

# KULI Interfaces

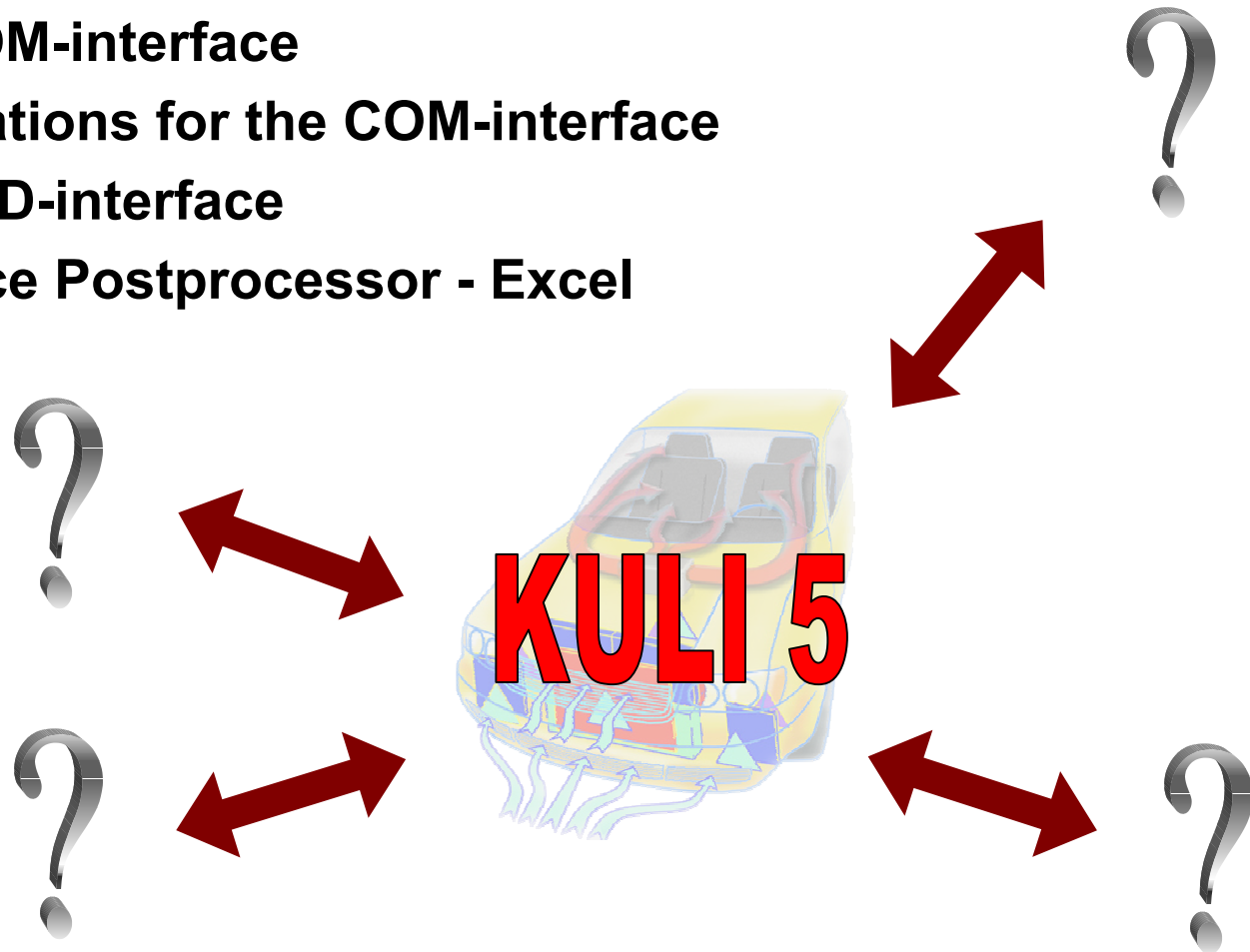


**ENGINEERING CENTER STEYR**  
**GmbH & Co KG**

**4<sup>th</sup> KULI User Meeting**  
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# Contents

- The COM-interface
- Applications for the COM-interface
- The CFD-interface
- Interface Postprocessor - Excel



# The COM Interface

## The Basis



Also known as ActiveX<sup>®</sup>, OLE

Extensions: DCOM, COM+, MTS, Windows<sup>®</sup> DNA

- Programming language independent
- Supported by many programs
- The operating system provides Runtime Environment

# Interface Functions - Events

IKuliAnalysisCtr2

Bases and Interfaces  
 AddToBatchList([ in ] BSTR fileName)  
 BatchMode([ in ] BOOL newVal)  
 BatchMode([ out , retval ] BOOL \* pVal)  
 Cancel(void)  
 CleanUp([ out , retval ] BOOL \* succ)  
 EnableEvents([ in ] BOOL newVal)  
 EnableEvents([ out , retval ] BOOL \* pVal)  
 GetCOMValueByID([ in ] BSTR comName, [ out , retval ] double \* value)  
 ...  
 SetCOMValueByID([ in ] BSTR comName, [ in ] double value, [ out , retval ] BOOL \* succ)  
 SetCOMValueByIDAsStr([ in ] BSTR comName, [ in ] BSTR sval, [ out , retval ] BOOL \* succ)  
 ShowResult(void)  
 SimulateCFD([ in ] BSTR cfdFile, [ in ] BSTR zResFile, [ out , retval ] BOOL \* succ)  
 SimulateOperatingPoint([ in ] LONG simNumber, [ out , retval ] BOOL \* succ)  
 StartAnalysis([ out , retval ] BOOL \* succ)  
 WriteResults([ in ] BOOL newVal)

