



Open Source in Aeronautics and Space Research

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ApacheCon NA 2010
(Atlanta, 11/03/2010)



DLR



DLR: German Aerospace Center

6500 employees across
29 research institutes and
facilities at

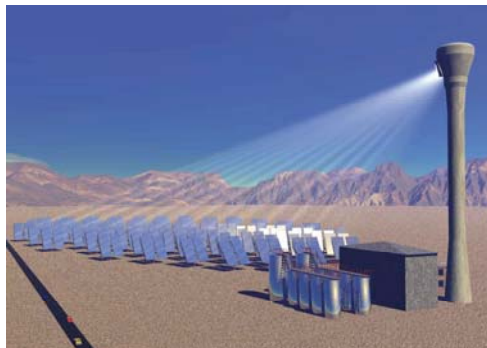
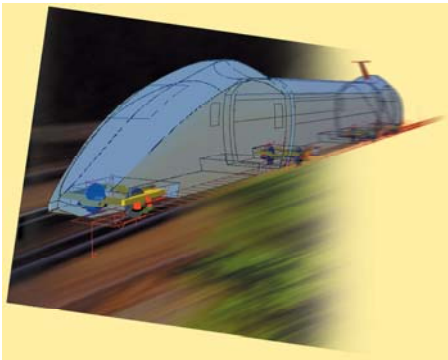
■ 13 sites.

Offices in Brussels,
Paris and Washington.



DLR: German Aerospace Center

➤ Research in:

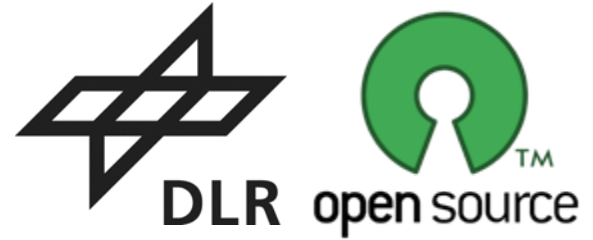


DLR: Meaning of Software

- DLR is largest German research institution
- Software is more and more required for day-to-day research
- >1000 DLR employees develop software



Open Source Software from DLR: SimBrowser



- SimBrowser: Preprocessing of Aerodynamic Simulations
 - Describe and visualize complex motions of physical objects
- Motivation
 - Validation of input files for high performance calculations
- Used Open Source Software: Qt and Open Inventor
- <http://www.dlr.de/opensource>



SimBrowser

Preprocessing of Aerodynamic Simulations

The screenshot displays the SimBrowser application window. The main view shows a 3D rendering of a satellite with solar panels, positioned in space above the Earth. The satellite is labeled "Sonnenausrichtung" (Sun orientation). The interface includes a "Tree View" on the left, a "Property Viewer" at the bottom left, and a central 3D view area with text overlays: "Simulations- und Softwaretechnik" and "Lageregelung des BIRD-Satelliten (Visualisierung echter Betriebsdaten)".

Tree View

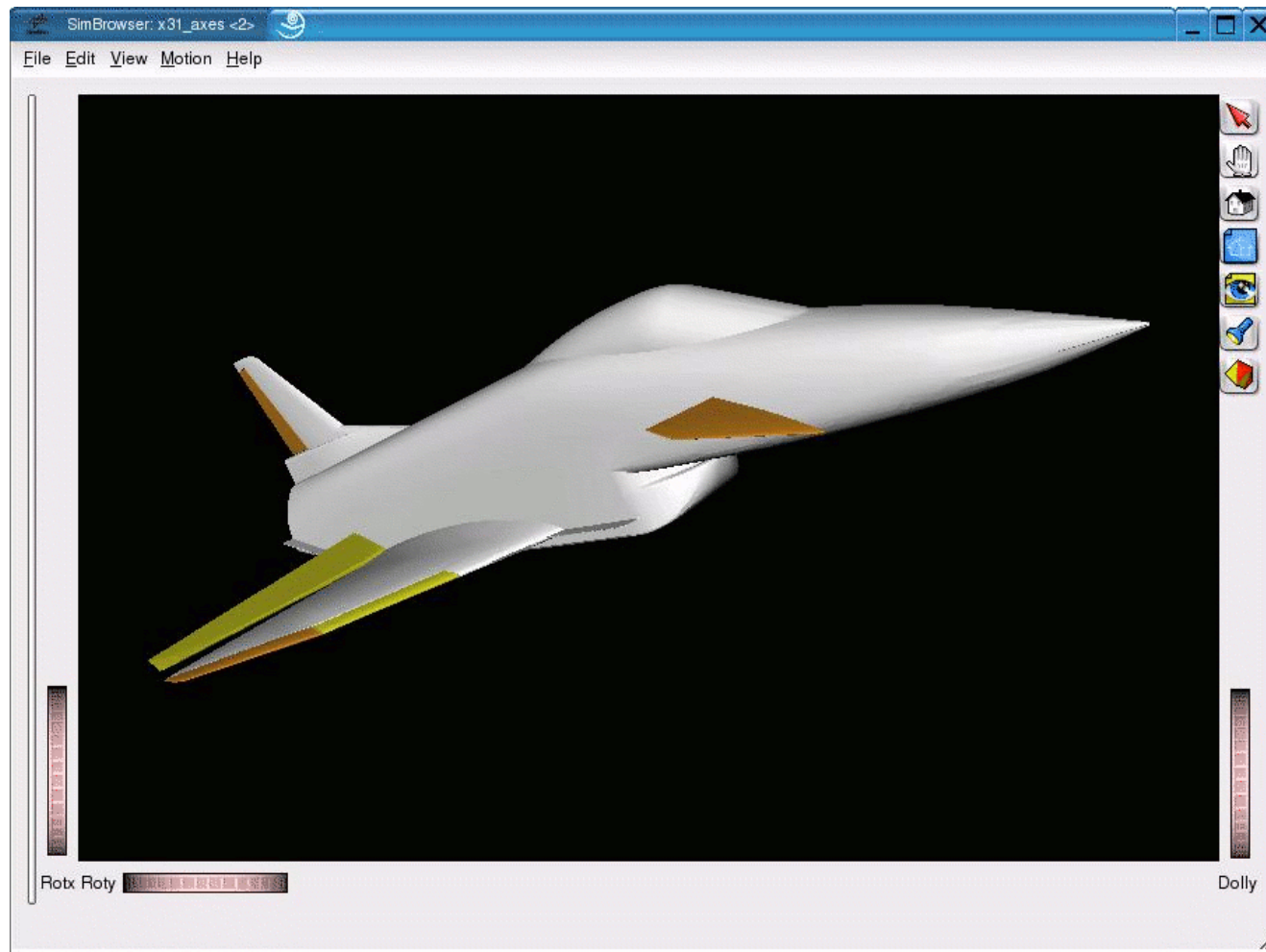
- object name
 - inertial
 - captionText_iv
 - modeText1_iv
 - sunlight_iv
 - n1
 - satBird_iv
 - n2
 - n3
 - earthTex_iv
 - spacelight_iv
 - stars_iv
 - sun_iv

Property Viewer

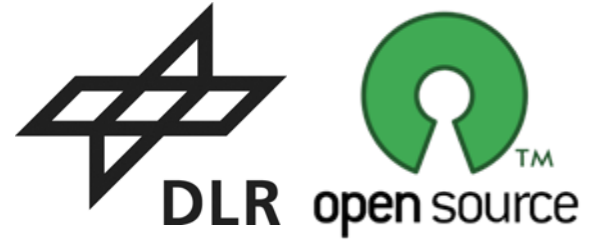
name	value
name	satBird_iv
grid block	
motion desc. ID	bird_program.p
axis local position	0, 0, 0
axis orientation	0, 0, 0
face sets (0-1)	1
color	0.8, 0.8, 0.8
draw style	filled
global position	-0, -0, -0
global rotation	0, 0, 1, 0

