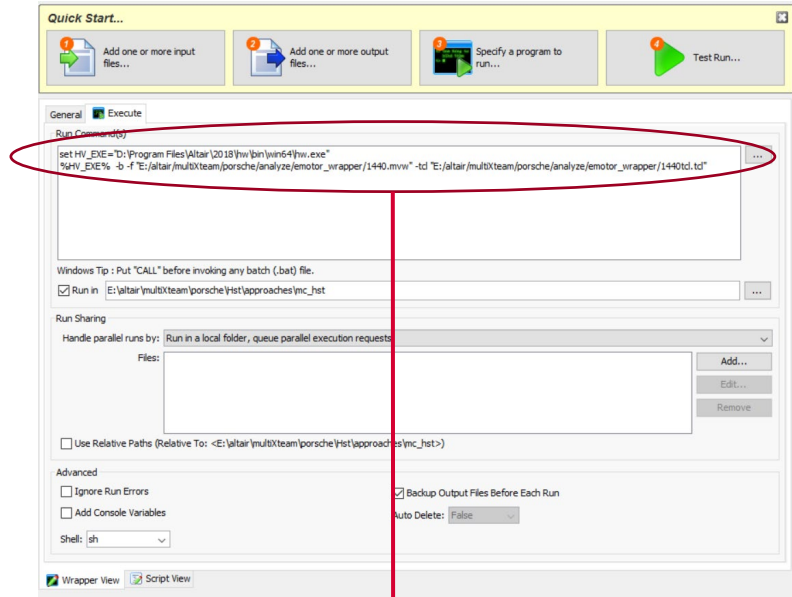
- Define tasks
 - Call a software
- Define for each tasks :
 - Input variables / files
 - Output variables / files



- Connect tasks
 - Links between different tasks variables



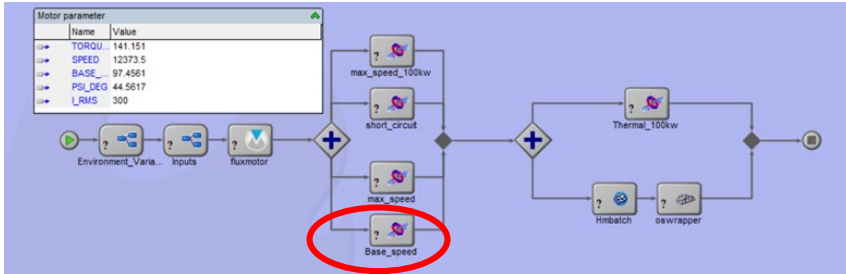
DEFINE TASKS



```
hw.exe -b session.mvw - tcl script.tcl
```



TASK INPUT / OUPUT DEFINITION



Flux scripts based on Python

- Automatic identification of variables
- Same for java, VB ...

Or file parsers for generic ASCII files

QuickWrap 13.0 [E:\altair\multixteam\porsche\mc2\MOTOR_B_2\approaches\nom_1\mc\Base_speed.scriptWrapper]

File View Wrapper Help

Quick Start...

- 1 Add one or more input files...
- 2 Add one or more output files...
- 3 Specify a program to run...
- 4 Test Run...

General Execute Base_speed.py

Template File: E:\altair\multixteam\porsche\mc2\MOTOR_B_2\approaches\nom_1\mc\Base_speed.py.template

File to Generate: E:\altair\multixteam\porsche\mc2\MOTOR_B_2\approaches\nom_1\mc\Base_speed.py

Encoding: UTF-8

File View Table View Data View

Delimiters: Automatic

```

1! Flux2D 18.1
2loadProject('E:\altair\multixteam\porsche\mc2\MOTOR_B_2\approaches\nom_1\mc\corner_point_4_HSTV.F3G.FL
3#! Wed Sep 05 22:03:46 CEST 2018 loadProject('D:/tmp/PorscheFluxMotor/2018_08_24_motor_B_2/2018_07_26_
4
5DeleteAllResults(deletePostprocessingResult='yes')
6deleteMesh()
7ParameterGeom['IM_TM1'].expression='4.5'
8ParameterGeom['IM_WM1'].expression='27.900000000000002'
9ParameterGeom['IM_H1'].expression='3.15'
10ParameterGeom['IM_W1'].expression='0.45'
11ParameterGeom['IM_V1'].expression='18.0'
12ParameterGeom['IM_TM2'].expression='4.275'
13ParameterGeom['IM_WM2'].expression='20.7'
14ParameterGeom['IM_H2'].expression='18.0'
15ParameterGeom['IM_W2'].expression='0.9'
16ParameterGeom['IM_T3'].expression='1.35'
17ParameterGeom['IM_V2'].expression='96.3'
18ParameterGeom['IM_R3'].expression='1.35'
19ParameterGeom['IM_T3'].expression='11.25'
20ParameterGeom['IM_V3'].expression='54.0'

