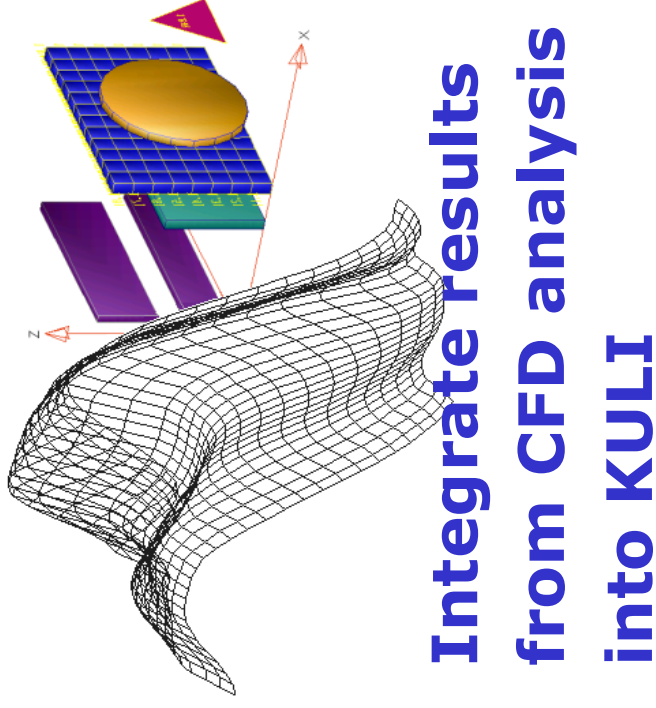


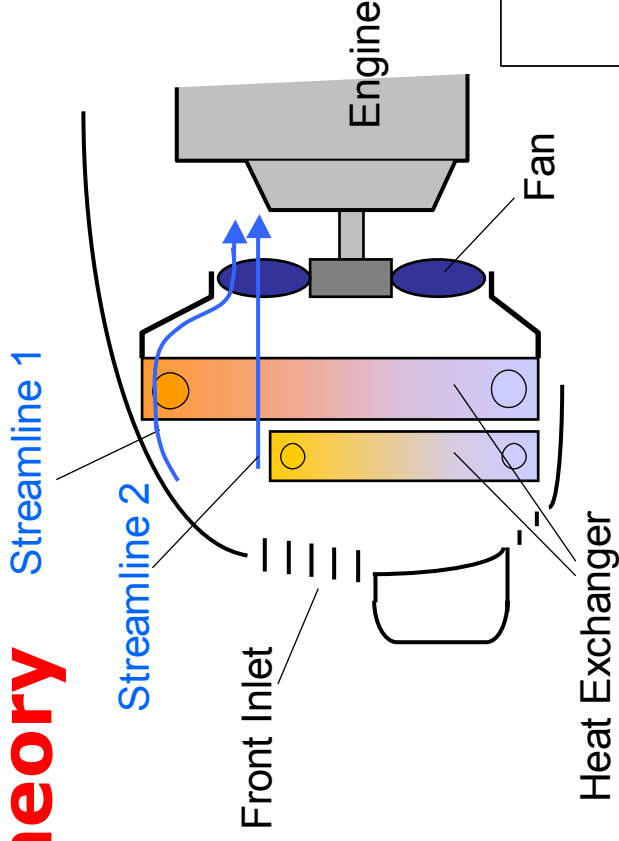
KULI CFD Interface



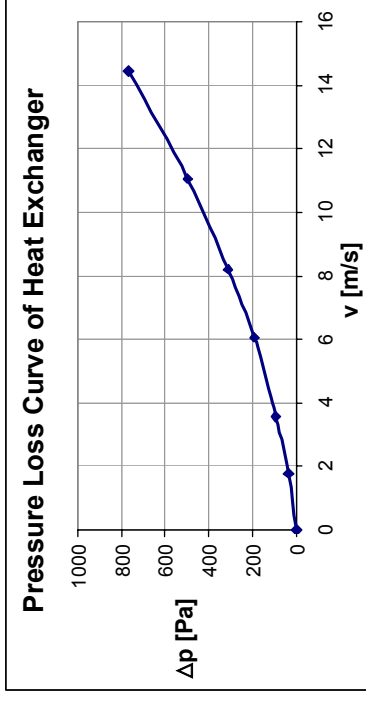
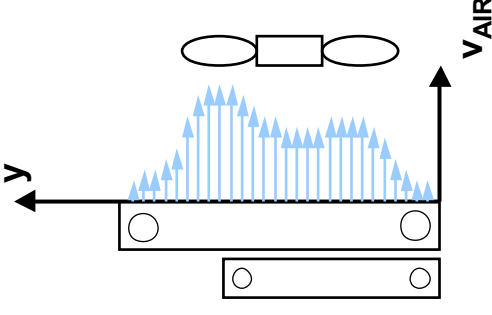
Overview:

- Theory
- Use CFD Data in KULI
- Results
- Optimizing Cooling Air Path

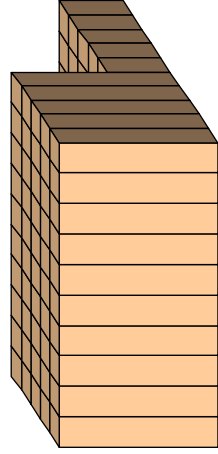
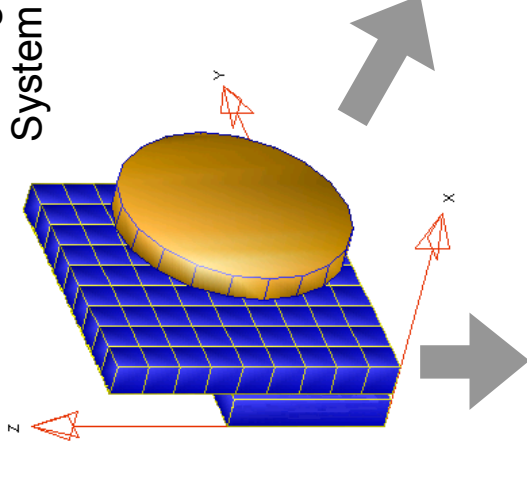
Theory



$$\zeta\text{-value} : \zeta = \frac{2 \Delta p}{\rho v^2}$$

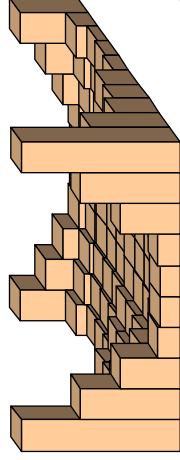
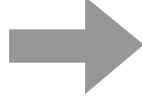


