



Gekoppelte Simulationen in TENT

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Köln



Übersicht

- ▶ **Einleitung**
- ▶ **TENT Unterstützung für gekoppelte Simulationen**
- ▶ **TENT in Projekten**
 - ▶ **AMANDA**
 - ▶ **IMENS**



Einleitung

- ▶ **Multidiziplinäre Simulation**
 - ▶ **Strömung-Struktur**
 - ▶ **Strömung-Wärme**
 - ▶ **Wärme-Struktur**
- ▶ **Kopplungsmethoden**
 - ▶ **enge Kopplung**
 - ▶ **schwache Kopplung**



Vorraussetzungen für eine gekoppelte Simulationen:

- ▶ **Simulationscodes für die Einzeldisziplinen**
- ▶ **Kopplungsalgorithmen**
- ▶ **Kopplungssoftware (MpCCI)**
- ▶ **Hardwareresourcen**
 - ▶ **Übertragungsbandbreite**
 - ▶ **Rechenleistung**
- ▶ **Umgebung zur Konfiguration und Steuerung der Simulation (TENT)**

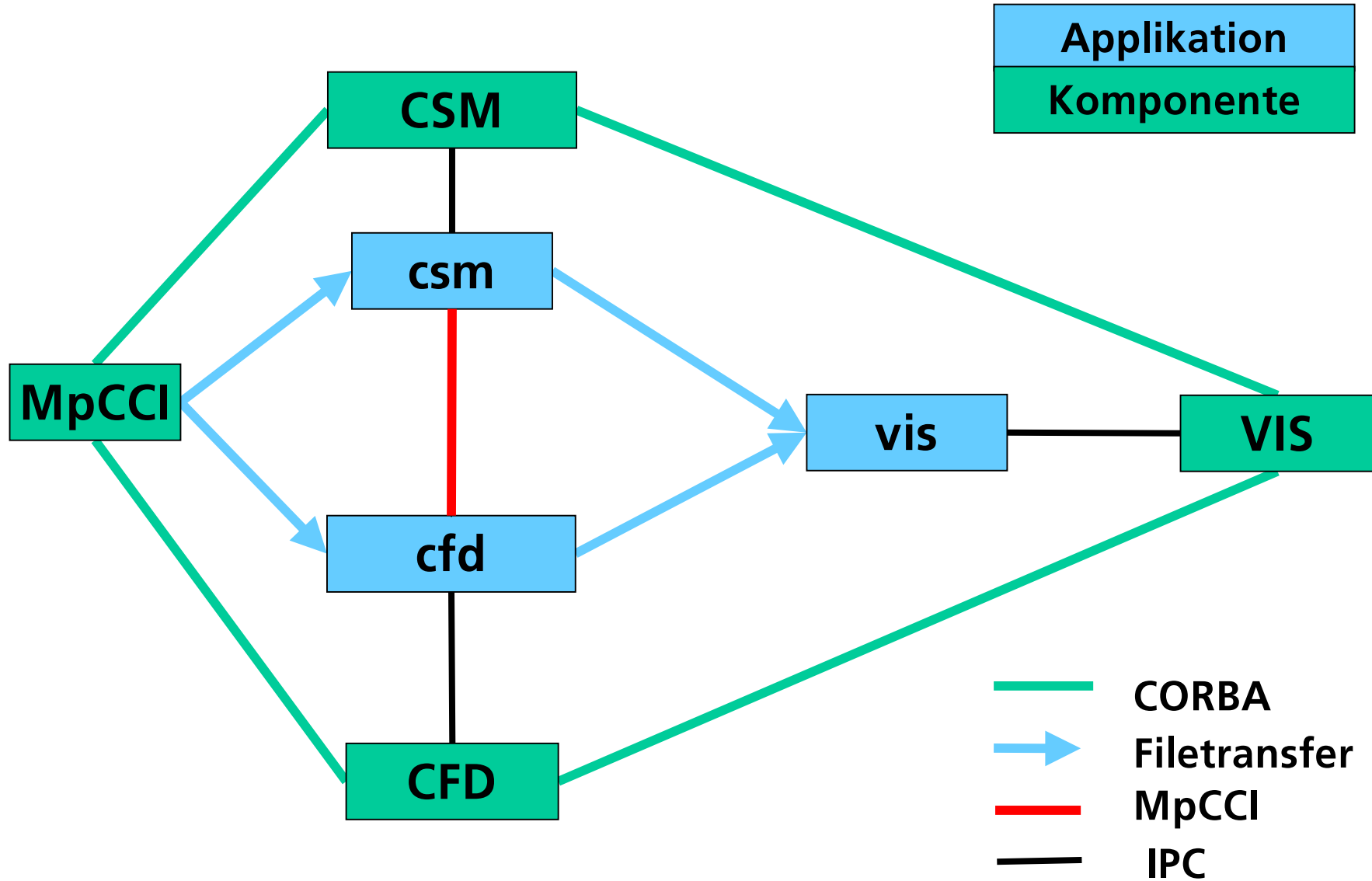


Was stellt TENT zur Verfügung?