SimBrowser

Preprocessing of Aerodynamic Simulations



Open Source Software from DLR: SUMO



- SUMO: Simulation of Urban MObility
- Road traffic simulation software



- GNU General Public License (GPL)
- <http://sumo.sourceforge.net>

SUMO

Road Traffic Simulation Software



- Motivation for DLR: Evaluation of existing and design of new concepts



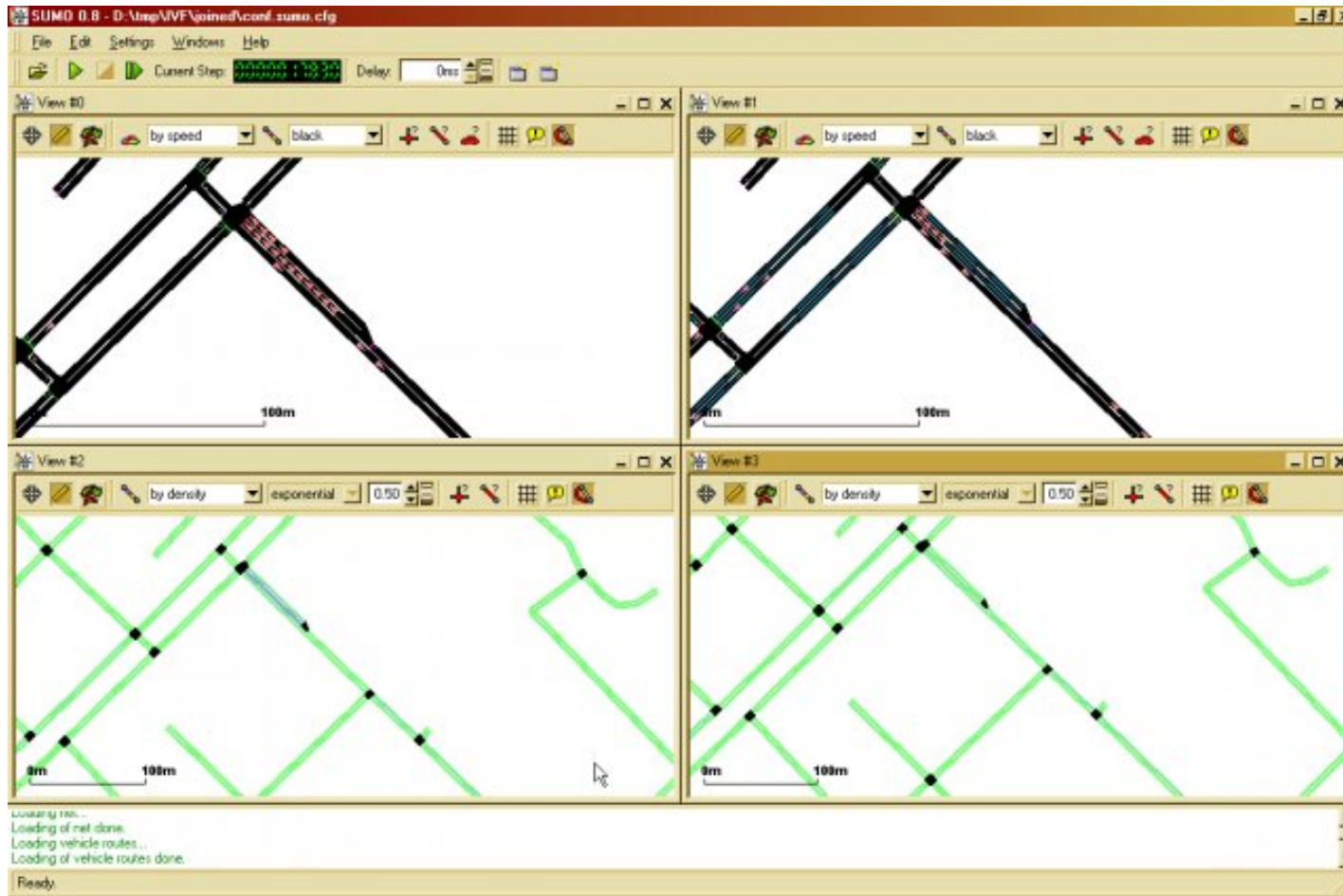
SUMO

Road Traffic Simulation Software



SUMO

Road Traffic Simulation Software



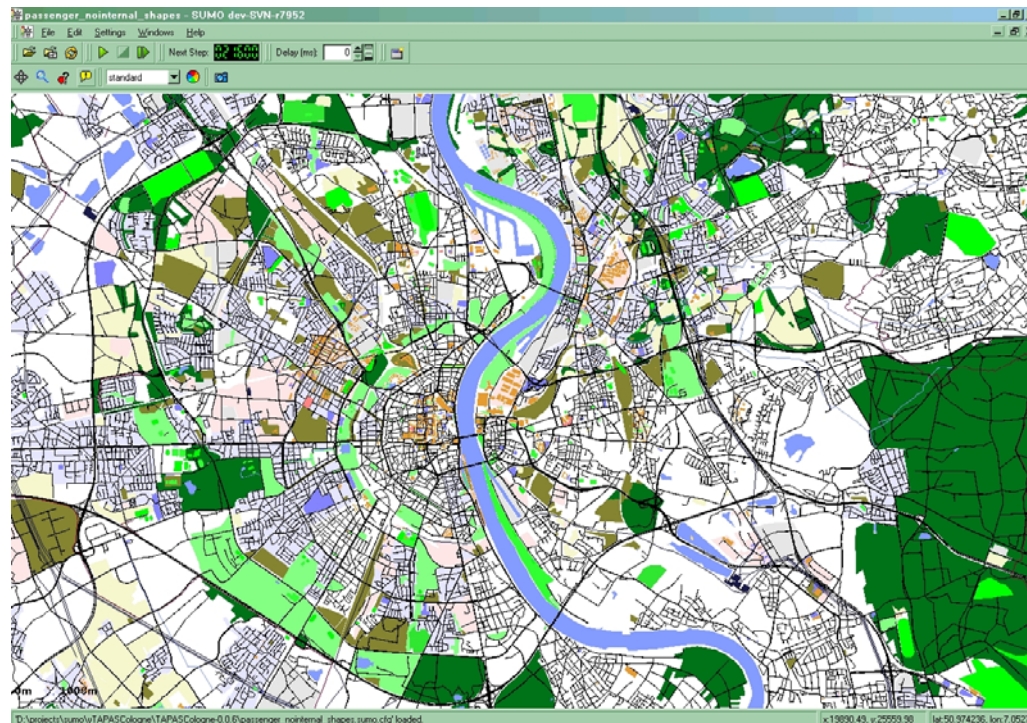
SUMO

Road Traffic Simulation Software



One example scenario: World Cup 2006 in Germany

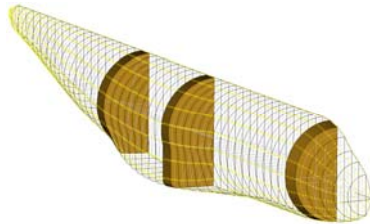
➤ Traffic forecast 30 minutes in future via SUMO (in Cologne)