Cooling
System

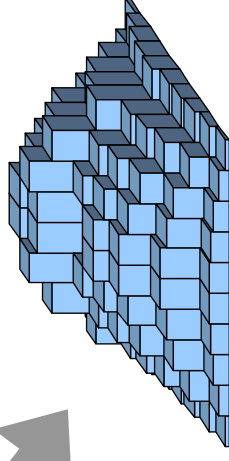


ζ -values of
block elements

Air flow
in block

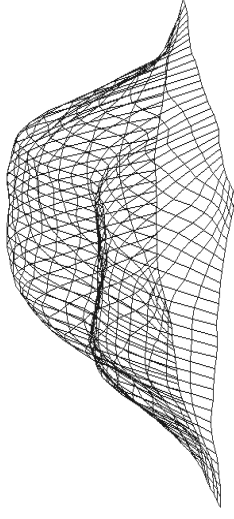


ζ -values of
resistance matrix



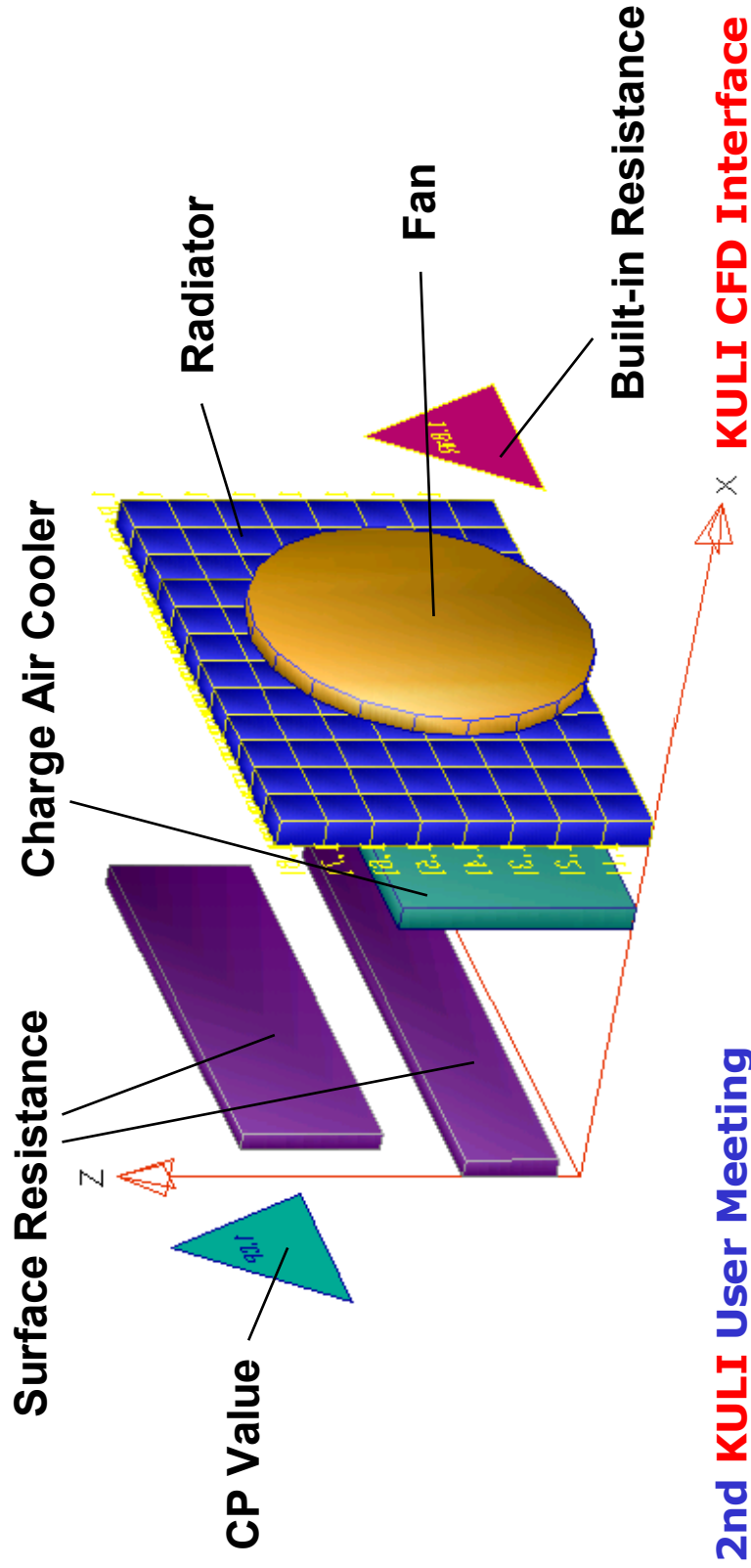
Air velocity distribution
on cooling system block

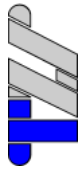
Air velocity distribution
from CFD analysis