## KuliAnalysis2.dll

### • Methods and properties

### • Events

\_IKuliAnalysisCtr2Events

OnCheckForCancel(void)  
 OnEndOfTimeStep([ in ] long l\_timeStepNo, [ in ] double d\_time)  
 OnError([ in ] BSTR s\_fkt, [ in ] BSTR s\_msg, [ in ] BSTR s\_add, [ in ] long l\_type)  
 OnMessage([ in ] BSTR s\_fkt, [ in ] BSTR s\_msg, [ in ] BSTR s\_add, [ in ] long l\_type)  
 OnNextIteration([ in ] long l\_itNo)  
 OnNextTime([ in ] long l\_timeStepNo, [ in ] double d\_time)

## Improvements for COM-Interface

- **New method ObjectExists**
  - Possibility to check if a COM object of the given name exists
- **New property WriteResults**
  - Possibility to quickly disable output to \*.aus-file
  - time savings of more than 10%
- **New parameter for method SimulateOperatingPoint(n)**
  - Possibility to calculate only desired operating point
  - Possibility to calculate all active operating points
- **Events are „fired“ more often**
  - More possibilities for control of transient calculations
- **Actuators for fluid circuits**
  - More efficient interface to e.g. Flowmaster

# Application of COM-interface: MS Excel

Microsoft Excel - KULI-Excel\_steadystate.xls

Datei Bearbeiten Ansicht Einfügen Format Extras Daten Fenster ? Acrobat

G33

**KULI - Excel Interface**

Run KULI

Name of KULI \*.scs-file (include full directory path!)

C:\Support\Test\Kuehlsysteme\ExCAR\_com\_51.scs

Write \*.aus-File: Yes

Number of input parameters:			Number of output parameters:		
number	parameter name (*)	value (**)	number	parameter name (*)	value (**)
1	EngineRPM	2500	1	EntryTempM	96,30146431
2	AmbientTemp	20	2	QuantHeatA	32,63809345
3			3		
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					

...

```

KULI.SimulateOperatingPoint (1)

'read output parameters
For i = 1 To outputno
    paramName = Cells(9 + i, 7)
    currentValue = KULI.GetCOMValueByID(paramName)
    Cells(9 + i, 8) = currentValue
Next i

'perform memory cleanup
KULI.CleanUp

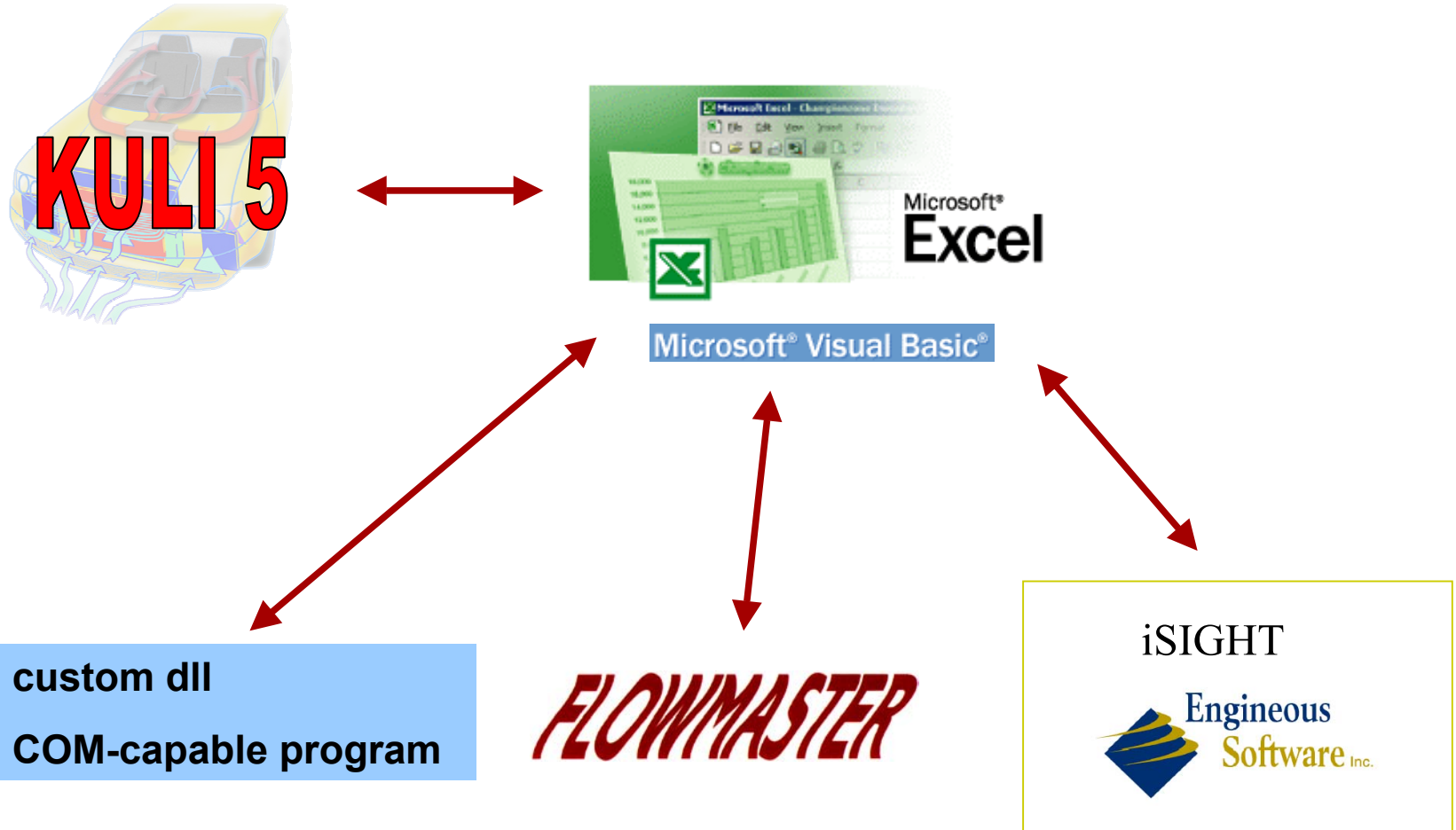
Set KULI = Nothing
End Sub