Open Source Software from DLR: TIGLViewer

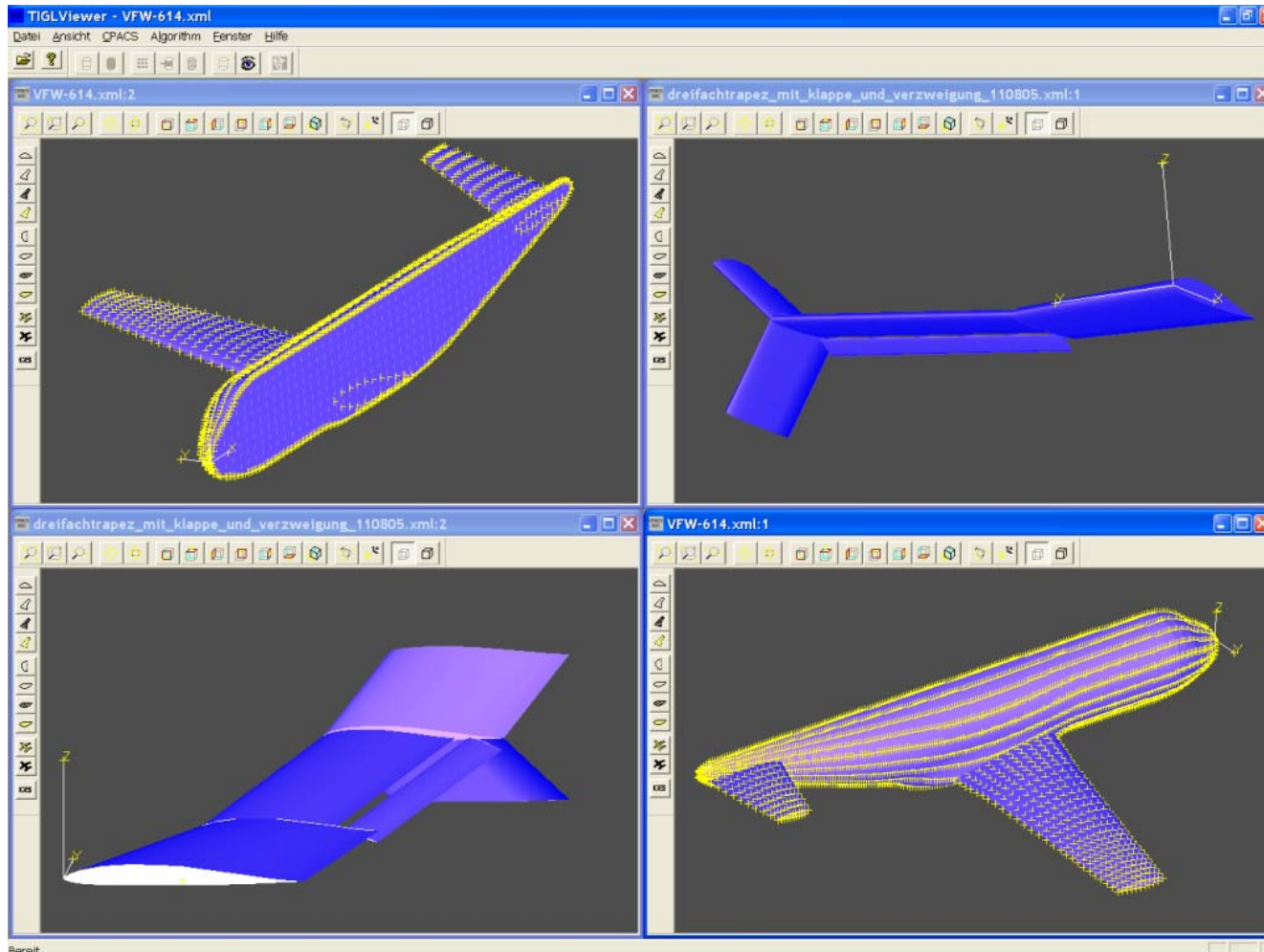
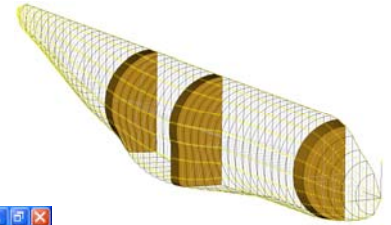


- TIGLViewer
 - Direct visualization of new aircraft configurations
- Motivation for DLR:
 - Easy and fast graphical visualization of complex geometric functions