Use CFD Data in KULI - Example 1

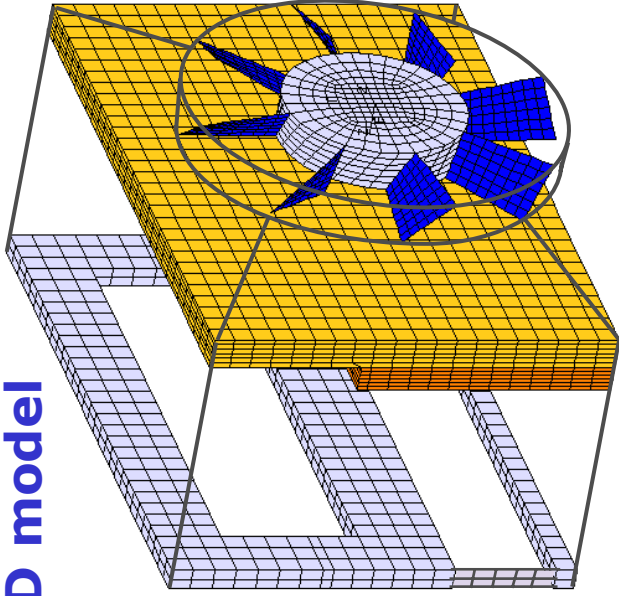
Cooling System



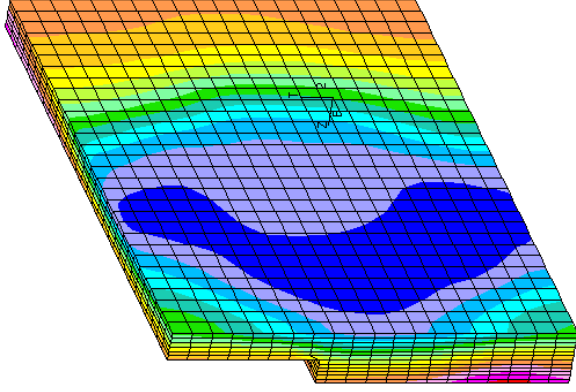


Use CFD Data in KULI

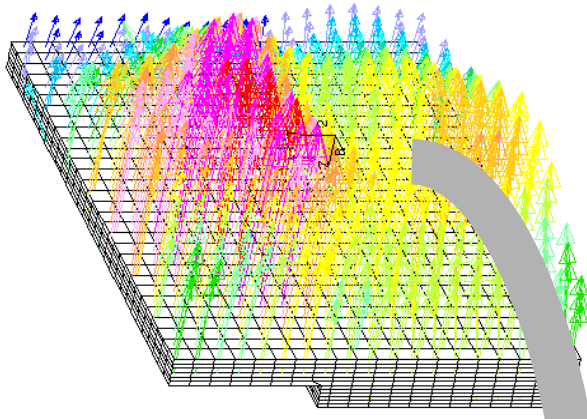
CFD model



Pressure distribution



Velocity distribution



CFD data file

2nd **KULI** User Meeting

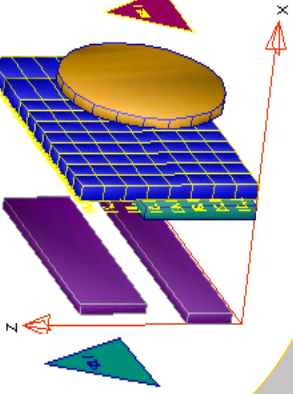
KULI CFD Interface



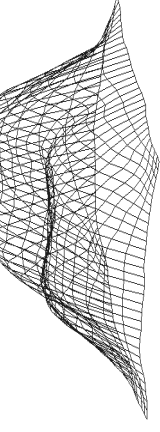
STEYR-DAIMLER-PUCH
ENGINEERING CENTER STEYR
A COMPANY OF **MAGNA**

Use CFD

Cooling System



CFD velocity distribution



Resistance Matrix [ExCFDInt...

File Extras

Resistance Matrix

Input data | CFD velocity field | Zeta-values of resistance matrix

User	TZS	Surrounding air pressure [hPa]	1013.
Date (0=current)	Thursday, 07. October 1999 12:30:08	Surrounding Temp. [°C]	15.
Comments	KULI/CFD-Interface	Rel. moist. content of air [%]	60.
CFD data file	ExCFDInterface...	Air flow in block [m ³ /s]	1.15
KULI file	ExCFDInterface...	Block No.	Block 1
		Block height [mm]	
		Block width [mm]	
		Position CFD velocity field	
		Y-coordinate [mm]	230
		Z-coordinate [mm]	200

Generate resistance matrix

Status not generated

• KULI file

• CFD data file

• Material properties

• Air flow (optional)