```

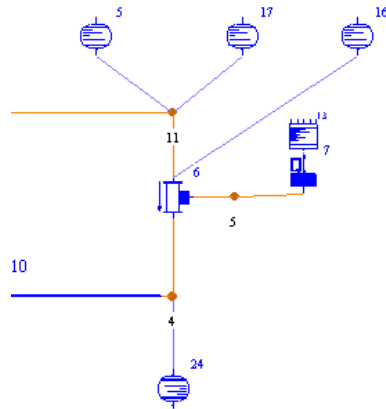
KULI-connection Messages Explanations

Bereit

## Application of COM-interface: MS Excel



# Application of COM-interface: Flowmaster



```
Set gauge_temp = Analysis.GetGauge(5)
Set gauge_press = Analysis.GetGauge(17)
Set gauge_press_2 = Analysis.GetGauge(24)
Set gauge_massFlow = Analysis.GetGauge(16)
If (gauge_temp Is Nothing) Or (gauge_press Is Nothing) Or (gauge_massFlow :
```

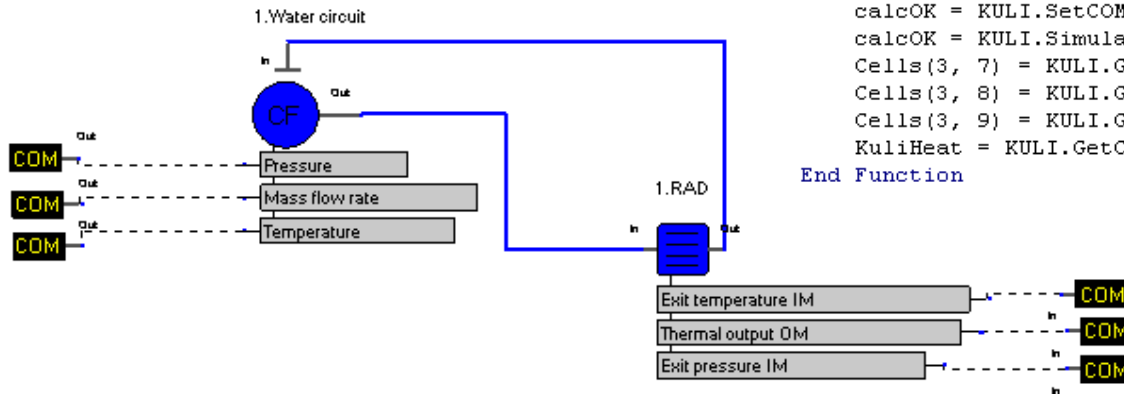
## FLOWMASTER



```
Public Function KuliHeat(temp, press, massFlow As Double)
```

```
'start KULI-analysis to enable iteration
calcOK = KULI.SetCOMValueByID("SetMassFlowKuli", massFlow)
calcOK = KULI.SetCOMValueByID("SetPressureKuli", press)
calcOK = KULI.SetCOMValueByID("SetTempKuli", temp)
calcOK = KULI.SimulateOperatingPoint(1)
Cells(3, 7) = KULI.GetCOMValueByID("GetPressureKuli")
Cells(3, 8) = KULI.GetCOMValueByID("GetTempKuli")
Cells(3, 9) = KULI.GetCOMValueByID("GetHeatFlowKuli")
KuliHeat = KULI.GetCOMValueByID("GetHeatFlowKuli")
```

```
End Function
```