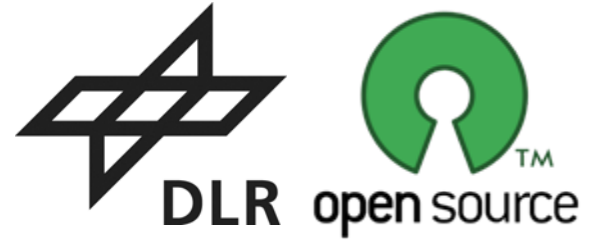


- Used Open Source Software: OpenCASCADE
- <http://www.dlr.de/opensource>

TIGLViewer



Open Source Software from DLR: RCE



- RCE: Remote Component Environment
- Software Integration Platform



- Eclipse Public License (EPL) V1.0
- <http://rcenvironment.sourceforge.net>



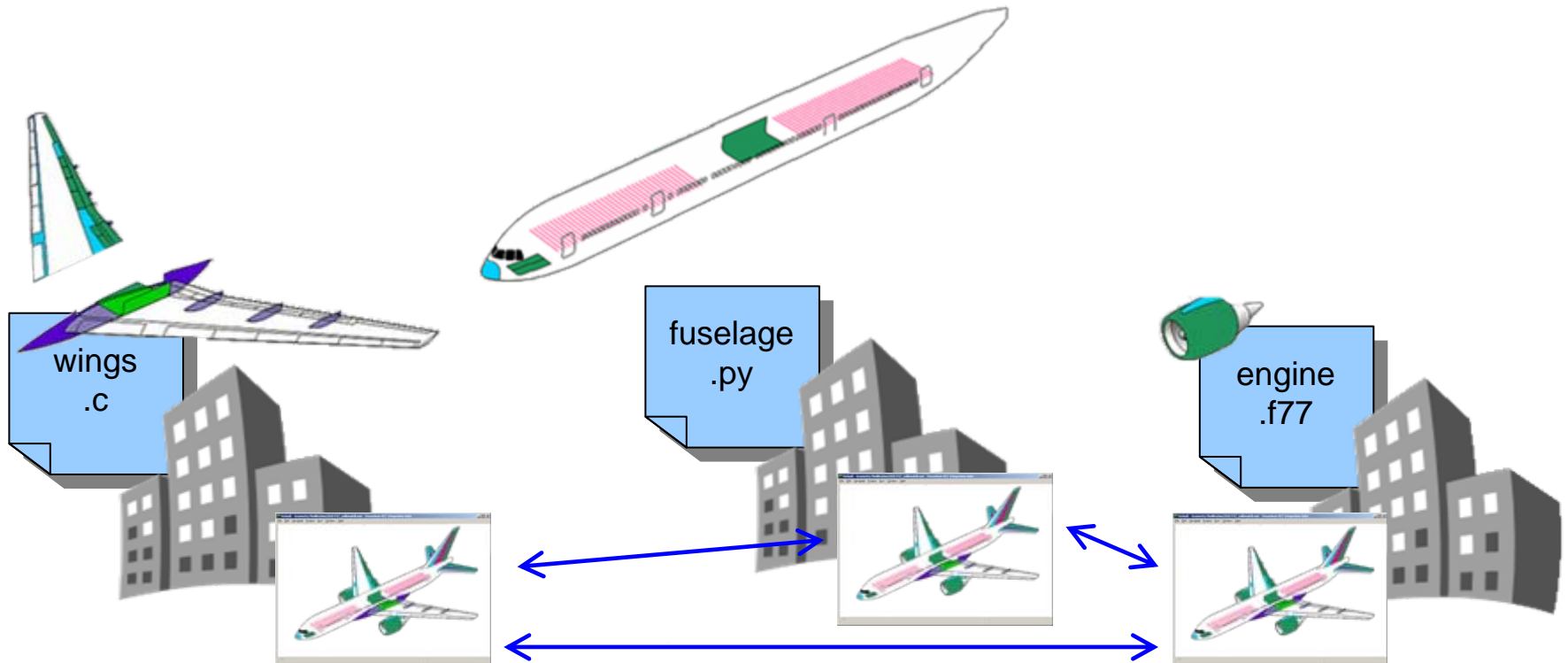
RCE

Software Integration Platform



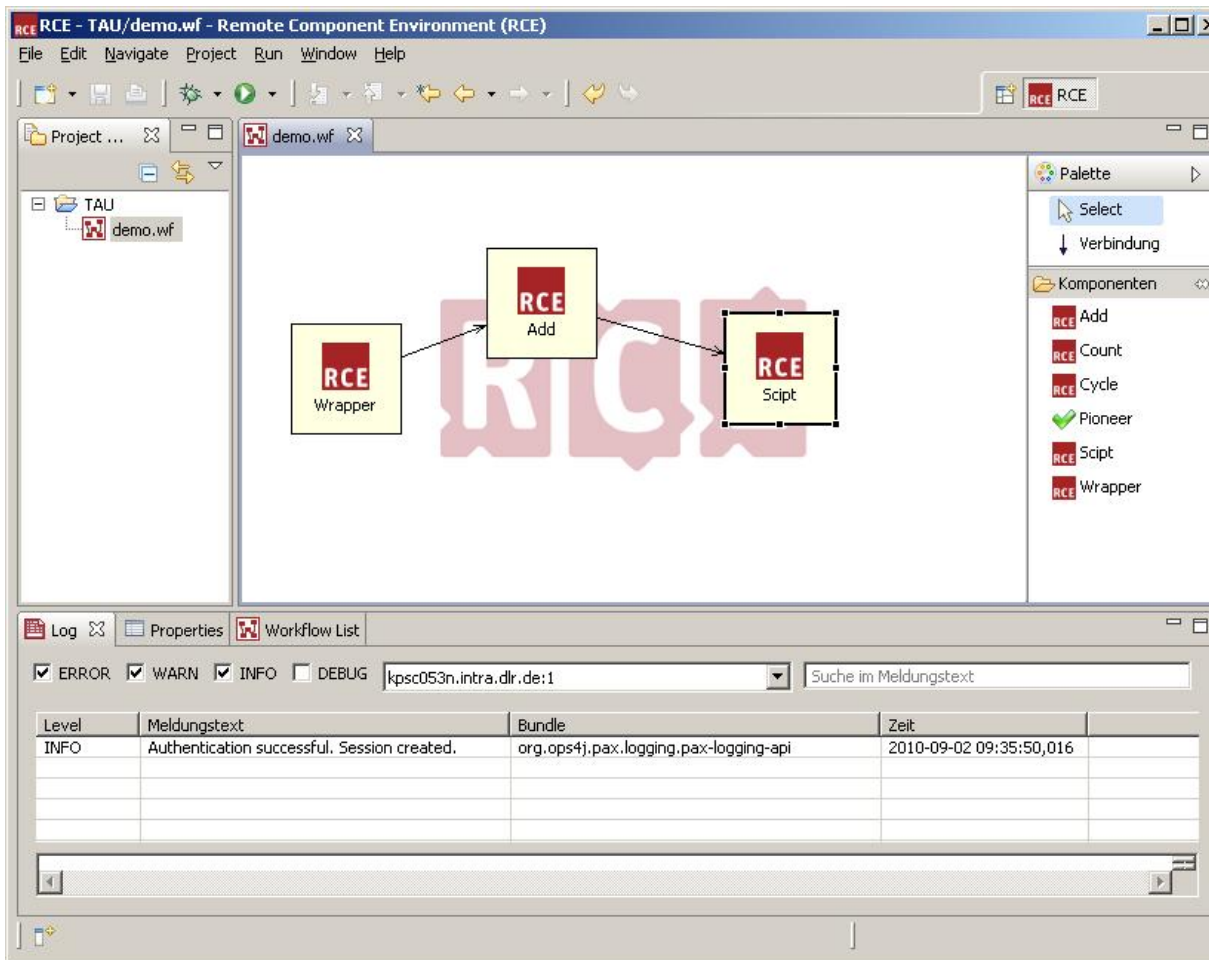
Motivation for DLR

- One platform containing many specific applications



RCE

Software Integration Platform



Built on Top of RCE: SESIS

Ship Design and Simulation System



- Simulation environment for the early design of ships



SEGIS

Ship Design and Simulation System



Propeller - ex.pff - Reconfigurable Computing Environment

File Edit Navigate Project Propeller Window Help

Propeller Lightship Weight Default

*UND SKAL, D=5.7M *ex.pff

baute Propeller
propeller
Ship1
SHIPDATA
cfdd.lock
cfdd.mox
complete
geom.loc
geom.mox
load.lock
load.mox
main.lock
main.mox
prop.mox
Cosn
Prop
resi.lock
resi.mox
room.lock
room.mox
wght.lock
wght.mox
Ship2
SHIPDATA

Number of blades: 4
Clockwise orientation:
Radius: 3,050 m
Volume: 0,456 m³
Volume moment of inertia: 1,446 m³ m²
Design pitch ratio: 1,160 1
Design chord: 2,836 m
Design rake: 0,076 m
Disc area: 29,225 m²
Developed area ratio: 0,696 1
Projected area ratio: 0,597 1
Skew: 44,798 °

Color

General Profiles Extended PFF

Problems

0 errors, 2 warnings, 0 infos (Filter matched 2 of 35 items)

Description	Resource	Path	Location
Warnings (2 items)			
Maximum relative profile radius $t=1$	ex.pff	Propeller	Unknown
Profile.relRadius > 1	ex.pff	Propeller	Unknown

Blade Characteristics Chart ex.pff

Blade Comparison Chart chi

3D Propeller

SVG View

Profile View 2D

Operation Toolbox Logging Browser

Propeller

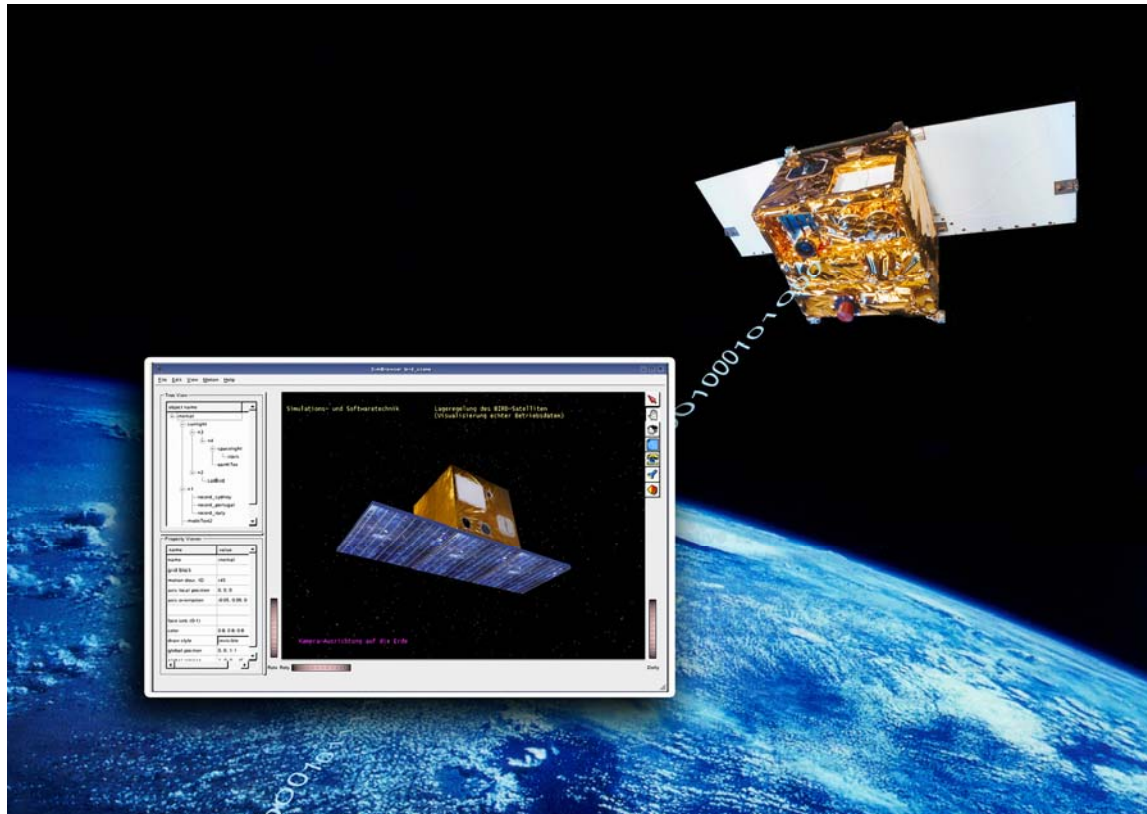
- blade
 - pitch
 - rake
 - scale
 - add
 - chord
 - chi
 - camber
 - thickness

Restore Defaults Perform

44M of 124M

Built on Top of RCE: VirSat Virtual Satellite

- Simulation environment for the early design of spacecrafts



VirSat

Virtual Satellite

The screenshot displays the VirSat software interface for configuring a virtual satellite. The main window is titled "Resource - N/A - Virtueller Satellit".

Study Navigator: Shows a hierarchical tree structure of the satellite components: ExampleRepoLUID, Ahab, Ahab2, AOCS, CDSH, Payload, Power, Battery, Battery, Battery, and Battery.

Power Component Configuration:

- Power ID:** e4c34c48-b0a1-4daf-ab42-b0db87c87a23
- Discipline assignment:** POWER (selected), with an "Apply Discipline" button.
- Mode assignment:** No Mode (selected), with an "Apply Mode" button.
- Output Parameters:** A table listing parameters for the system component.

Name	Current Value	Unit	Shared	Origin	Description
length	0.5	m	no	Inserted	N/A
Mass	3.1	kg	no	Inserted	N/A
Power	2.0	W	yes	Inserted	N/A
Temperature	210.0	K	no	Overwritten	N/A
- Calculations:** A table showing calculations for the system component.

Calculation type	System-Component	Parameter	Value	Unit	Description
Sum	...	Mass	3.1	kg	N/A
Sum	...	Mass	3.1	kg	N/A

Orbit Viewer (VTK): A 3D visualization of the Earth with a red orbital path around it, and a bright sun in the background.

Repository Manager: A table listing repositories and their components.