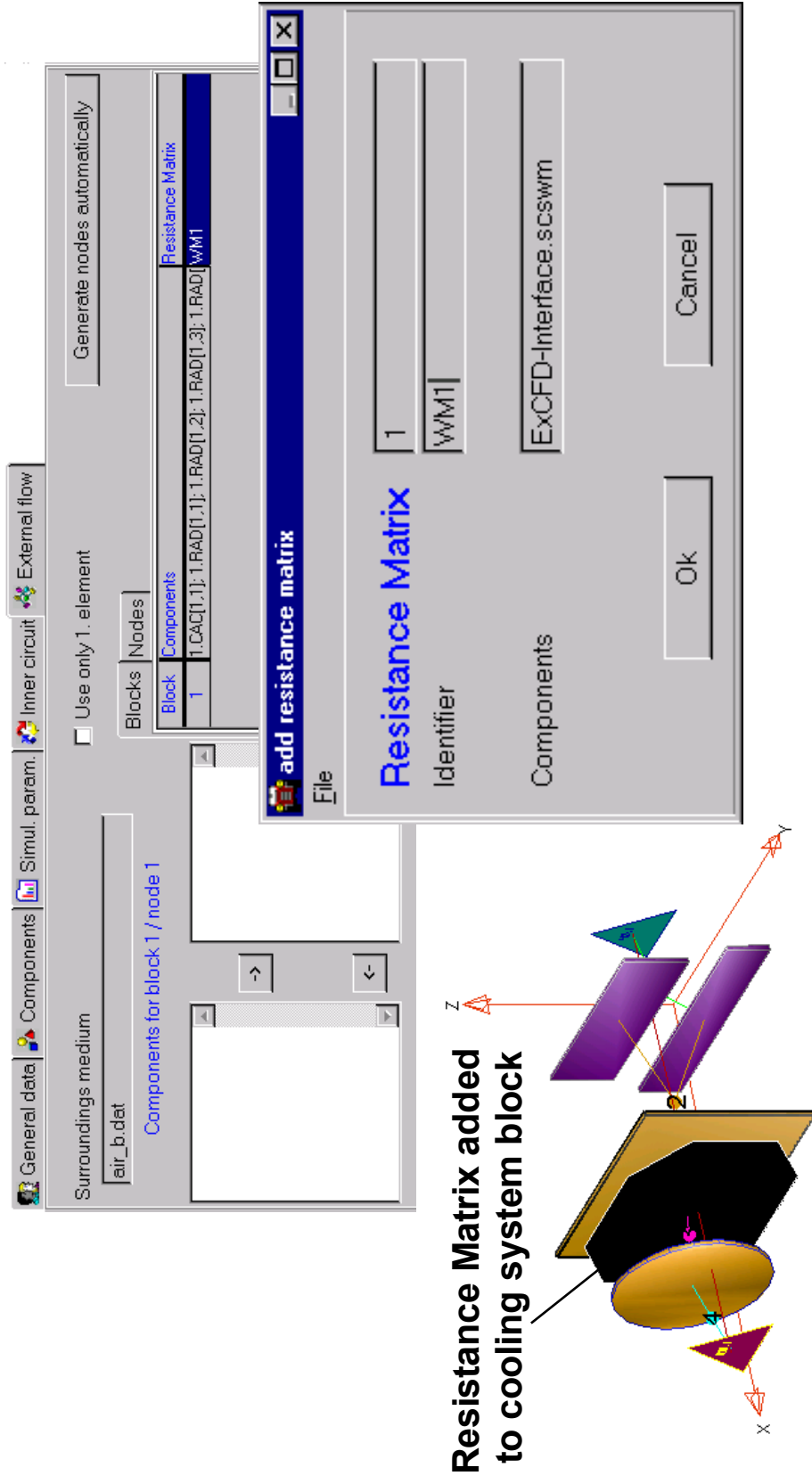
• Block number

• Position CFD velocity field

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KULI CFD Interface

Use CFD Data in KULI

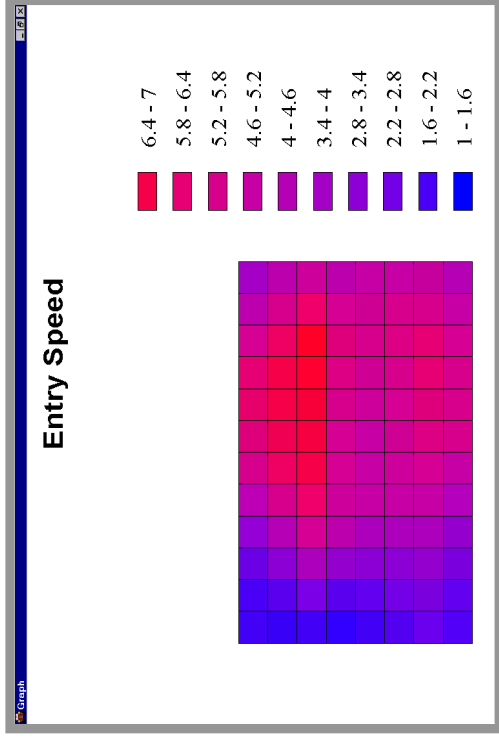


2nd KULI User Meeting

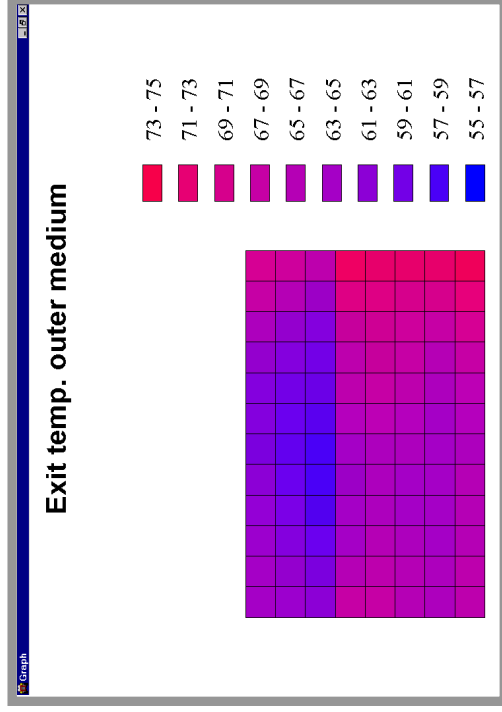
KULI CFD Interface