## KULI 5.1

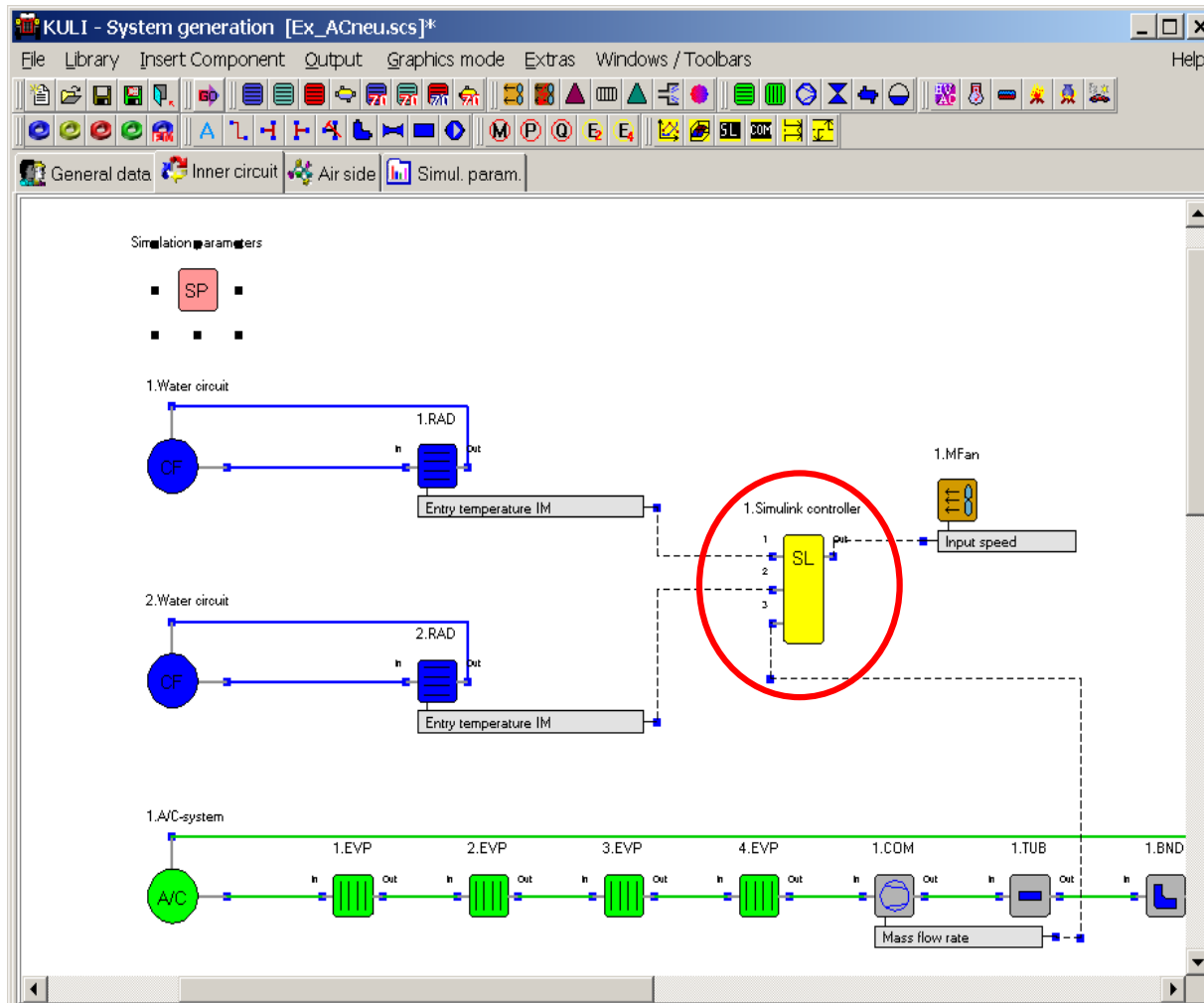


## Application of COM-interface: Matlab/Simulink (1)

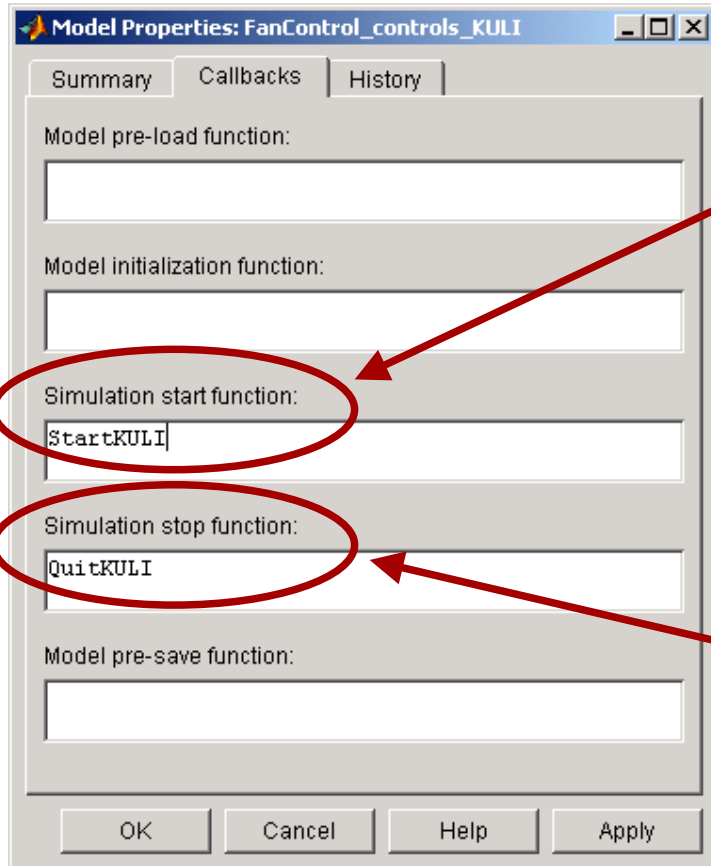


- **KULI controls SIMULINK**
  - direct interface - exists since KULI 5.0
  - some limitations concerning number of parameters and time control
- **SIMULINK controls KULI**
  - can be implemented with COM commands
  - more flexible time control (e.g. variable time steps in SIMULINK, fixed time steps in KULI)
  - any number of interface parameters using COM objects