Name	Proxy	Repository	No. Components	Changed
ExampleRepoLUID	Subversion	Project	20 Components	no

Tasks:

- Current primary discipline:** SYSTEM
- Available Disciplines:** AOCS, COMMS, CONFIGURATION, COST, DATAHANDLING, DLS, GNC, INSTRUMENTS, LIFESUPPORT, MISSION, PROPULSION, SIMULATION, THERMAL, ADMIN.
- Assigned Disciplines:** SYSTEM, STRUCTURE, POWER, HARNESS, MECHANISMS, RADIATION.
- Buttons: Add discipline, Remove discipline, Set primary.

Built on Top of RCE: Chameleon

Multidisciplinary Integration Environment

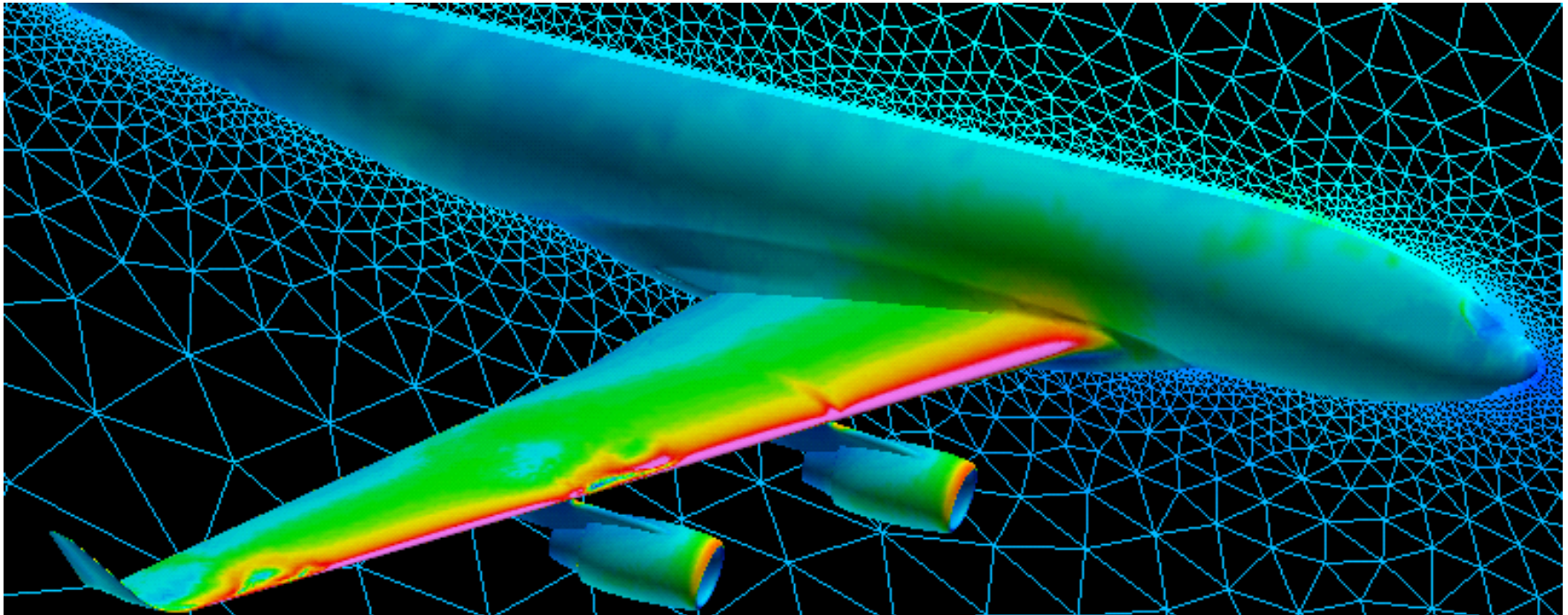


- A simulation environment for the early design of new aircraft configurations
- Chameleon should enable engineers to
 - Integrate any simulation tool
 - Communicate data between simulation tools



Chameleon

Multidisciplinary Integration Environment

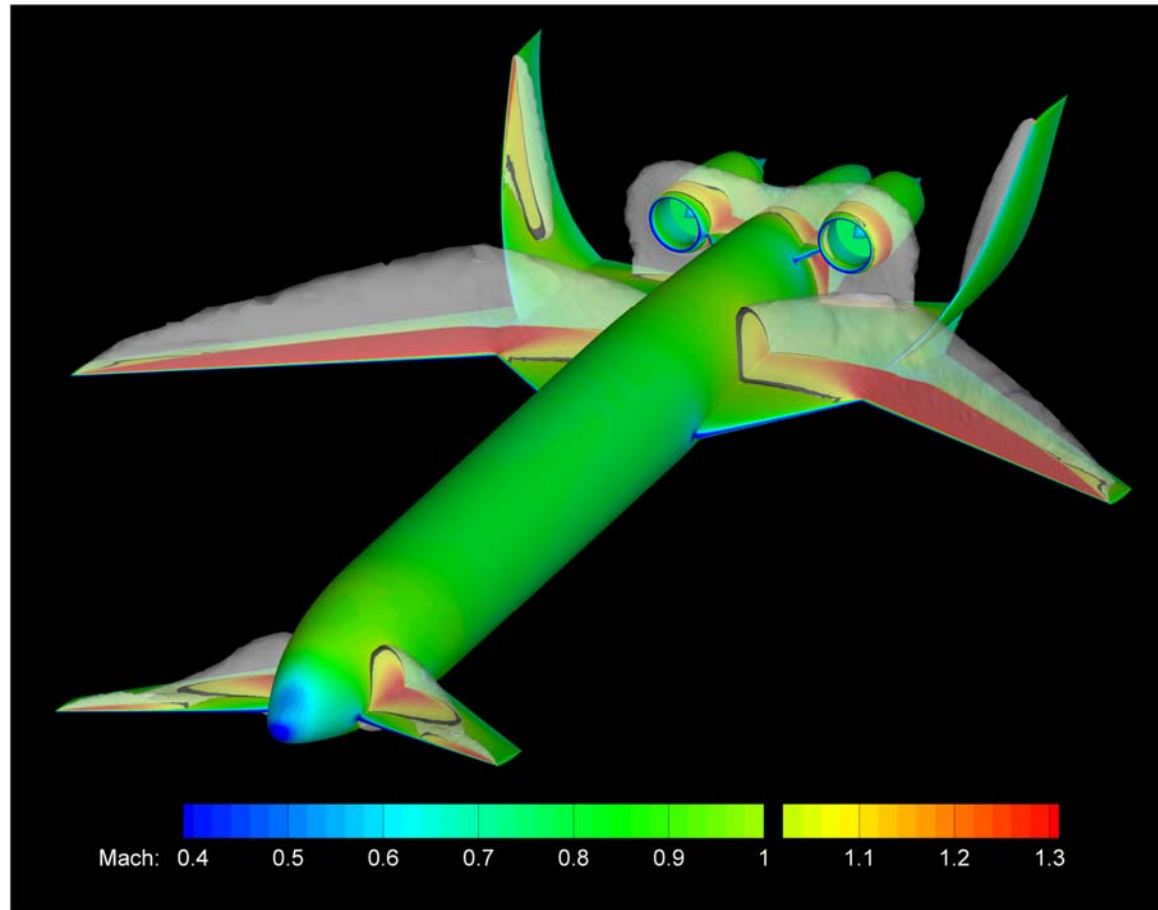


- Build up simulation processes and workflow
- Optimizing aircraft configurations