- ▶ **GUI zur Steuerung und Konfiguration einzelner Komponenten**
- ▶ **Startmechanismus**
- ▶ **Datentransfermechanismus**
- ▶ **Kopplungssteuerung**



Ein Kopplungsszenario





Projekte

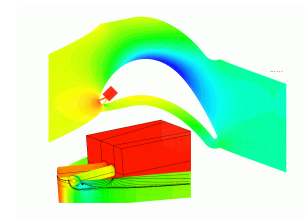
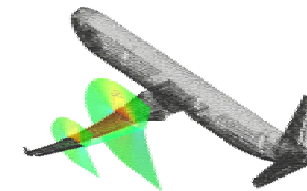
▶ **AMANDA**

▶ **IMENS**



AMANDA - Ziele

- ▶ **Softwaresystems zur Durchführung multidisziplinärer Simulationen**
- ▶ **Implementierung von Pilotanwendungen**
 - ▶ **getrimmtes, elastisches Flugzeug**
 - **Aerodynamik**
 - **Strukturmechanik**
 - **Flugmechanik**
 - ▶ **luftgekühlte Turbinenschaufel**
 - **Aerodynamik**
 - **Wärmeleitung**





AMANDA – Partner

▶ DLR

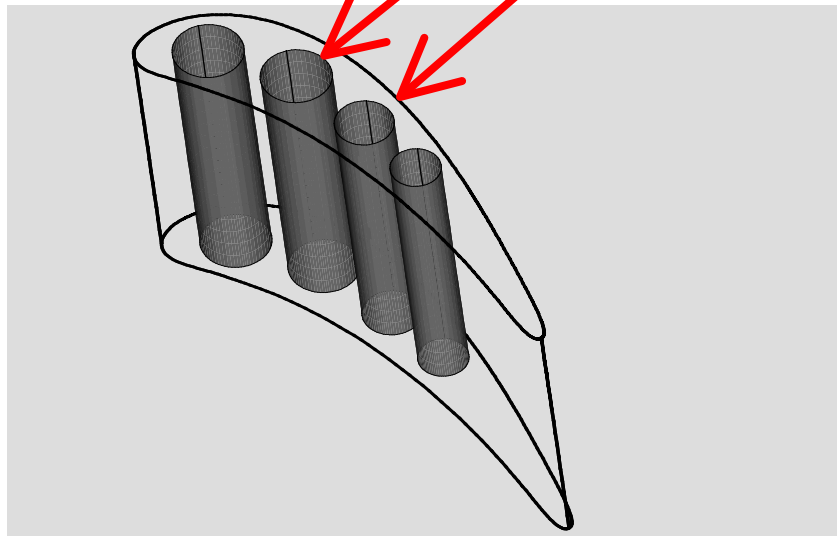
- ▶ Simulation- und Softwaretechnik
- ▶ Institut für Aeroelastik
- ▶ Institut für Aerodynamik und Strömungstechnologie
- ▶ Institut für Robotik und Mechatronik
- ▶ Institut für Antriebstechnik

▶ FhG

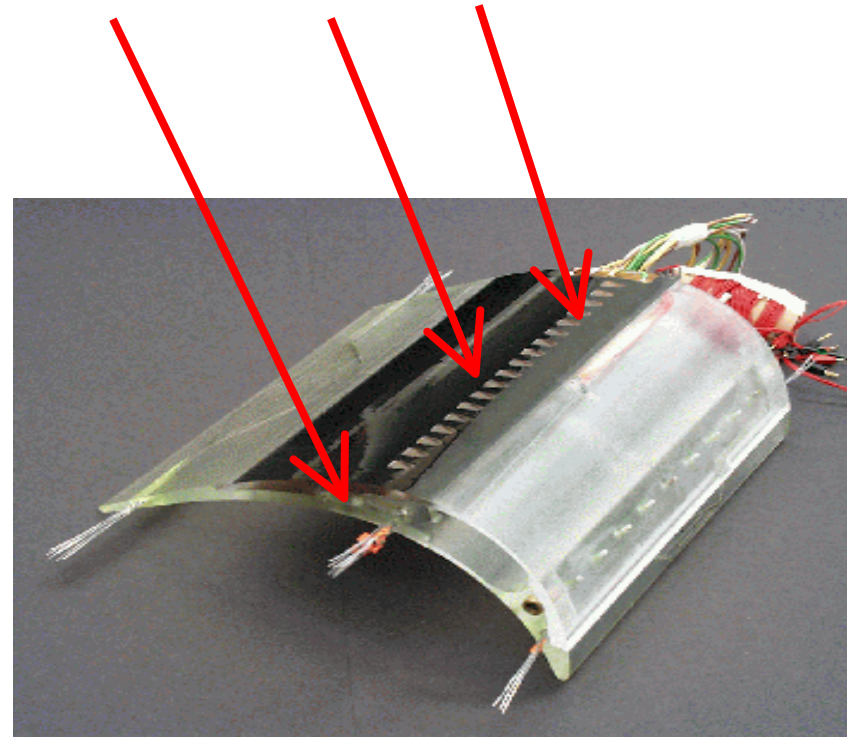
- ▶ Institut für Algorithmen und wissenschaftlichem Rechnen