# KULI controls Simulink



## Simulink controls KULI (1)



- **Script to start KULI**

- open connection to KULI dll
- open KULI model
- initialize KULI model

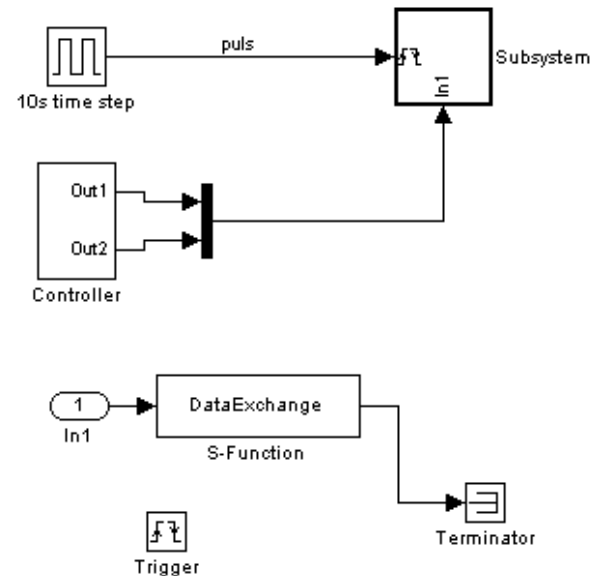
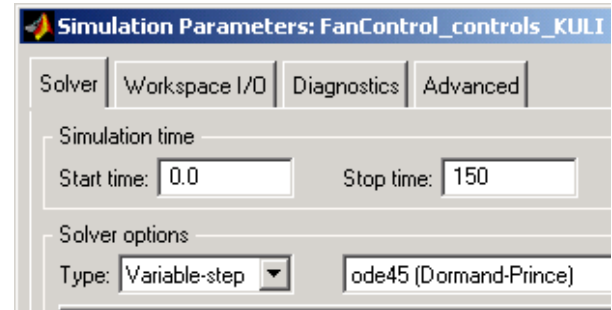
### SIMULINK model properties

- **Script to quit KULI**

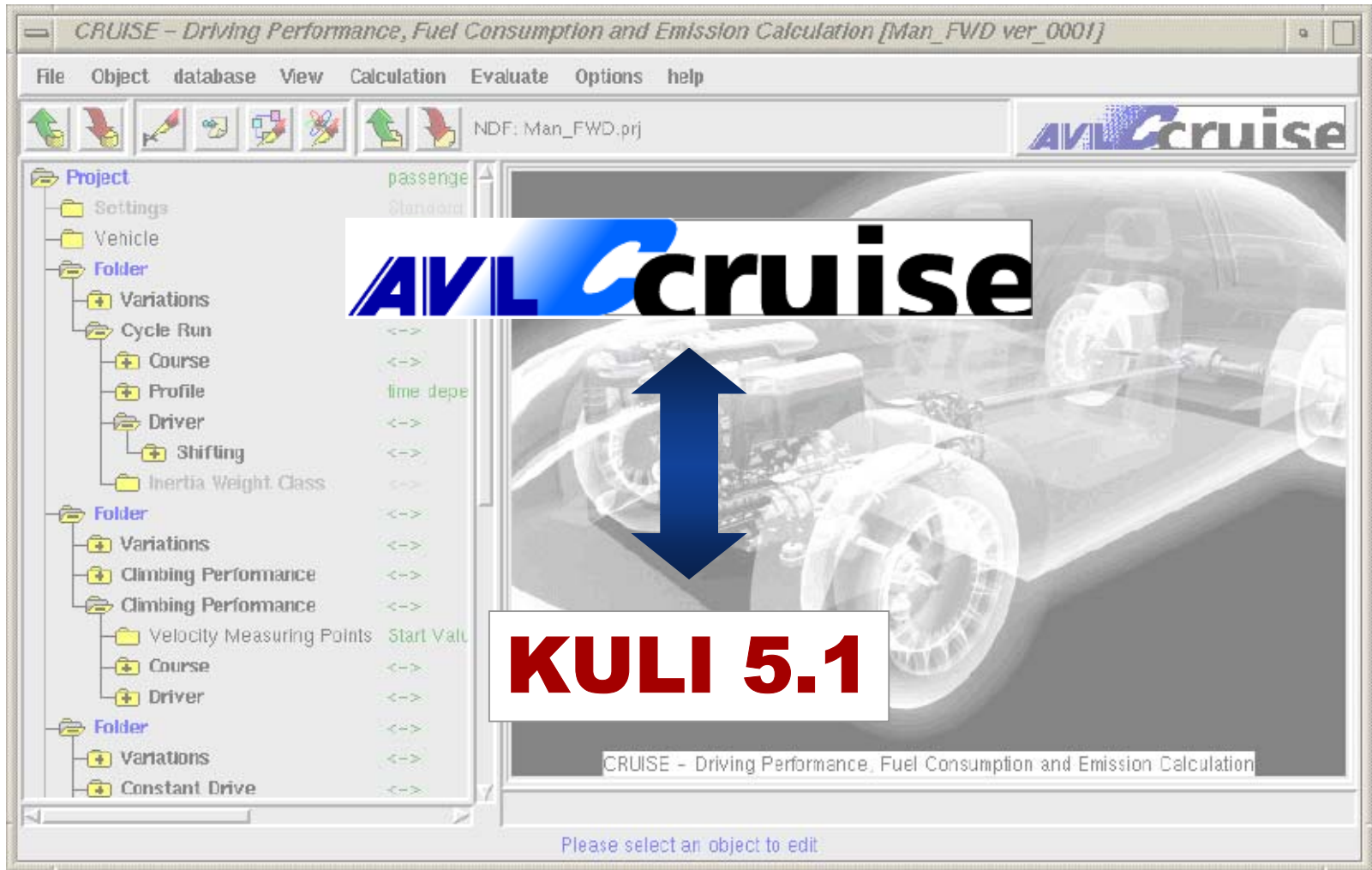
- close KULI model
- quit KULI connection