Chameleon

Multidisciplinary Integration Environment



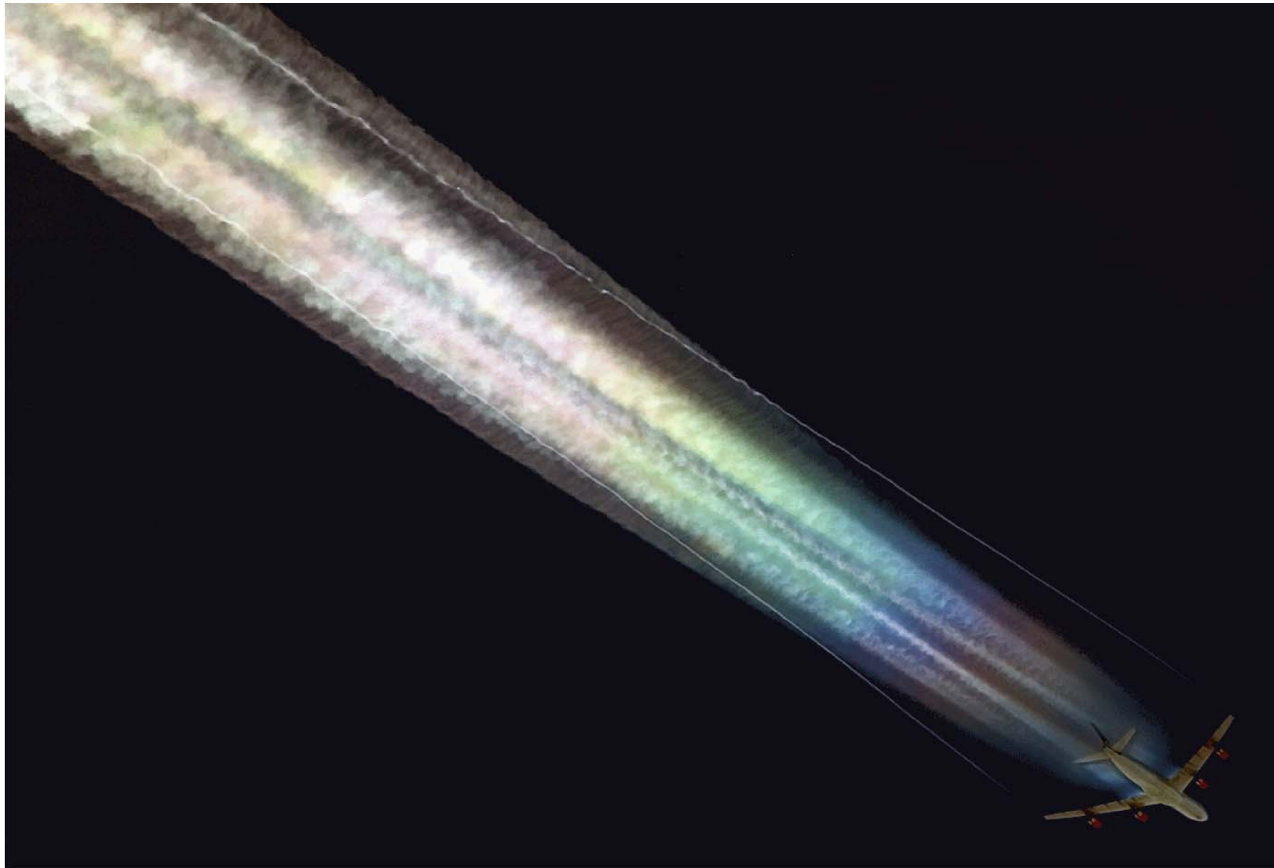
Creating experimental aircraft configurations