```

Wrapper View Script View



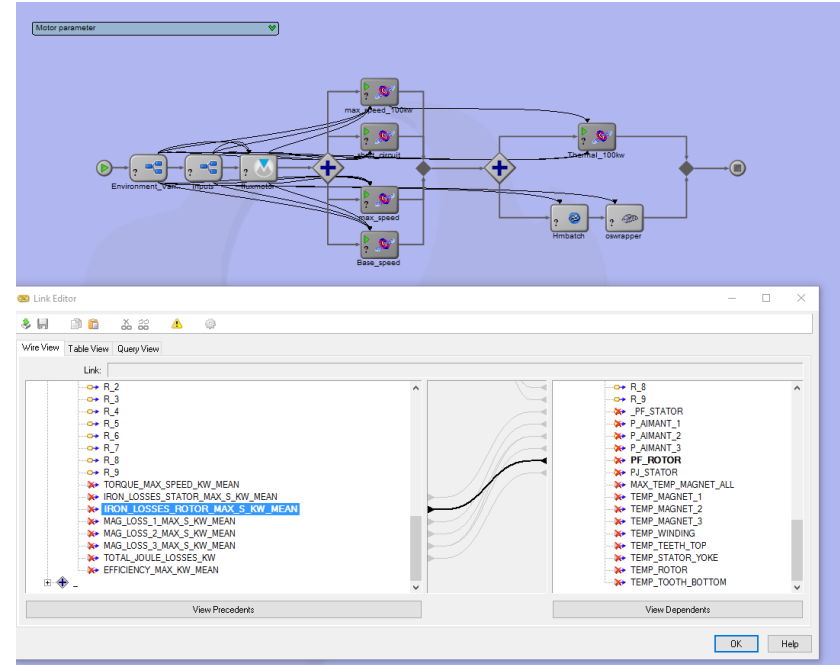
LINKS BETWEEN TASKS

Task organisation

- Parallel
- Serie
-

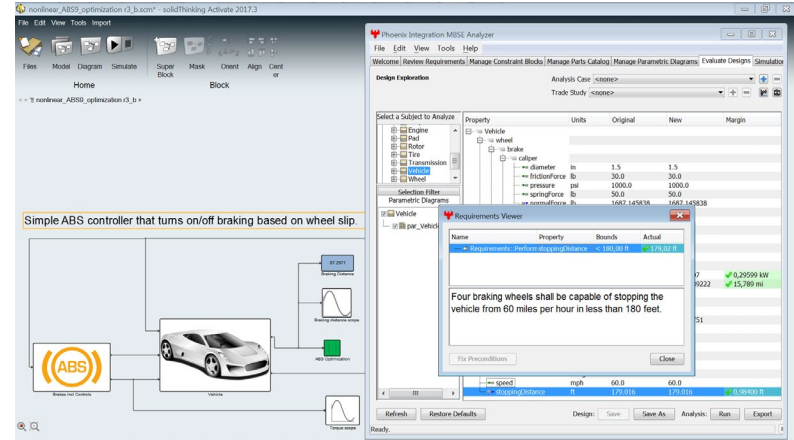
Task dependancies

- Variable transfer definition

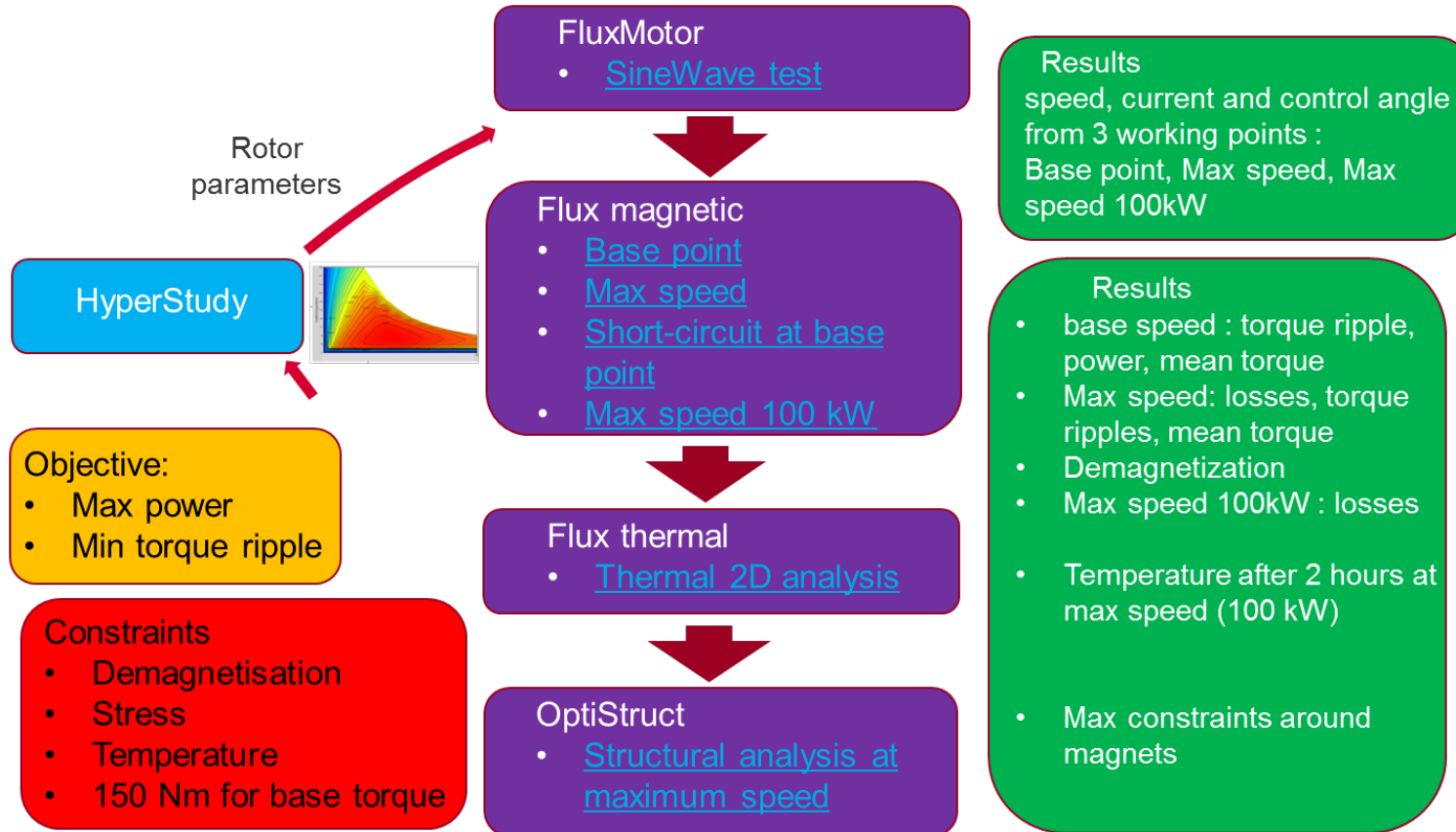


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- ModelCenter presentation
- **Workflow automation**
- Connexion of the workflow with HyperStudy
- Conclusion



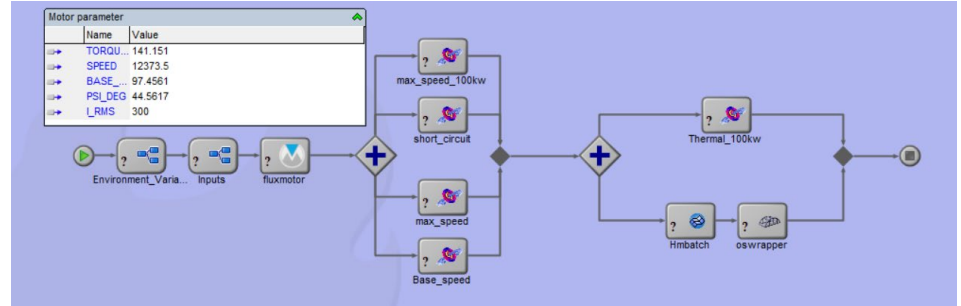
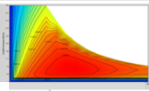
MULTIPHYSIC DESIGN OF AN E-MOTOR