## Simulink controls KULI (2)

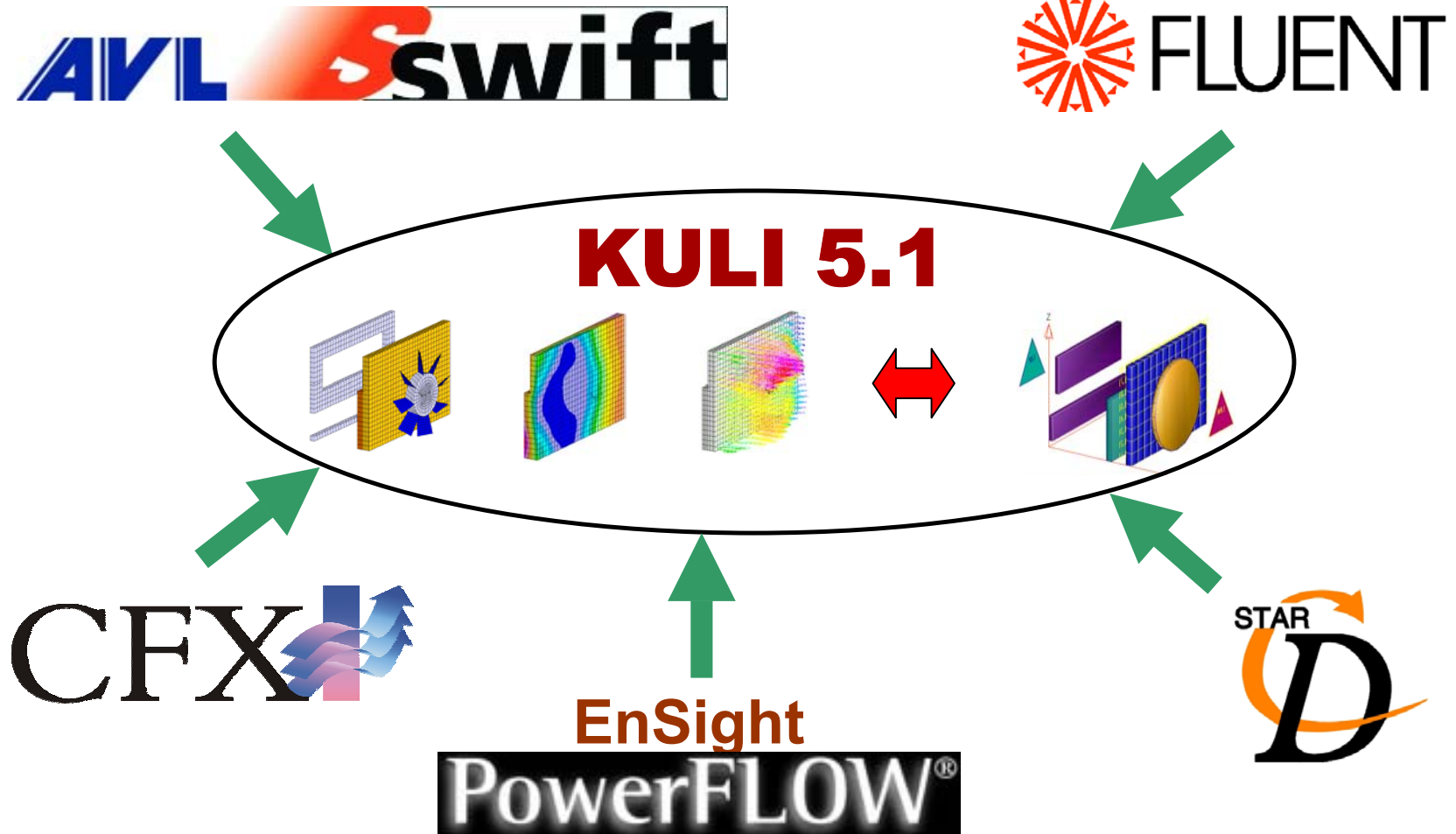
- Time control
  - SIMULINK can have its own time (e.g. variable time step)
  - using a pulse generator KULI is called only at certain times
  - time steps of pulse generator and within KULI must be the same
- Data exchange
  - Data exchange is executed within S-function
  - input and output parameters are set using standard COM-commands
  - calculation of KULI time step is also handled within S-function