Chameleon

Multidisciplinary Integration Environment



Simulating climate impacts





Chameleon

Multidisciplinary Integration Environment

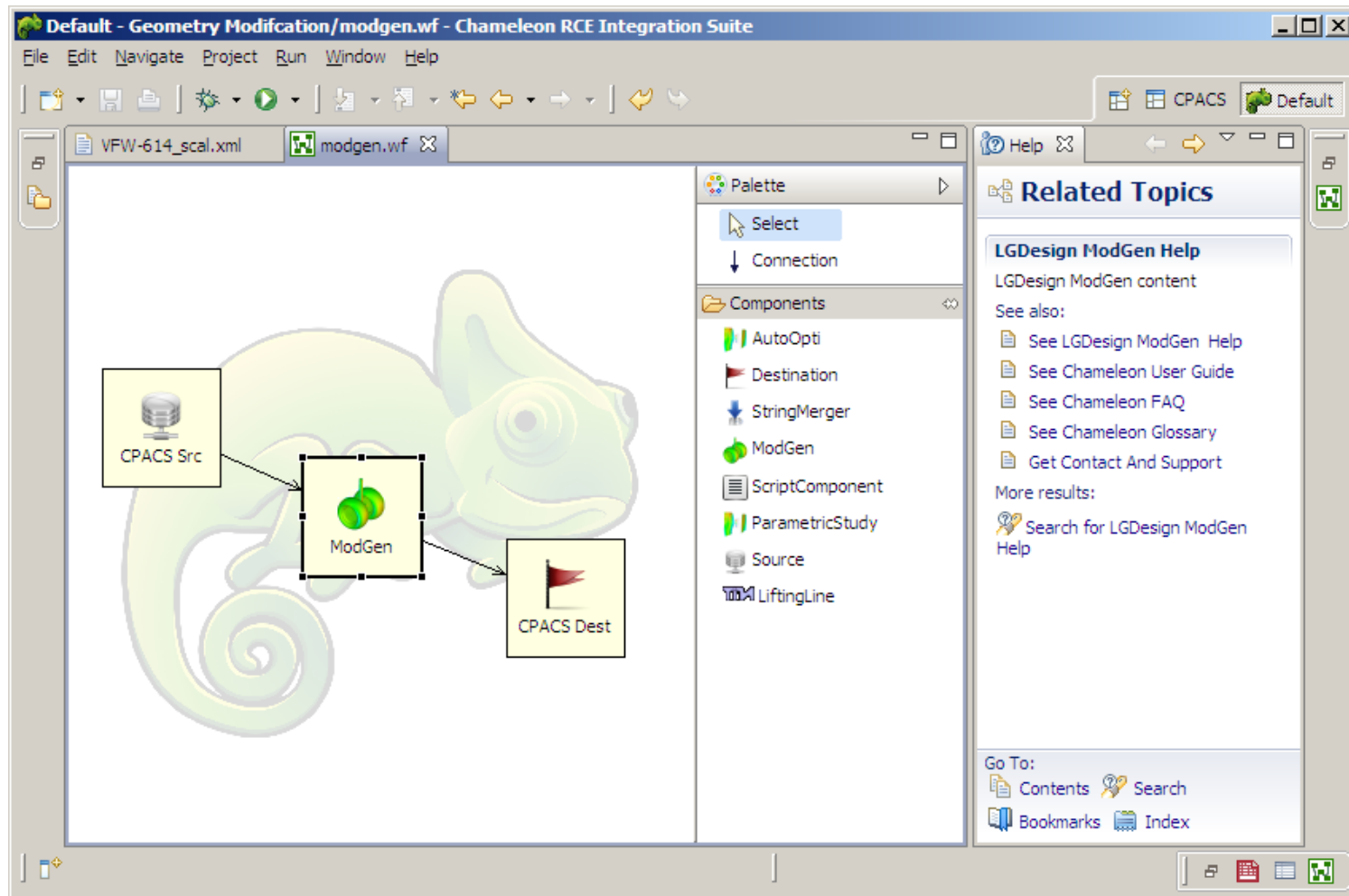


Simulating the air transport system



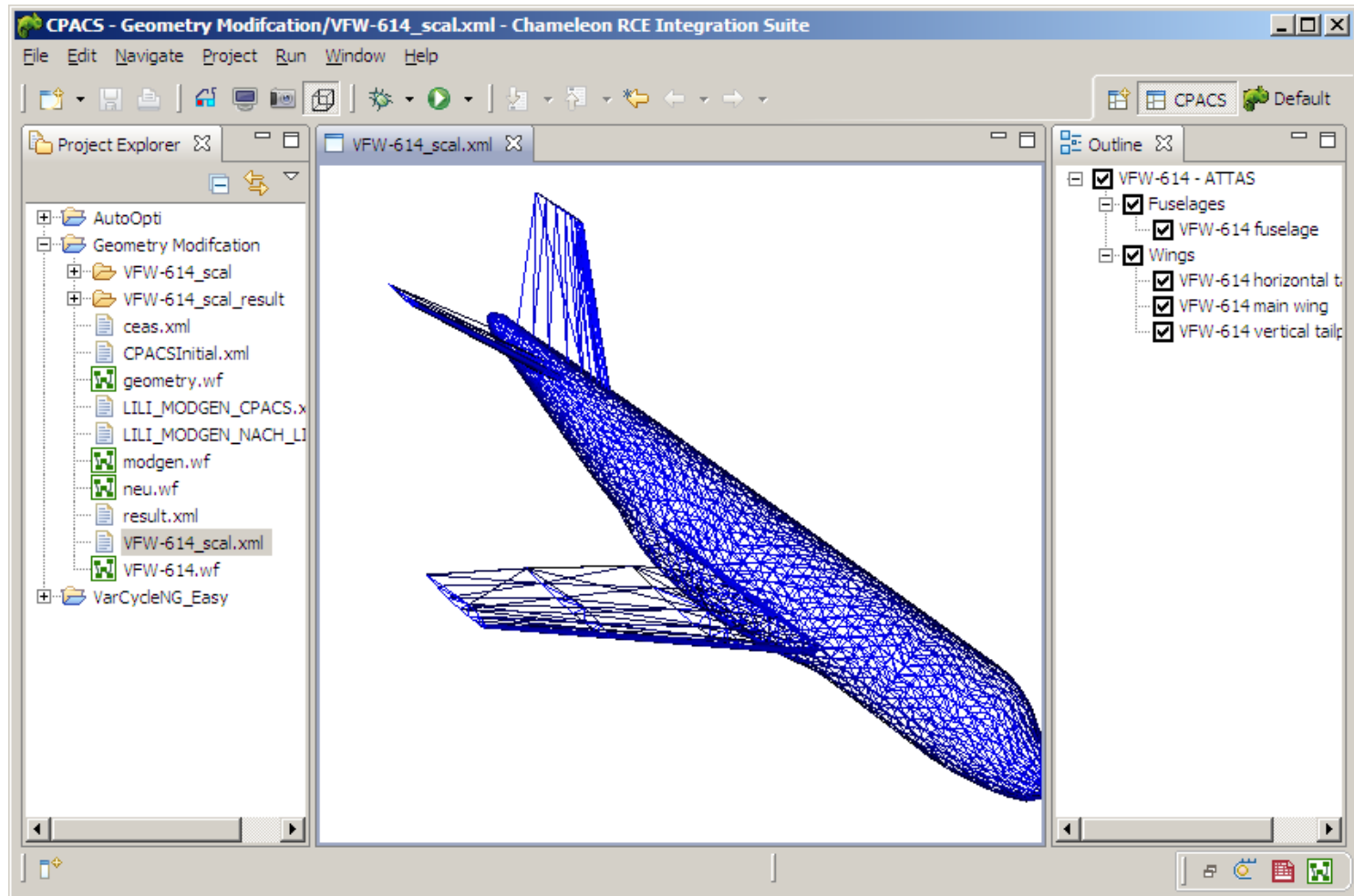
Chameleon

Multidisciplinary Integration Environment



Chameleon

Multidisciplinary Integration Environment



Open Source Software from DLR: RepoGuard



- Content validation framework for version control systems



- Apache License V2.0
- <http://repguard.tigris.org/>

RepoGuard

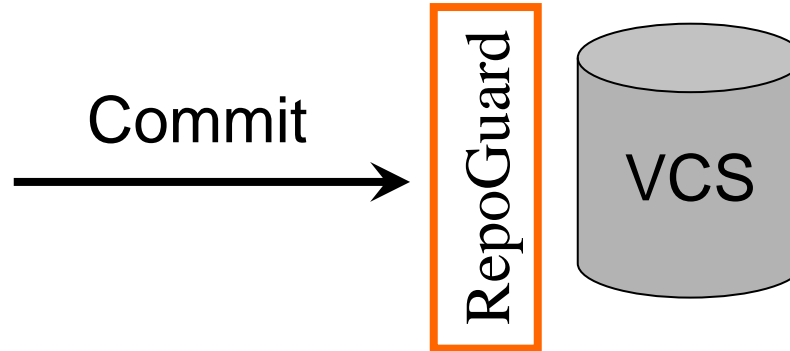
Validation Framework for VCS's

➤ Motivation for DLR

- Scientists develop software, but are not software developer
- Essential: tool support to ensure a good code base and the compliance with code conventions

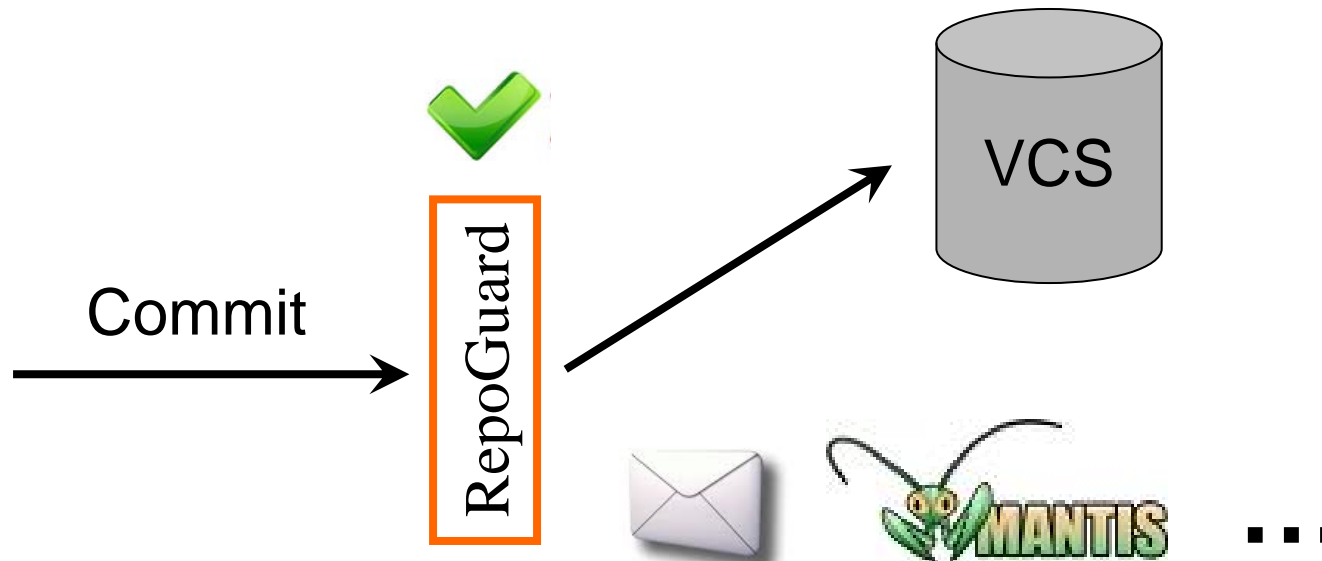
```

01522 Private Function CleanUpLine(ByVal sLine As String) As String
01523     Dim lQuoteCount As Long
01524     Dim lCount     As Long
01525     Dim sChar      As String
01526     Dim sPrevChar  As String
01527
01528     ' Starts with Rem it is a comment
01529     sLine = Trim(sLine)
01530     If Left(sLine, 3) = "Rem" Then
01531         CleanUpLine = ""
01532         Exit Function
01533     End If
01534
01535     ' Starts with ' it is a comment
01536     If Left(sLine, 1) = "'" Then
01537         CleanUpLine = ""
01538         Exit Function
01539     End If
01540
01541     ' Contains ' may end in a comment, so test if it is a comment or in the
01542     ' body of a string
01543     If InStr(sLine, "'") > 0 Then
01544         sPrevChar = ""
01545         lQuoteCount = 0
01546
01547         For lCount = 1 To Len(sLine)
01548             sChar = Mid(sLine, lCount, 1)
01549
01550             ' If we found "" then an even number of " characters in front
01551             ' means it is the start of a comment, and odd number means it is
01552             ' part of a string
01553             If sChar = "" And sPrevChar = "" Then
01554                 If lQuoteCount Mod 2 = 0 Then
01555                     sLine = Trim(Left(sLine, lCount - 1))
01556                     Exit For
01557                 End If
01558             ElseIf sChar = "" Then
01559                 lQuoteCount = lQuoteCount + 1
01560             End If
01561             sPrevChar = sChar
01562         Next lCount
01563     End If
01564     CleanUpLine = sLine
01565 End Function
    
```