Luftgekühlte Turbinenschaufel

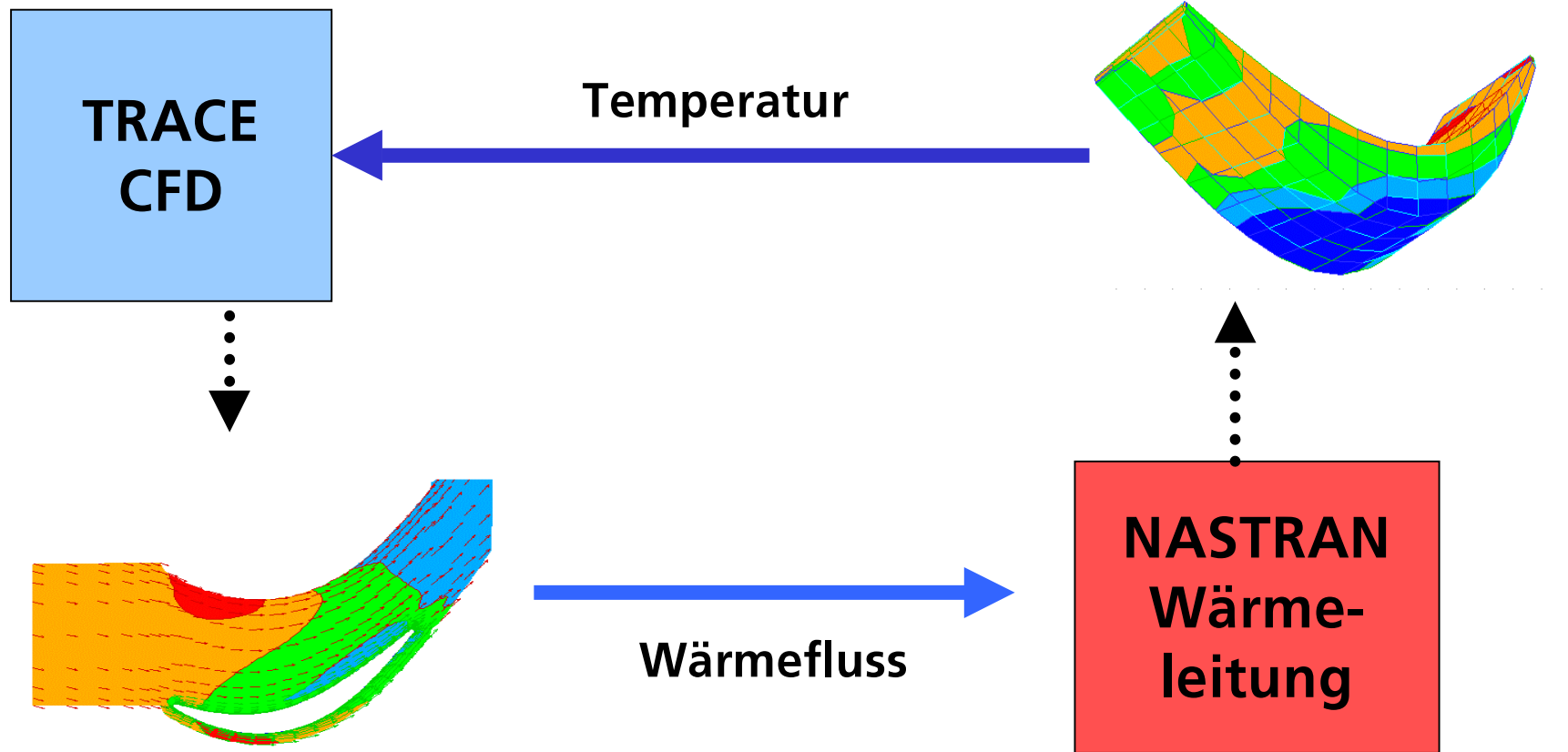
Kühlbohrungen



Austrittslöcher



Luftgekühlte Turbinenschaufel - Workflow





TENT GUI - Trace/Nastran Kopplung

The screenshot displays the TENT GUI interface with the following components:

- Component Repository:** Shows a tree structure with 'ComponentFactory' and 'thor.sistec.kp.d'.
- Properties Panel:** A table listing properties for the selected 'JobBlock' component.
- Workflow Diagram:** A flowchart showing the execution sequence: MCP/GUI → MpCCIControl.thor → NastranCoProcess.sim.thor → TraceS.vis.mpcci.thor. Additionally, MpCCIControl.thor connects to TraceS.mpcci.thor, which connects to TraceS.post.mpcci.thor.
- Logger:** A text area showing system logs with timestamps and component names.
- Control Bar:** Includes a 'Steps' counter (1) and navigation icons (back, forward, stop, refresh).
- Footer:** Displays 'Java HotSpot(TM) Client VM Sun Microsystems Inc. 1.3.0'.

Property	Value	Type
Root Object		DataObject
ApplicationEnvironment		DataObject
DataTag		1 long
Executable	/work/hpk/TENT/TENT_applications/bin...	file
HostName	thor.sistec.kp.dlr.de	string
UserName	amanda	string
WorkingDirectory	/work/hpk/TENT/TENT_projects/mpcci/...	file
ApplicationProperties		DataObject
Parameter	ProblemType: FLUID-THERMA...	string
MpCCIProperties		DataObject
CodeBlock	code simulationcode1 temperature	string
JobBlock		DataObject
coupling_no		1 long
nprocs		1 long
environment		DataObject

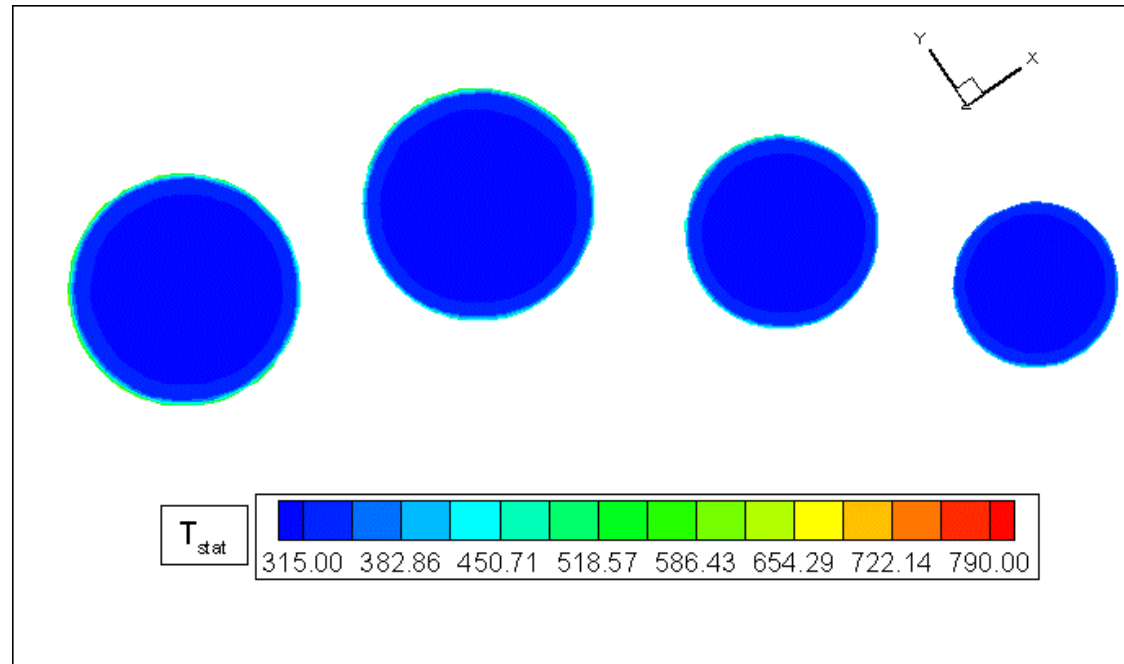
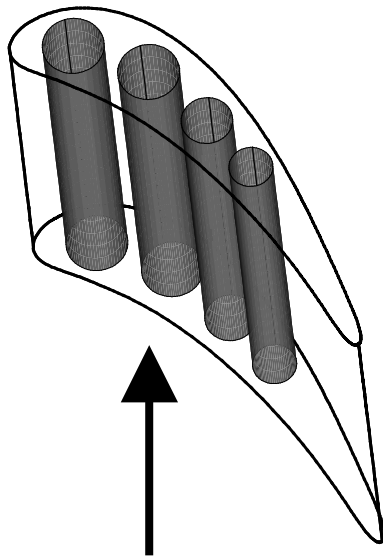
```
graph TD; MCP/MCP/GUI --> MpCCIControl.thor; MpCCIControl.thor --> NastranCoProcess.sim.thor; NastranCoProcess.sim.thor --> TraceS.vis.mpcci.thor; MpCCIControl.thor --> TraceS.mpcci.thor; TraceS.mpcci.thor --> TraceS.post.mpcci.thor;
```

```
[29.10.2001 03:00:51] mpcciTraces[1]: WARNING: TentEventManagerBase:addListener: listener added more than once
[29.10.2001 03:00:52] mpcciControl[1]: INFO: MpCCI-Control: MpCCI-Reference added to list

[29.10.2001 03:00:52] simNastranCoProcess[1]: INFO: addSE_TimeStepReadyEventListener
[29.10.2001 03:00:52] mpcciControl[1]: INFO: MpCCI-Control: MpCCI-Reference added to list

[29.10.2001 03:00:52] mpcciTraces[1]: INFO: addSE_TimeStepReadyEventListener
```