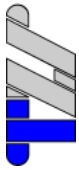
Results

Air velocity distribution on block



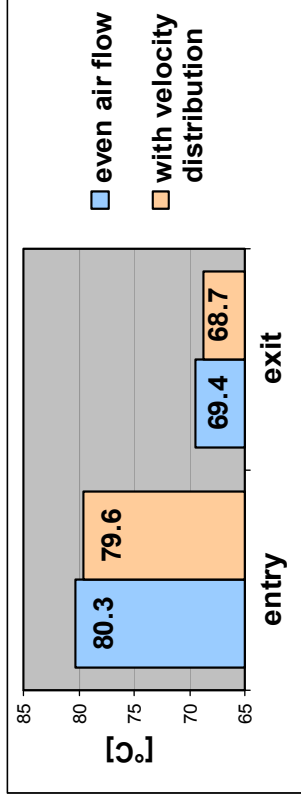
Exit temperature of cooling air



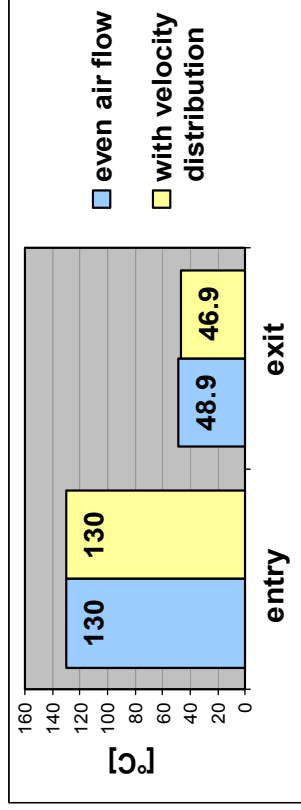


Results

Coolant temperature in radiator

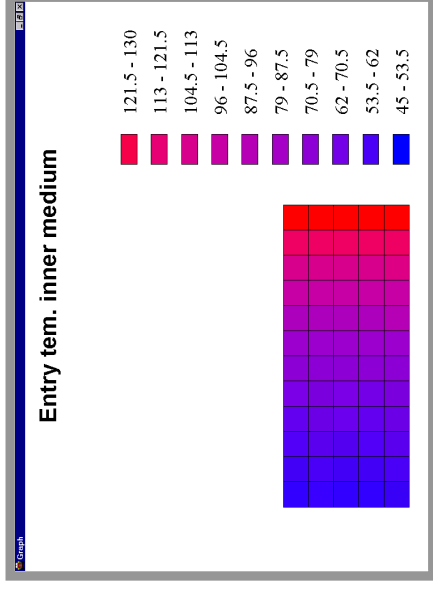
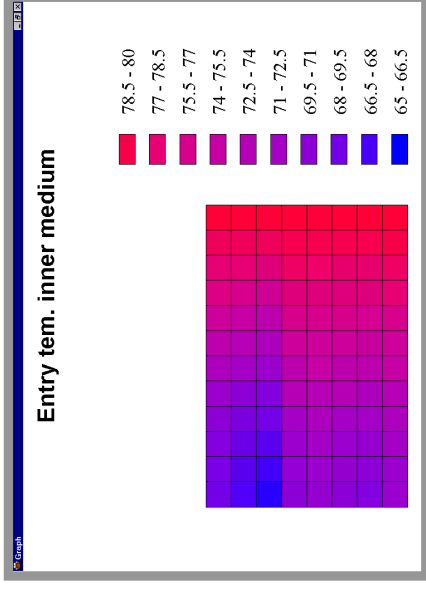


