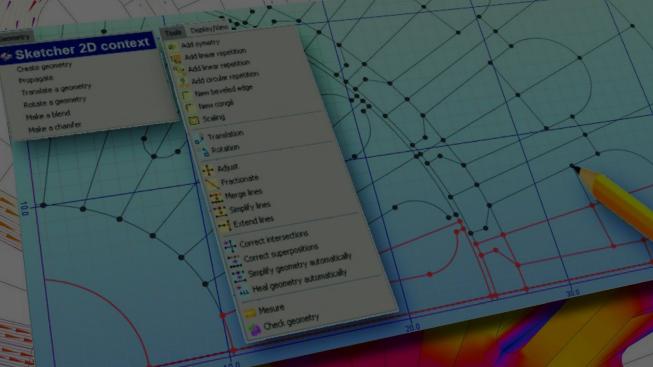
Using Workflow Automation Tools for the Multi-physics Optimization of Traction Motors

Jean-Baptiste Mouillet – Director – April 2019





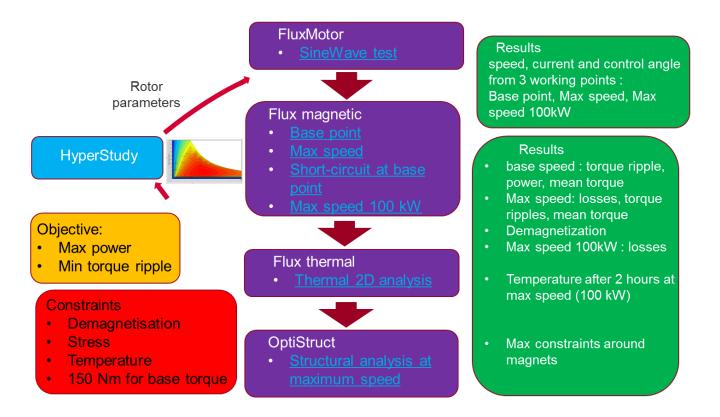
Introduction

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

 Conclusion 	۱
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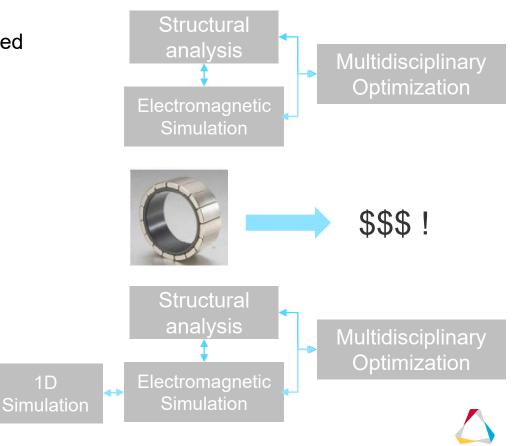
MULTIPHYSIC OPTIMIZATION OF AN E-MOTOR WORKFLOW



MOTIVATION FOR AUTOMATING THE WORKFLOW

1D

- Multiple Altair Hyperwork softwares involved
 - FluxMotor, Flux, Hypermesh, OptiStruct ۰
 - + HyperStudy
- Connected to other processes
 - Cost estimates
 - Ex : Magnet weight and cost
 - Manufacturing constraints ۲
- Possible modifications of the process
 - Improvement (add inverter, NVH, cooling ...)
 - Adaptation to another project



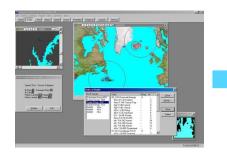
- Introduction
- ModelCenter presentation
- Workflow automation
- Connexion of the workflow with HyperStudy
- Conclusion

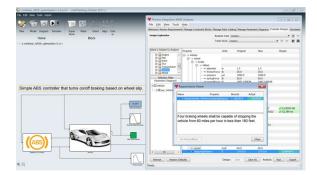
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		Image: Second Control of	15,789 mi



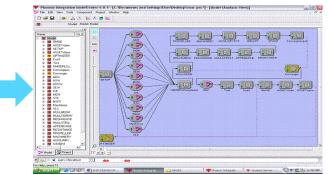
MODEL CENTER

- Developped 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)



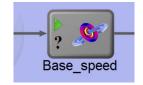
Military vessel effectiveness model (cost / effectiveness / risk)