Lufgekühlte Turbinenschaufel - Wärmeverteilung in den Kühlkanälen

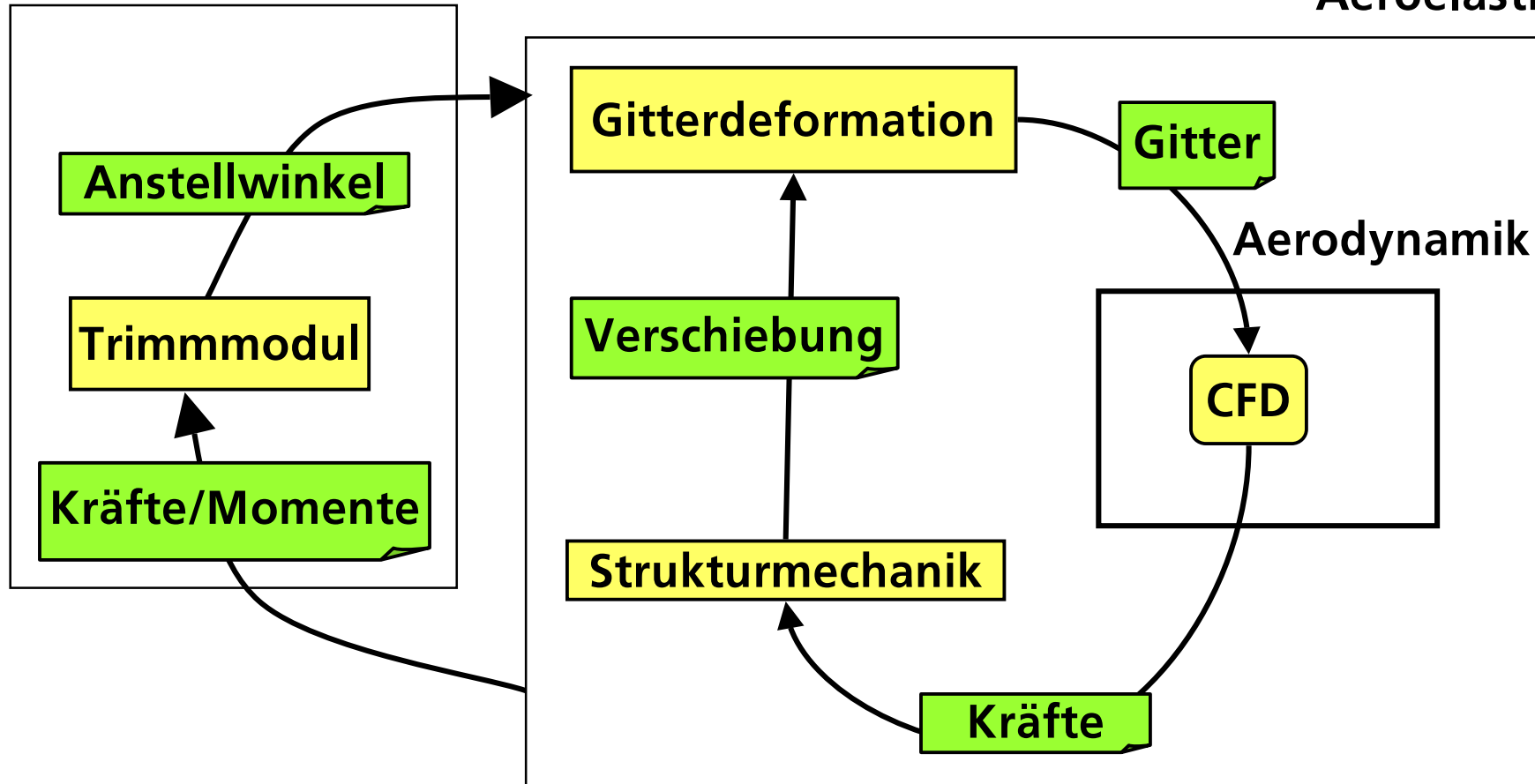


Simulation: AT

Das freifliegende, elastische Flugzeug

Flugmechanik

Aeroelastik





TENT GUI - FLOWer/Nastran Kopplung

The screenshot displays the TENT GUI interface with the following components:

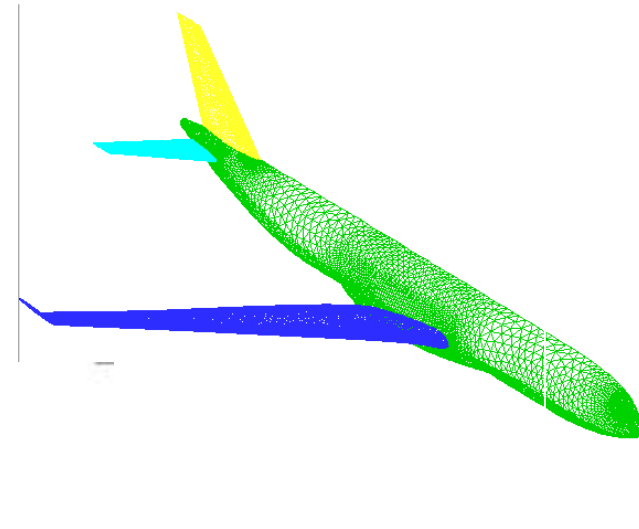
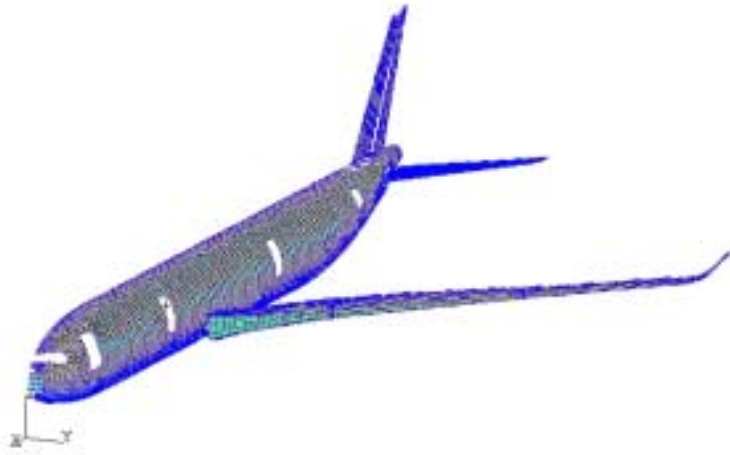
- Component Repository:** A tree view on the left showing the hierarchy of components, including 'ComponentFactory', 'thor.sistec.kp.dlr.de', 'beasg15.ea.bs.dlr.de', 'MpCCIControl', 'MpCCI-Control', 'SimMpCCI', 'NastranCoProcess-sim', 'FLOWerEngineMpCCI', 'Visualization', and 'VisToolTecplot'.
- Properties:** A table on the right showing the 'Starter Properties' for the selected component. The table has columns for Property, Value, and Type.
- Workflow Diagram:** A central diagram showing the execution flow between components: 'MCP/GUI' connects to 'NASTRAN-FLOWer.MpCCI-Control.beasg15', which then connects to 'Nastran.sim.beasg15', 'FLOWer.sim.beasg15', and 'FINa.local.vis.beasg15'.
- Logger:** A window at the bottom showing a log of system messages, including program names, working directories, application host names, user names, and server host names.

Property	Value	Type
Root Object		DataObject
ApplicationEnvironment		DataObject
ApplicationProperties		DataObject
MpCCIProperties		DataObject

```
[29.10.2001 03:21:07] simNastranCoProcess[65536]: INFO: Program Name: /beasg15/ten/gui/ncp/coupling/struct_gui
[29.10.2001 03:21:07] simNastranCoProcess[65536]: INFO: WorkingDirectory: /beasg15/ten/projects/flower/FlowerNastranLocal
[29.10.2001 03:21:07] simNastranCoProcess[65536]: INFO: applicationHostName: beasg15.ea.bs.dlr.de
[29.10.2001 03:21:07] simNastranCoProcess[65536]: INFO: userNameOnApplicationHost: tent
[29.10.2001 03:21:07] simNastranCoProcess[65536]: INFO: NumberOfProcessors: 1
[29.10.2001 03:21:07] simNastranCoProcess[65536]: INFO: CodeId: 1
[29.10.2001 03:21:07] simNastranCoProcess[65536]: INFO: ServerHostName 129.247.40.30
```