Charge air temperature in charge air cooler

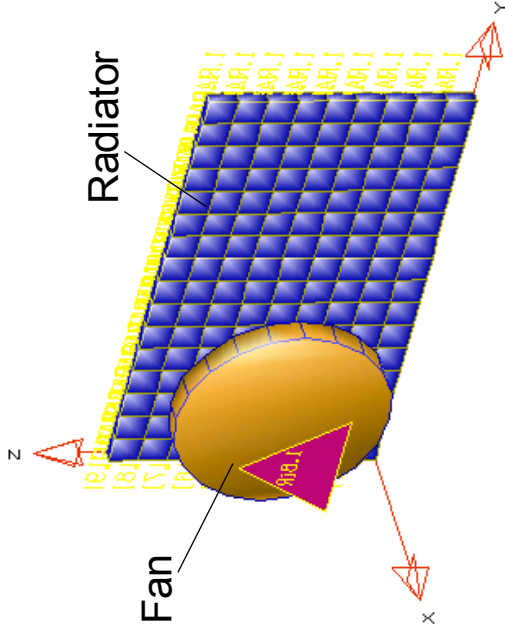


2nd KULI User Meeting

KULI CFD Interface

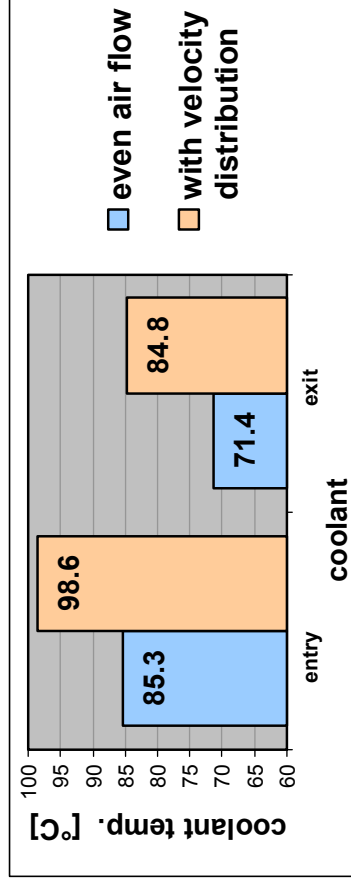
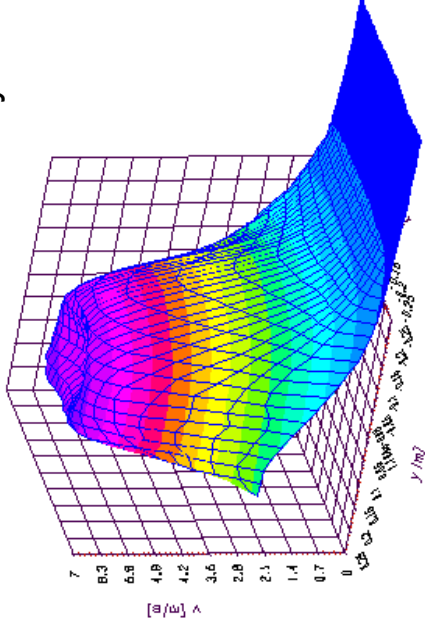


Example 2



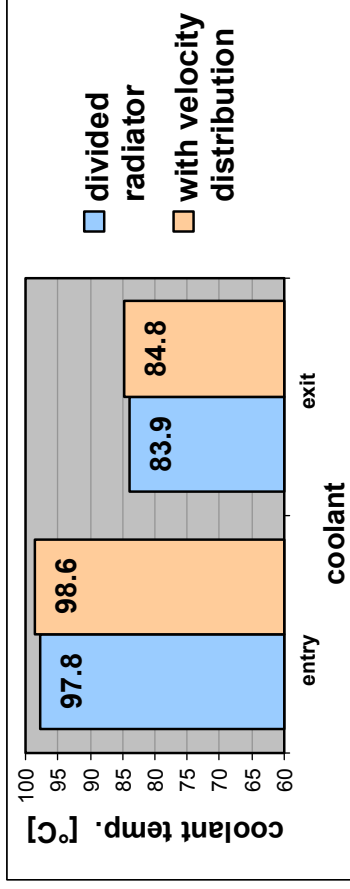
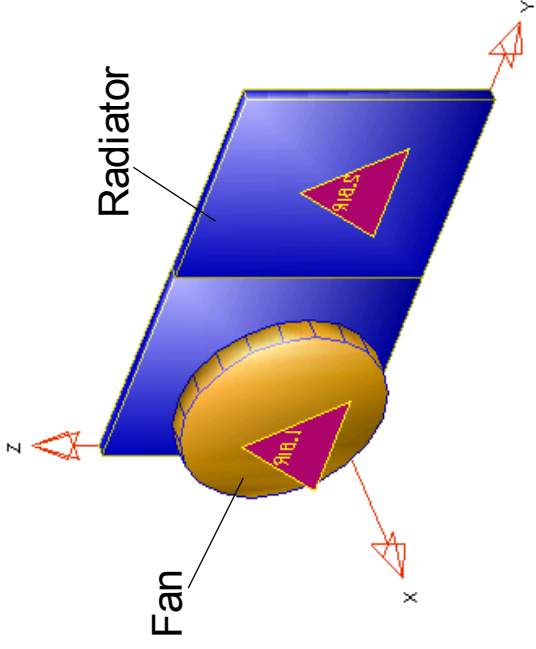
**Coolant temperature
in radiator:**

