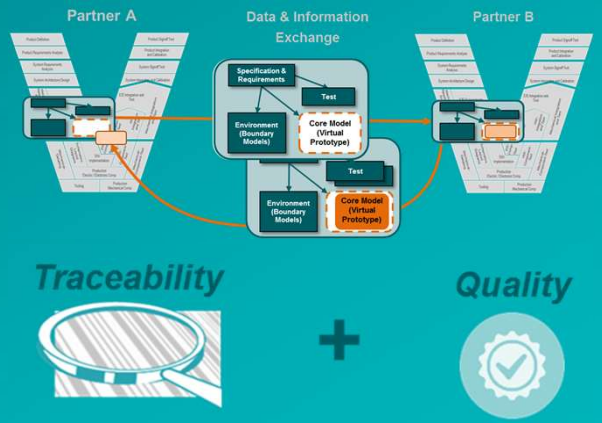
Workshop “Traceability of Simulation Tasks”

DC – Motor Mild Hybrid

Hans-Martin Heinkel (Robert Bosch GmbH)
Kim Steinkirchner(PROSTEP AG)

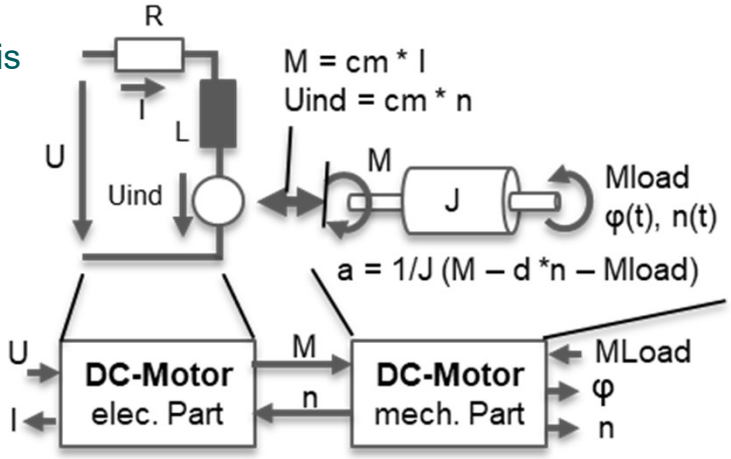
Sep 2020



“Traceability and proof of quality of Simulation Tasks”
Example: DC-motor

Engineering/Simulation Task

- Pre-selection of a DC-motor for a mild hybrid application (drive Unit)
- DC-Motor has to accelerate against a Load MLoad = 1 Nm in 1s from 0 to 1000 rad/s. Voltage U = 48 V
- A simple simulation model which contains the basic physical effect is used
- Neglected effects
  - Commutation effects (losses are considered in R)
  - Eddy currents
  - Friction (should be added to Mload)



In / Outputs	Name	Unit	Format	Comment
Elecrical Part DC Motor Model				
Supply Voltage	U	V	Float32	
Current	I	A	Float32	
Motor Torque	M	Nm	Float32	
Mechanical Part DC Motor Model				
Acceleration	a	Rad/s^2	Float32	internal
Rotation speed	n	Rad/s	Float32	
angle	φ	Rad	Float32	
Load Torque	Mload	Nm	Float32	

Parameters	Name	Unit	Format	default Value
Elecrical Part DC Motor Model				
Resistance	R	Ohm	Float32	1
Inductance	L	mH	Float32	1
motor constant	cm	Nm/A	Float32	0,2
Mechanical Part DC Motor Model				
Inertia	J	Kgm^2	Float32	0,002
Damping	d	Nm/rad	Float32	0.001
Friction	Mfr	Nm	Float32	0,01

“Traceability and proof of quality of Simulation Tasks”
Example: Engineering Task DC-motor

Project Name
Mild Hybrid Variant AAA-55
Project Number
P987658
Version
2
Prj Leader
J. Miller
Description of project
Developing of variant of a mild hybrid based on platform DDC
SubTask
Pre-selection of a DC-motor for a mild hybrid application
Verify if DC-Motor part number XY12346 can be used
Requirements
DC-Motor part number XY12346 has to accelerate against a Load MLoad = 1 Nm in 1s from 0 to 1000 rad/s
Simplified requirements, deriveded from mild hybrid req. Simplification: Friction is added to Mload
Boundary Conditions
U = 48 V

“Traceability and proof of quality of Simulation Tasks”
Example: Engineering Task DC-motor

Part	DC-Motor
Part Number	XY12346
Organistion	KKKK
Date	05 Dec 2015

* additional measurement conditions see appendix cdefg

Parameter	**Value**	**Unit**	**Tolerances**	**measurement conditions***
R (Resistance)	0,2	Ohm	-5 up +10%	20 degreeCel, after 20 min operation
R (Resistance)	0,22	Ohm	-5 up +10%	70 degreeCel, after 20 min operation
R (Resistance)	0,24	Ohm	-10 up +20%	20 degreeCel, new, 0 min operation
L (Inductance)	1,0	mH	-5 up +10%	20 degree Celsius
cm (motor constant)	0,03	Nm/A	-5 up +10%	20 degree Celsius
J (Inertia)	0,002	Kgm2	-2 up +2%	20 degree Celsius
d (Damping)	0,001	Nm/rad	-10 up +20%	20 degree Celsius
Mfr-Br (Friction Brushes)	0,007	Nm	-10 up +20%	20 degreeCel, after 20 min operation
Mfr-Br (Friction Brushes)	0,005	Nm	-10 up +20%	20 degreeCel, new, 0 min operation
Mfr-Be (Friction Bearing)	0,003	Nm	-10 up +20%	20 degree Celsius
Length motor	0,1	m	-2 up +2%	20 degree Celsius
Diameter motor	4	cm	-2 up +2%	20 degree Celsius
Weight motor	0,3	kg	-2 up +2%	20 degree Celsius
Length rotor	7	cm	-2 up +2%	20 degree Celsius
Diameter rotor	2,5	cm	-2 up +2%	20 degree Celsius
Weight rotor	150	g	-2 up +2%	20 degree Celsius
Temperature Range	-30 up +90	DegreeCel		
max continuous current	100	A		20 degree Celsius
max peak current	250	A		20 degreeCel, duration 5 s, repeat rate 5 min
xxx	xxx	aaa		
yyy	yyy	bbb		
zzz	zzz	ccc		

Artificial values, not corresponding to a real DC-motor

“Traceability and proof of quality of Simulation Tasks”
Example: Data Sheet DC motor

Parameter	Value
R (Resistance)	0,2 Ohm
L (Inductance)	1 mH
cm (motor constant)	0,03 Nm/A
J (Inertia)	0,002 Kgm^2
d (Damping)	0,001 Nm/rad
Mfr-Br (Friction Brushes)	0,007 Nm
Mfr-Be (Friction Bearing)	0,003 Nm

Parameter	Value
Length motor	0,1 m
Diameter motor	4 cm
Weight motor	0,3 kg
Length rotor	7 cm
Diameter rotor	2,5 cm
Weight rotor	150 g
Temperature Range	-30 - +90 DegreeCel
xxx	xxx
yyy	yyy
zzz	zzz

Parameter values are only examples