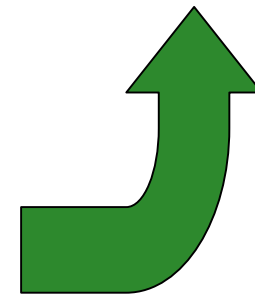
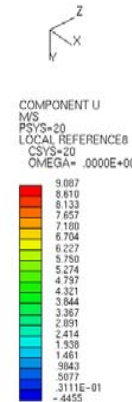
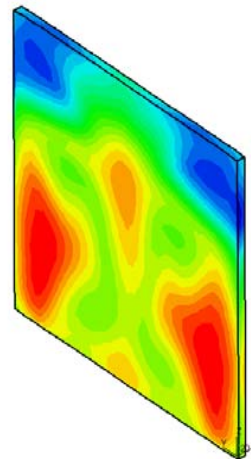
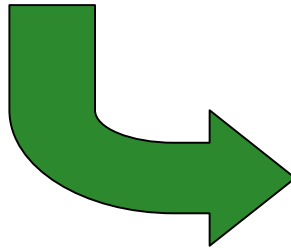
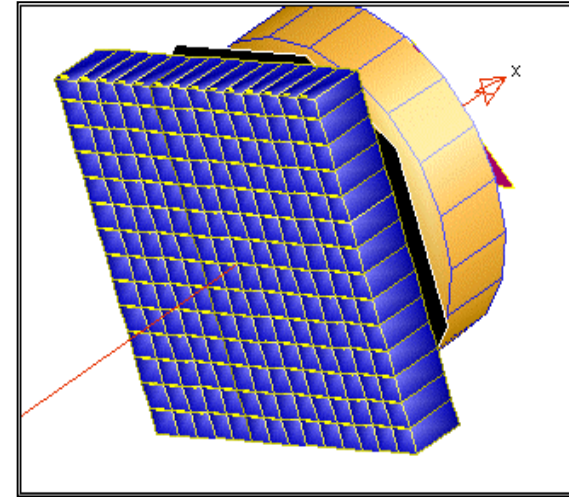
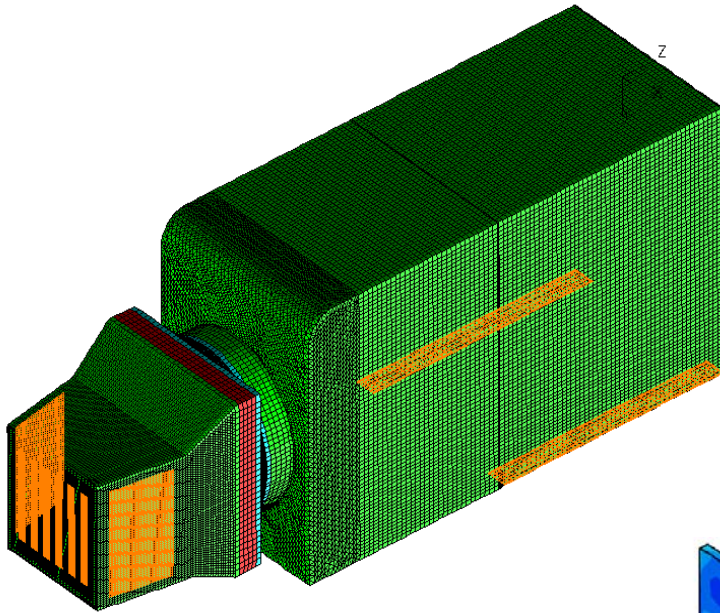
## Applications for COM-interface (5)



## Interfaces to CFD software

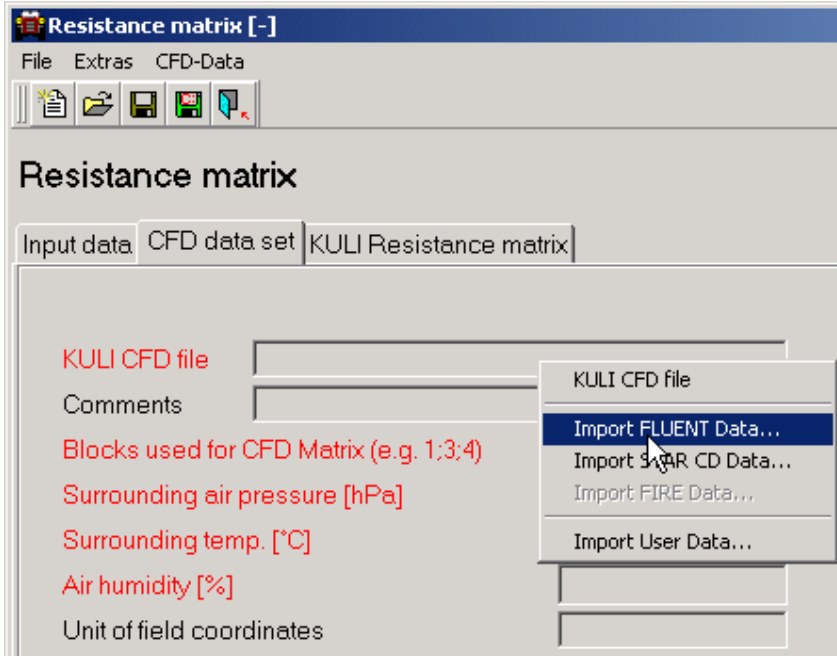


# CFD -> KULI: standard procedure





## Facelift for the CFD-interface (1)



- **direct CFD data import**
  - **accessible via context menu**
  - **conversion to KULI cfd file and import into resistance matrix dialog in one step**



## Facelift for the CFD-interface (2)

File Extras CFD-Data

Resistance matrix

Input data | CFD data set | KULI Resistance matrix

Status: generated

ATTENTION: The resistance matrix will be generated for the first active simulation point.