Air Velocity Distribution



Example 2

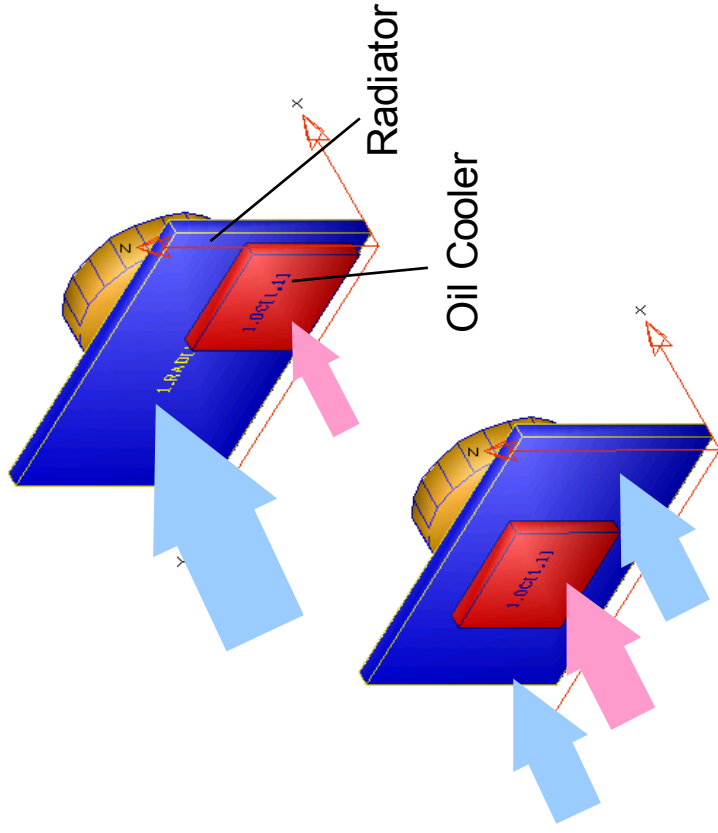
In previous KULI versions the uneven air flow could be approximated by dividing the radiator:



Coolant temperature in radiator:

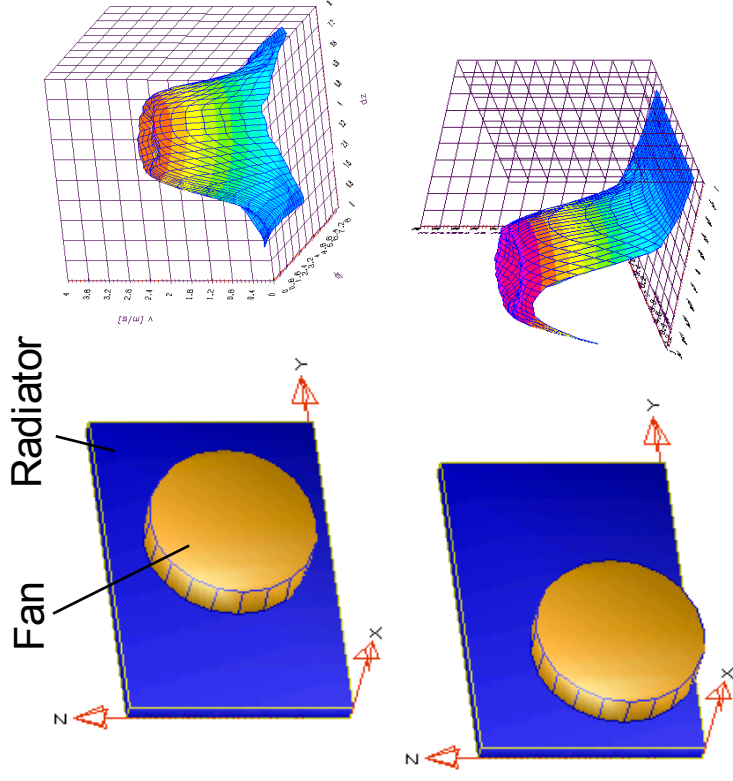
Optimizing cooling air path

Position of heat exchangers



2nd **KULI** User Meeting

Position of fan



KULI CFD Interface

Advantages

- Combine quick KULI simulation with accuracy of CFD analyses
- Effect of air flow distribution on heat transfer
- Optimizing cooling air path
- Interface to STAR CD