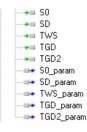


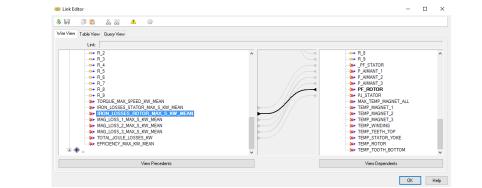
CREATE A WORKFLOW WITH MODELCENTER

- Define tasks
 - Call a software

- Define for each tasks :
 - Input variables / files
 - Output variables / files







- Connect tasks
 - · Links between different tasks variables

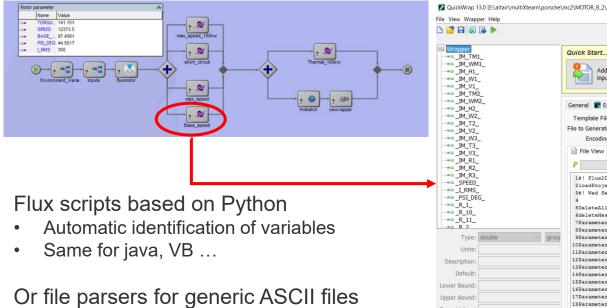
DEFINE TASKS

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General 💽 Execute		
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Windows Tip : Put "CALL" before invoking any batch (.bat) file.		
Run in E:\altair\multiXteam\porsche\Hst\approaches\mc_hst		
Run Sharing Handle parallel runs by: Run in a local folder, queue parallel execution requ	ieste	
Fles:		Add Edt Remove
Use Relative Paths (Relative To: <e:\altair\multixteam\porsche\hst\appro< td=""><td>oaches\mc_hst>)</td><td></td></e:\altair\multixteam\porsche\hst\appro<>	oaches\mc_hst>)	
Advanced		
Ignore Run Errors Add Console Variables	Backup Output Files Before Each Run Auto Delete: False	
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2 Wrapper View Script View		



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

TASK INPUT / OUPUT DEFINITION



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ГМ2_ WM2				
12_ 12_	General 🔳 Execute 😹 Base_speed.py			
W2				
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V2_	File to Generate: E:\altair\multiXteam\porsche\mc2\MOTOR_B_2\approaches\nom_1\mc\Base_	speed.py		
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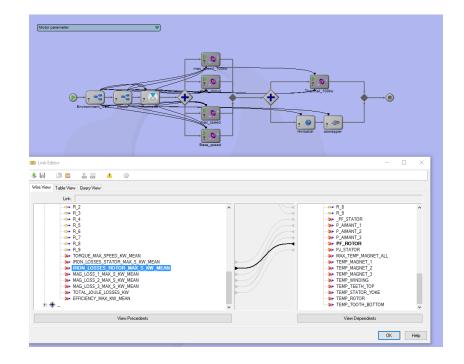
LINKS BETWEEN TASKS

Task organisation

- Parallel
- Serie
-

Task dependancies

Variable transfer definition

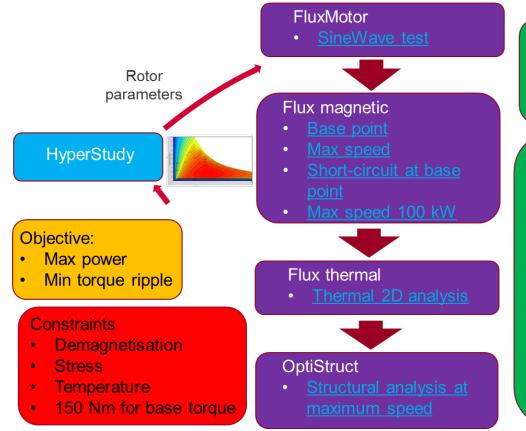


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- Conclusion

nonlinear_ABS9_optimization r3_b.s	cm* - solidThinking Activate 2017.3			- 6 :
File Edit View Tools Import	Super Mask Orient Align Cent	Phoenix Integration MBSE Analyzer File Edit View Tools Help Welcome Review Requirements Manage Constraint Blocks M Dealer Exploration		
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Simple ABS controller th	hat turns on/off braking based on wheel slip.	Sinicia Solucio Markova Prosech ■ ■ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □	Force Ib 30.0 re pai 1000.0 force Ib 50.0 Force Ib 1687.145838.	
			I be capable of stopping the rhour in less than 180 feet. mph 60.0 th 170/010 Design: Save Save A	2 51 60.0 179.010 € 0,96400 R



MULTIPHYSIC DESIGN OF AN E-MOTOR



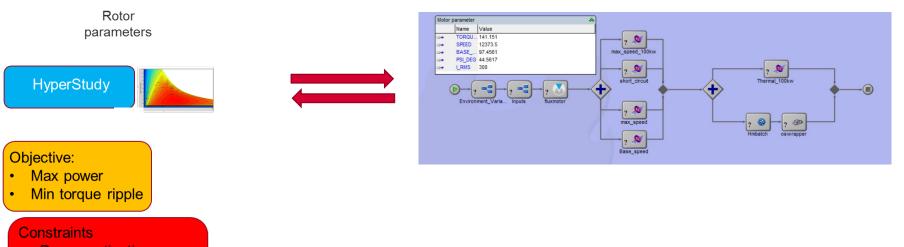
Results

speed, current and control angle from 3 working points : Base point, Max speed, Max speed 100kW