EMOTOR OPTIMIZATION WORKFLOW

Rotor parameters

HyperStudy



Objective:

- Max power
- Min torque ripple

Constraints

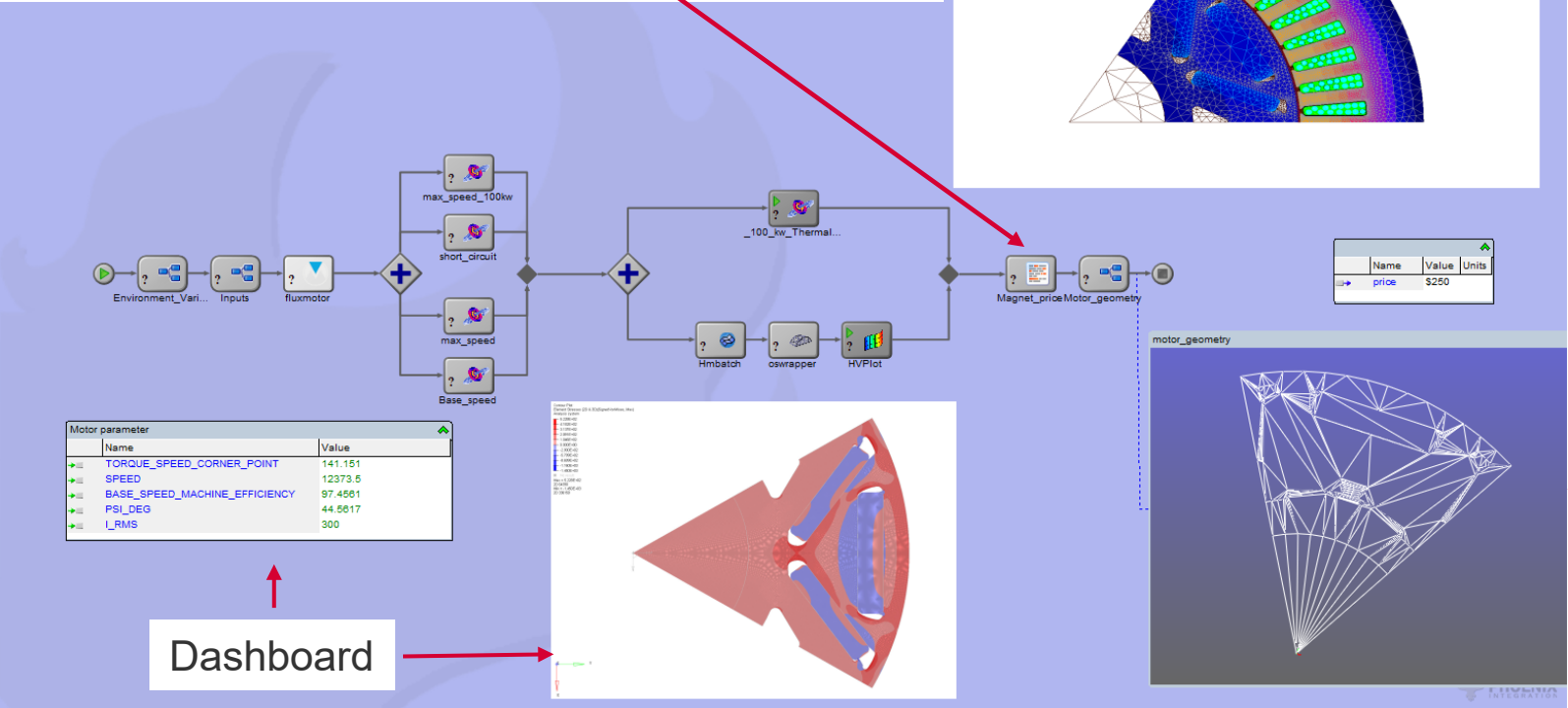
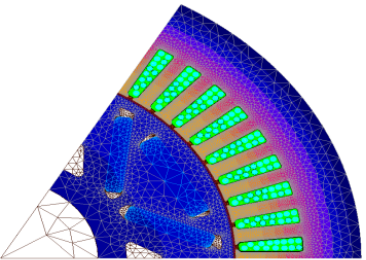
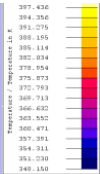
- Demagnetisation
- Stress
- Temperature
- 150 Nm for base torque