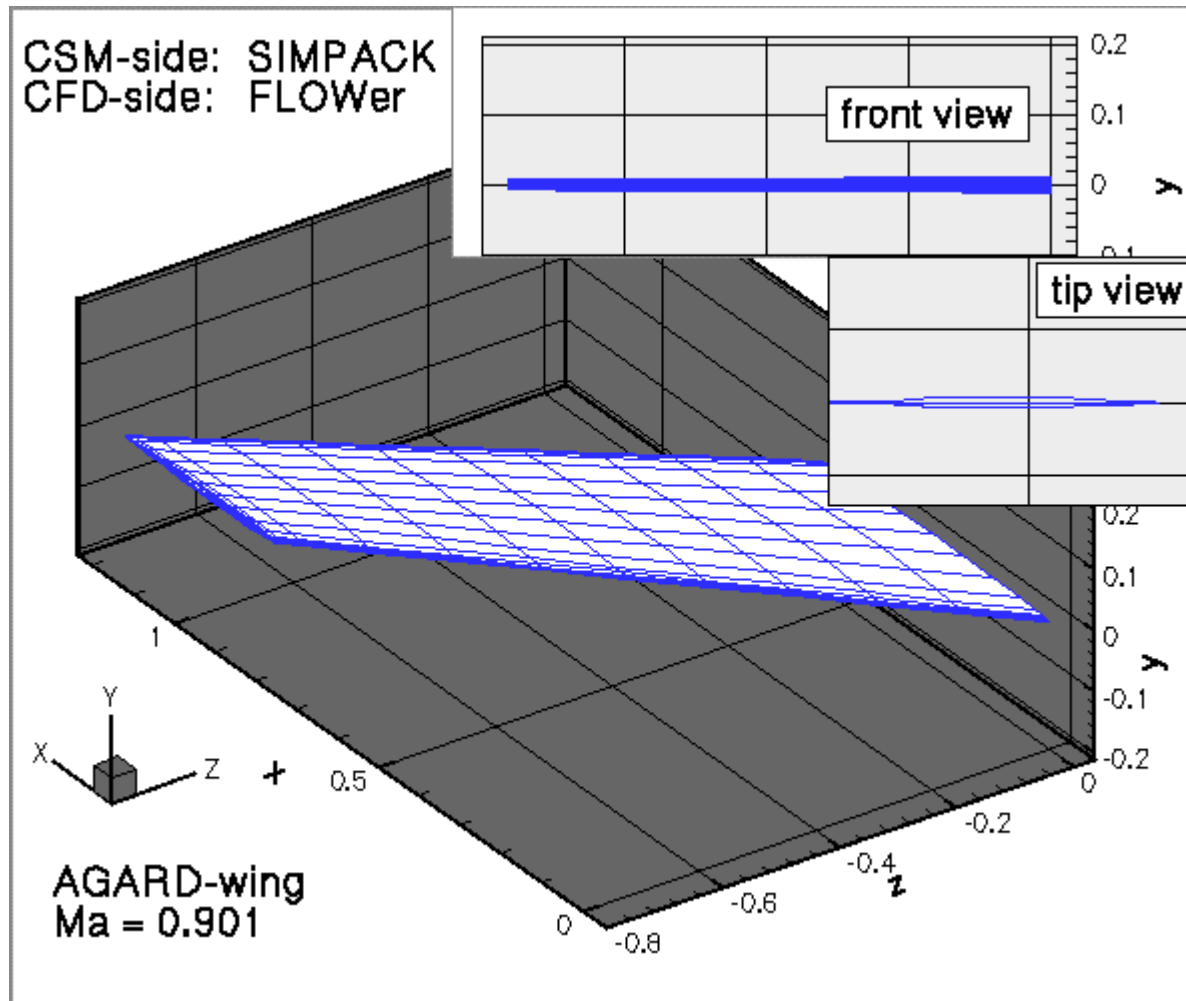
A340 – Tau/Nastran Kopplung



Simulation: AS/AE



FLOWer/Simpack Kopplung



IMENS - Ziele

- ▶ Simulation der Wiedereintrittsphase eines Raumgleiters
- ▶ Struktur-Wärmeleitung-Strömung
- ▶ Simulationssystem aus
 - ▶ TAU
 - ▶ Ansys
 - ▶ Nastran
 - ▶ Kopplungsmodul





IMENS - Partner

▶ DLR

- ▶ Simulation- und Softwaretechnik
- ▶ Institut für Strukturmechanik
- ▶ Institut für Aerodynamik und Strömungstechnologie
- ▶ Institut für Bauweisen- und Konstruktionsforschung