Generate resistance matrix

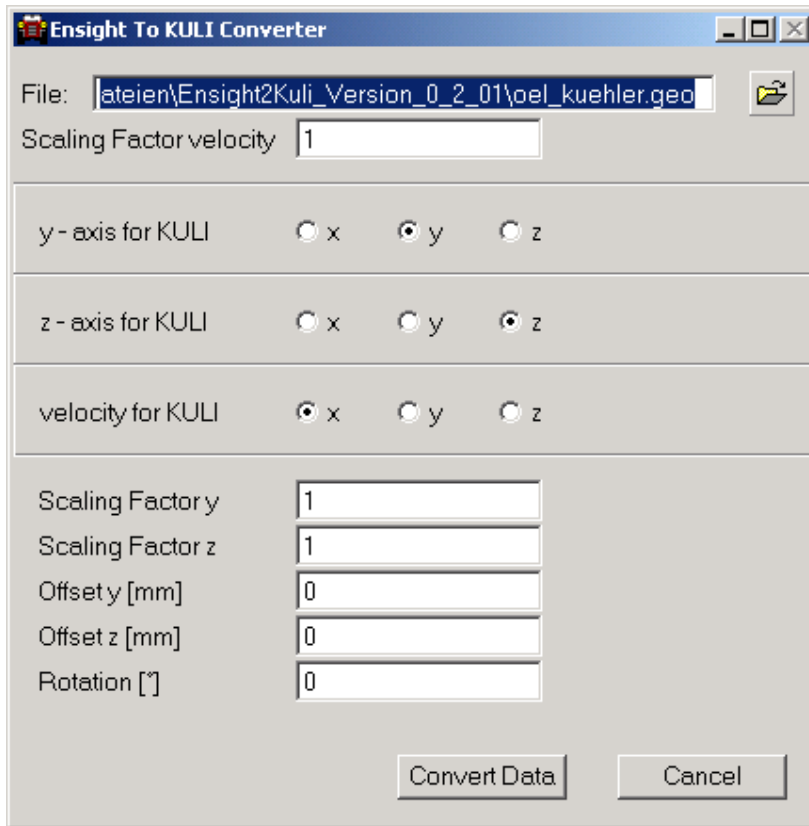
„Generate“-button on tab „Resistance matrix“ => more logical behavior

Output of volume and mass flow rates from CFD data

y-coordinate [mm]	z-coordinate [mm]	Zeta-values
-328	-59	4.01291
-328	-24	16.4688
-328	183	1.36247
-328	218	1.80557
-328	253	3.2545
-328	286	3.84506
-328	321	5.27357
-328	357	9.07016
-294	50	2.07605

	Sum absolute	Vector sum
Air mass flow rate from CFD data [kg/s]	1.16841	0.817147
Air vol. flow rate from CFD data [m³/s]	0.971417	0.679378

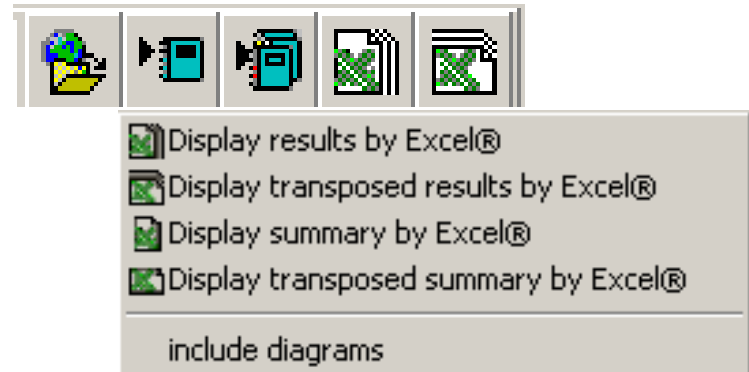
## Facelift for the CFD-interface (3)



- **Ensight To KULI Converter**
  - converts Ensight output to KULI cfd files
  - several options for scaling, moving, rotating

## Interface Postprocessor – Excel (1)

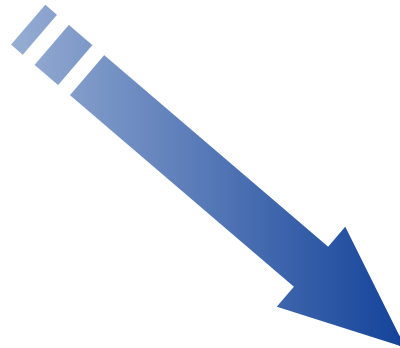
- Different types of export
- Display results
  - each component in the postprocessor is displayed on its own page in Excel
- Display summary
  - all exported data is displayed on a single sheet
  - separate sheets for multiple files
- Option to transpose data
- Option to include diagrams



## Interface Postprocessor – Excel (2)

Selected simulation results			
Diagrams			
Cross flow HX			
1.Radiator	ExCAR		
Label / stationary	1	2	3
Entry temp. IM [°C]	99.6597	88.3788	105.7
Mass flow IM [kg/s]	1.09167	1.00814	1.54715
Cooling air mass flow [kg/s]	0.594118	0.884697	1.61756

# KULI 5.1



Microsoft Excel - ExCAR.xls					
Datei Bearbeiten Ansicht Einfügen Format Extras Daten Fenster ?					
Arial 8 F K U					
F28 =					
	A	B	C	D	E
1	1.Radiator				
2	Label / stationary	1	2	3	
3	Entry temp. IM [°C]	99.6597	88.3788	105.7	
4	Mass flow IM [kg/s]	1.09167	1.00814	1.54715	
5	Cooling air mass flow [kg/s]	0.594118	0.884697	1.61756	
35					
36					
37					
1.RAD / 1.CAC /					

## Conclusion