IMPROVED WORKFLOW

Cost analysis tool :

Name	Value	Units
price	\$250	



Name	Value	Units
price	\$250	

Name	Value
TORQUE_SPEED_CORNER_POINT	141.151
SPEED	12373.5
BASE_SPEED_MACHINE_EFFICIENCY	97.4501
PSI_DEG	44.5617
I_RMS	300

CAD Tools

Dashboard



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The screenshot displays the Altair ModelCenter interface. The main workspace shows a simulation diagram for an ABS controller, with a car model and various sensors and actuators. A text box above the diagram reads: "Simple ABS controller that turns on/off braking based on wheel slip."

On the right, the "Phoenix Integration MSE Analyzer" window is open, showing a "Requirements Viewer" dialog box. The dialog box contains the following text:

Four braking wheels shall be capable of stopping the vehicle from 60 miles per hour in less than 180 feet.

The "Requirements Viewer" window also displays a table of requirements and their actual values:

Name	Property	Bounds	Actual
Requirements_PerformStoppingDistance		< 180.00 ft	179.01 ft
			0.26599 kW
			15.789 mi

Below the dialog box, a table shows the current simulation results:

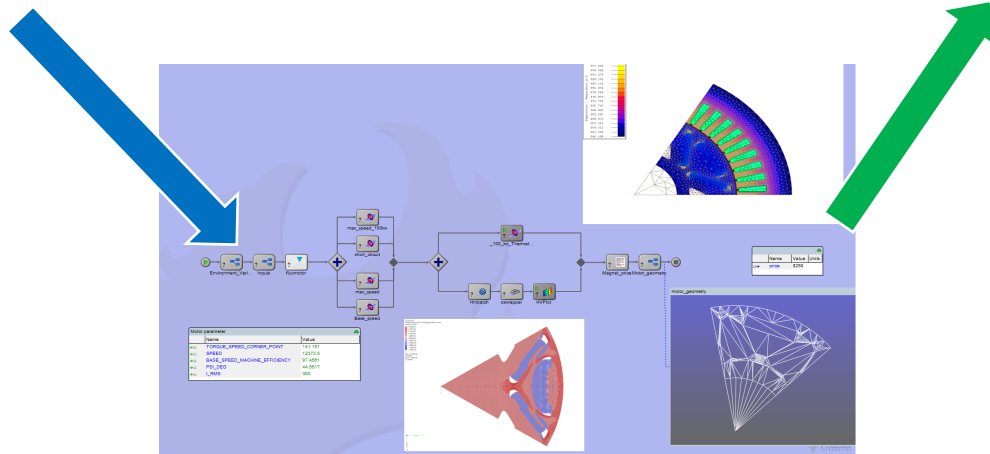
Property	Units	Original	New	Margin
speed	mph	60.0	60.0	
StoppingDistance	ft	179.01ft	179.01ft	0.00460 ft



MODEL CENTER ↔ HYPERSTUDY COUPLING IMPLEMENTATION

- Beta version of the coupling between ModelCenter and Hyperstudy
- Automated design variables and response definition in HSt from ModelCenter process
- Some customization is possible (written in python)
 - Clean useless variables
 -