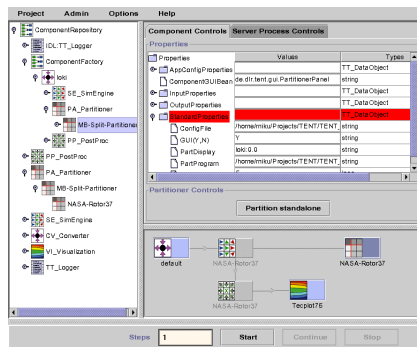
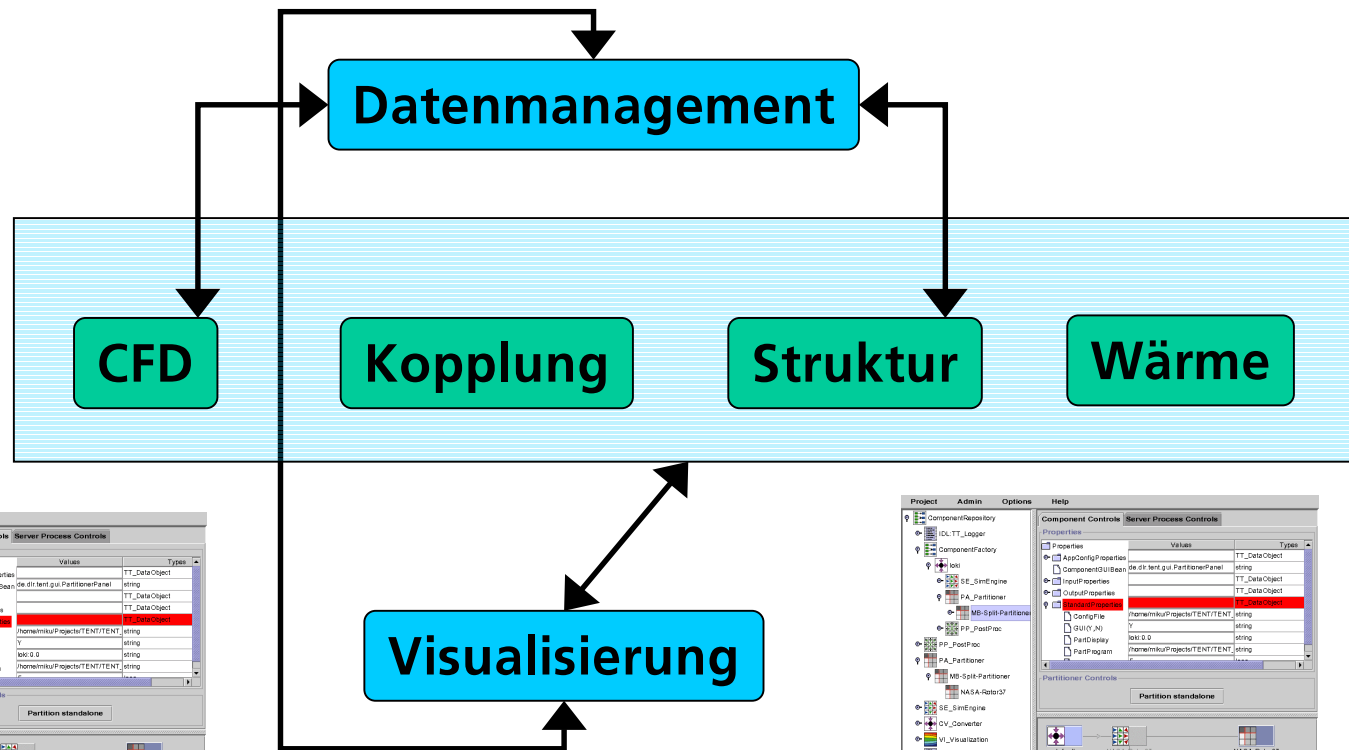
▶ Universität Braunschweig

- ▶ Institut für Flugzeugbau und Leichtbau

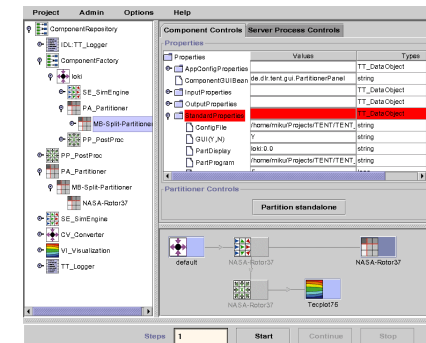
▶ Astrium



Das IMENS System



User interface A



User interface B



SISTEC Beitrag - Kopplungstechnologie

- ▶ **Softwarequalitätssicherung**
- ▶ **Integrationssystem**
 - ▶ **Kopplungskomponente**
 - ▶ **Benutzerverwaltung**
 - ▶ **Datenmanagement**
- ▶ **Co-Prozesse für kommerzielle Tools (Ansys , Nastran)**
- ▶ **Anwenderunterstützung**



Zusammenfassung und Ausblick

- ▶ **Zunahme der Bedeutung von multidisziplinären Simulationen in der Luft- und Raumfahrt**
- ▶ **Aufbau von softwaretechnischem und algorithmischem know-how**