Results

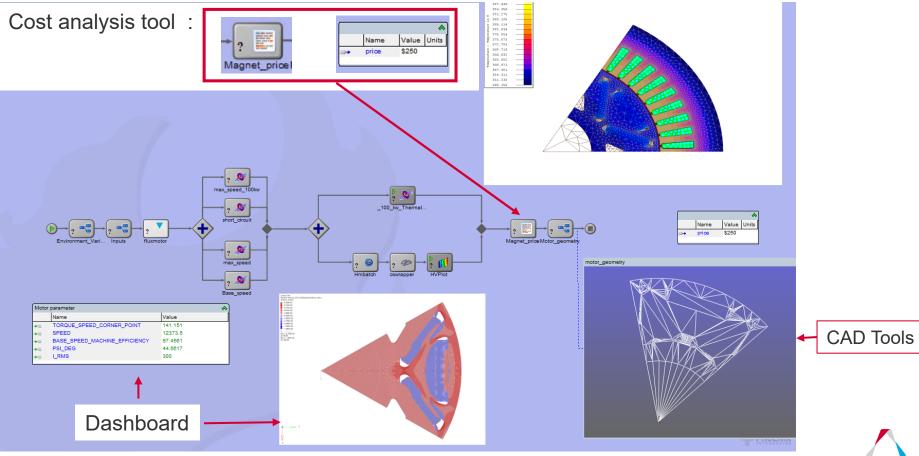
- base speed : torque ripple, power, mean torque
- Max speed: losses, torque ripples, mean torque
- Demagnetization
- Max speed 100kW : losses
- Temperature after 2 hours at max speed (100 kW)
- Max constraints around magnets

EMOTOR OPTIMIZATION WORKFLOW



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

IMPROVED WORKFLOW



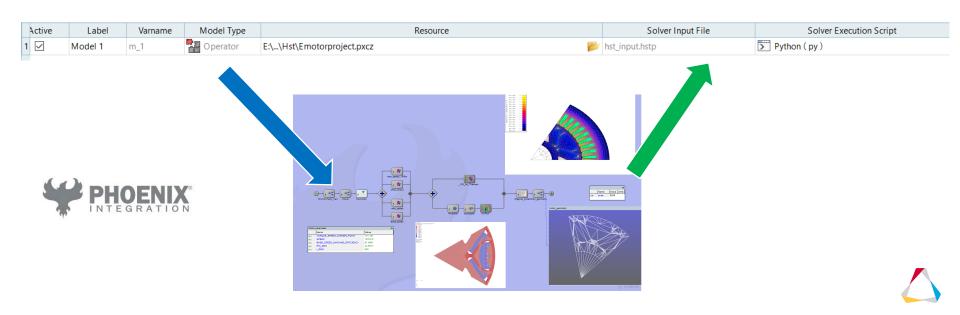
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Simple ABS controller that turns on/off braking based on wheel slip.	Constraints Constrai	Margin ₩ 0,20099 kW √ 15,789 mi
	Four braining wheels shall be capable of stopping the vehicle from 60 miles per hour in less than 180 feet.	- 0,98400 R

MODEL CENTER I 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

. . . .



MODEL CENTER \Leftrightarrow HYPERSTUDY RESULTS

	Active	Write	Execute	Extract	Comment
1	\checkmark	Success	Success	Success	
2	\checkmark	Success	Success	Success	
3	\checkmark	Success	Success	Success	
4	\checkmark	Success	Success	Success	
5		Success	Success	Success	
6	\checkmark	Success	Success	Success	
7	\checkmark	Success	Success	Success	
8	\checkmark	Success	Failure	Failure	
9	\checkmark	Success	Success	Success	
10		Success	Success	Success	
11		Success	Success	Success	
12	\checkmark	Success	Success	Success	
13	\checkmark	Success	Success	Success	
14	\checkmark	Success	Success	Success	
15	\checkmark	Success	Success	Success	
16	\checkmark	Success	Success	Success	
17		Success	Success	Success	
18	\checkmark	Success	Success	Success	
19	\checkmark	Success	Success	Success	
20		Success	Success	Success	

	Active	Task	Batch
1		Create Design	
2		Write Input Files	
3		Execute Analysis	
4		Extract Output Responses	
5		Purge	
6		Create Reports	

4			•		•	TEMP_ROTOR	X Axis	
							Label	
2-				•			1 1 + IM_TM1	
							2 01+ IM_WM1	
,	•						3 []+ IM_H1	
		 					4	
		 					5 UT+ IM_WM2	
							6 LT+ IM_T2 7 L+ IM_W3	
							8 "[+ IM_T3	
			•				• T. IM-12	
							Y Axis	Ξ
			•	•				
	•	 					Label	
		 		•			2 "[+ IM_WM1	
		 	•	•			3 []+ IM_H1	
							4 1 IM_TM2	
							5 []+ IM_WM2	
					•		6 []+ IM_T2	
							7 []+ IM_W3	
							. UT	

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





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