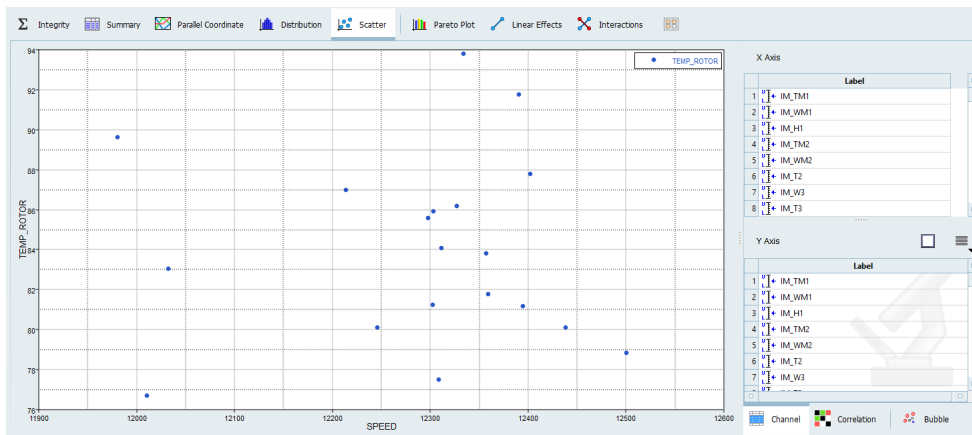
Active	Label	Varname	Model Type	Resource	Solver Input File	Solver Execution Script
1 <input checked="" type="checkbox"/>	Model 1	m_1	Operator	E:\...\Hst\Emotorproject.pxcz	hst_input.hstp	Python (.py)



MODEL CENTER ↔ HYPERSTUDY RESULTS

Active	Write	Execute	Extract	Comment	
1	<input checked="" type="checkbox"/>	Success	Success	Success	
2	<input checked="" type="checkbox"/>	Success	Success	Success	
3	<input checked="" type="checkbox"/>	Success	Success	Success	
4	<input checked="" type="checkbox"/>	Success	Success	Success	
5	<input checked="" type="checkbox"/>	Success	Success	Success	
6	<input checked="" type="checkbox"/>	Success	Success	Success	
7	<input checked="" type="checkbox"/>	Success	Success	Success	
8	<input checked="" type="checkbox"/>	Success	Failure	Failure	
9	<input checked="" type="checkbox"/>	Success	Success	Success	
10	<input checked="" type="checkbox"/>	Success	Success	Success	
11	<input checked="" type="checkbox"/>	Success	Success	Success	
12	<input checked="" type="checkbox"/>	Success	Success	Success	
13	<input checked="" type="checkbox"/>	Success	Success	Success	
14	<input checked="" type="checkbox"/>	Success	Success	Success	
15	<input checked="" type="checkbox"/>	Success	Success	Success	
16	<input checked="" type="checkbox"/>	Success	Success	Success	
17	<input checked="" type="checkbox"/>	Success	Success	Success	
18	<input checked="" type="checkbox"/>	Success	Success	Success	
19	<input checked="" type="checkbox"/>	Success	Success	Success	
20	<input checked="" type="checkbox"/>	Success	Success	Success	

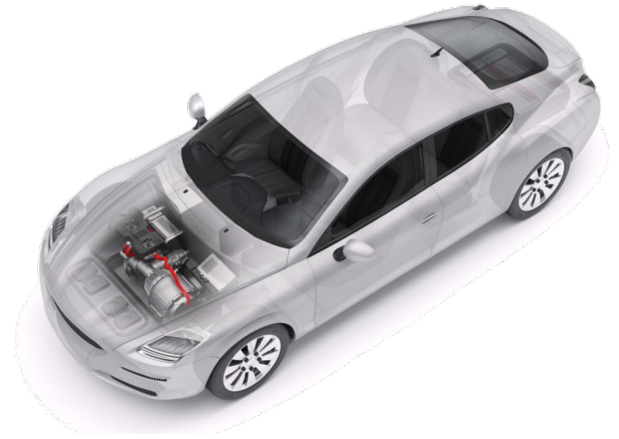
Active	Task	Batch
1	Create Design	<input checked="" type="checkbox"/>
2	Write Input Files	<input checked="" type="checkbox"/>
3	Execute Analysis	<input checked="" type="checkbox"/>
4	Extract Output Responses	<input checked="" type="checkbox"/>
5	Purge	<input type="checkbox"/>
6	Create Reports	<input checked="" type="checkbox"/>



CONCLUSION

Workflow automation of the E-Motor optimization process with ModelCenter allows :

- Improved visualisation and understanding of the process
- Improved connexion with other « non CAE » processes
- Easier maintenance of the process
 - Modifications / improvements
 - Adaptation to different products



THANK YOU!

WWW.ALTAIRHYPERWORKS.COM/FLUX