RepoGuard

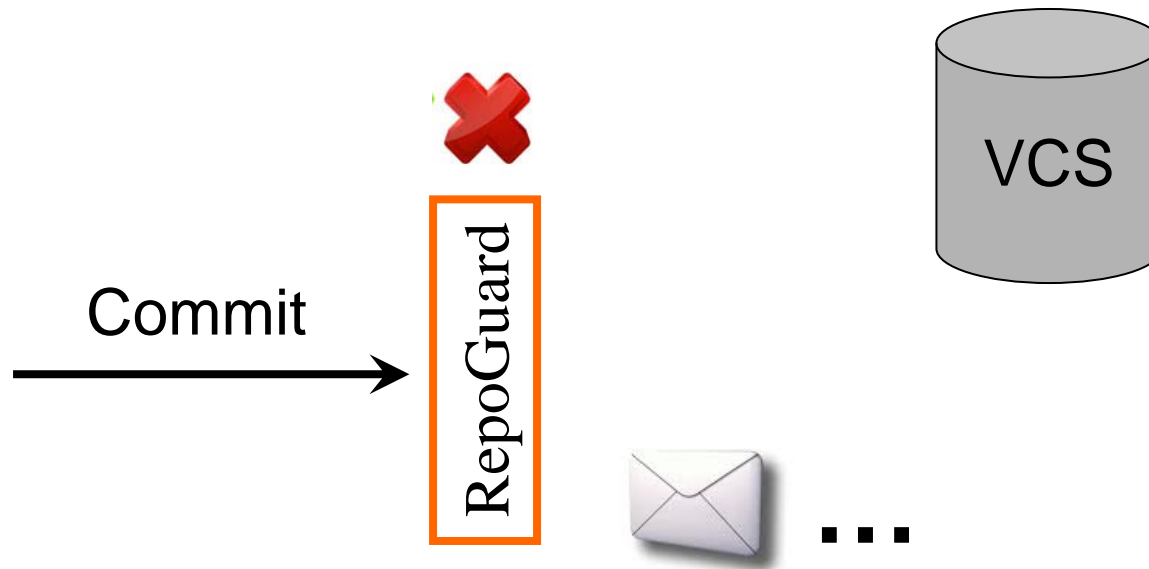
Validation Framework for VCS's



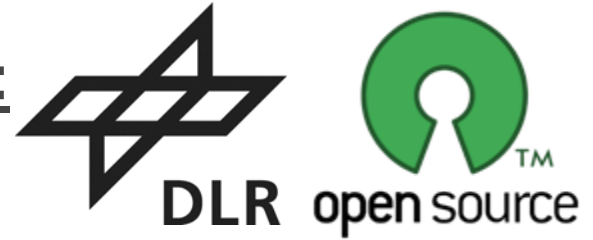


RepoGuard

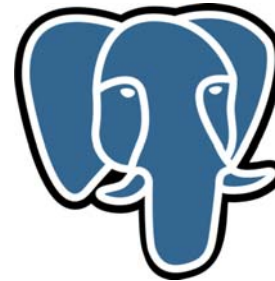
Validation Framework for VCS's



Open Source Software from DLR: DataFinder



➤ DataFinder: Scientific Data Management

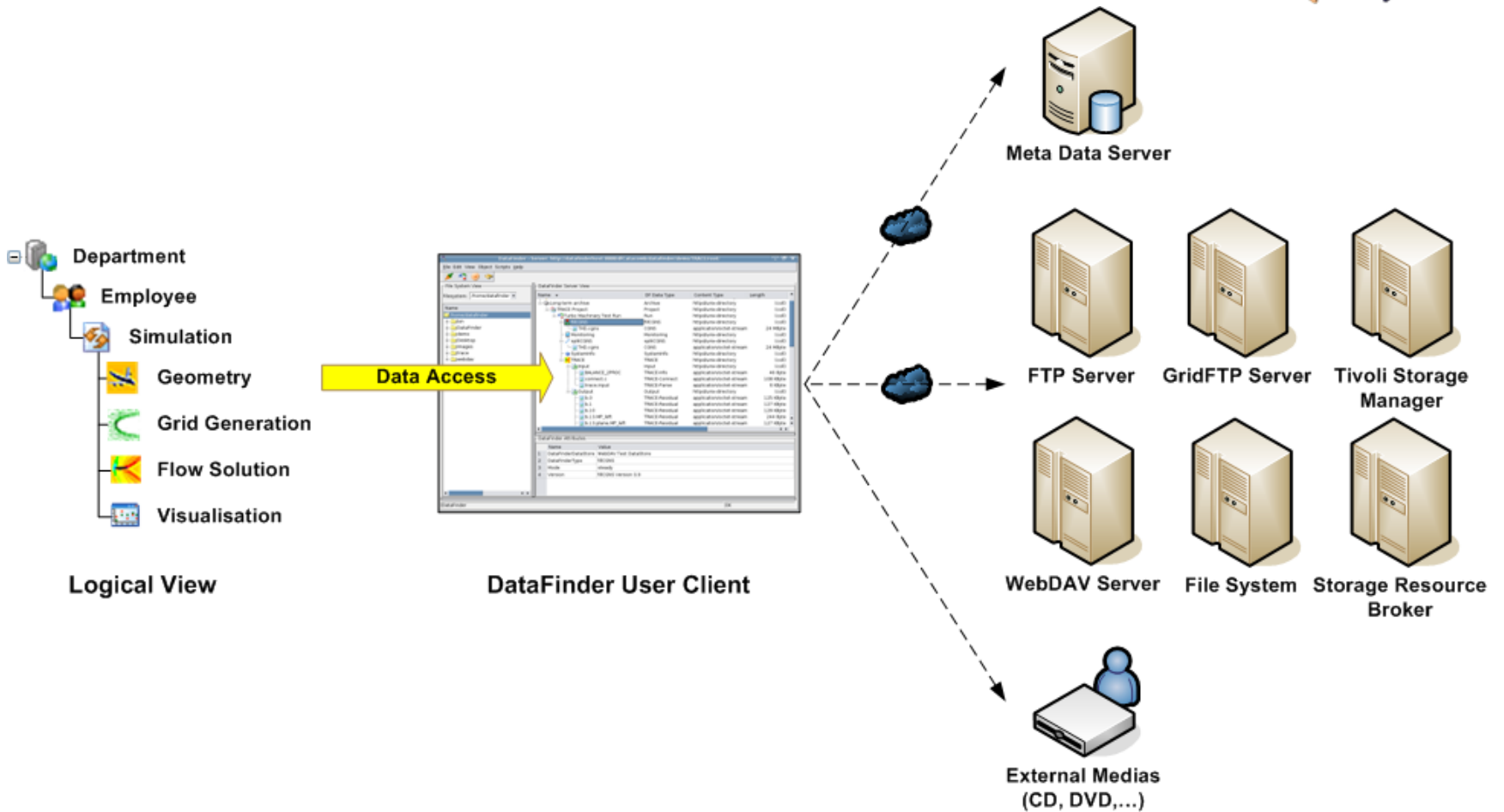


➤ BSD License

➤ <http://sourceforge.net/projects/datafinder/>



DataFinder Motivation



DataFinder

Graphical User Client



DataFinder - Server: http://192.168.211.130/datafinder/data/trace/

File Edit View Object Scripts Help

File System View

Drives: C:\

Name	Size
RECYCLER	(directory)
RHDSetup.log	563 Byte
System Volume Information	(directory)
tmp	(directory)
trace_63	(directory)
cgns	(directory)
BALANCE_PROC	15 Byte
input.cgns	135.289 MByte
input.cgns.backup	135.289 MByte
input	(directory)
trace.input	3.418 KByte
trace.solverinfo	1.442 KByte
TRACE_entry.input	898 Byte
TRACE_ext.input	25 Byte
TRACE_S2.input	174 Byte
post	(directory)
residual	(directory)
blk.0	12.152 KByte
blk.1	12.040 KByte
blk.2	12.042 KByte
blk.3	12.033 KByte
blk.4	12.085 KByte
blk.5	12.060 KByte
run.sh	1.129 KByte
run.sh.e1235	24 Byte
run.sh.o1235	17.616 KByte

DataFinder Server View

Name	Data Type	Content Type	Size	Modification Date	Creation Date	Owner
trace	Project	httpd/unix-directory	0 Byte	12. Feb. 16:52	12. Feb. 16:52	
MTU-12	User	httpd/unix-directory	0 Byte	17. Feb. 11:37	17. Feb. 11:37	
Müller	Project	httpd/unix-directory	0 Byte	17. Feb. 11:41	17. Feb. 11:41	
Verdichter	Run	httpd/unix-directory	0 Byte	17. Feb. 11:51	17. Feb. 11:51	
BC_Fourier	Monitoring	httpd/unix-directory	0 Byte	17. Feb. 11:52	17. Feb. 11:52	
SystemInfo	SystemInfo	httpd/unix-directory	0 Byte	17. Feb. 11:52	17. Feb. 11:52	
TRACE	TRACE	httpd/unix-directory	0 Byte	17. Feb. 11:51	17. Feb. 11:51	
Input	Input	httpd/unix-directory	0 Byte	17. Feb. 11:51	17. Feb. 11:51	
BALANCE_1PROC	TRACE-Info	application/octet-stream	15 Byte	17. Feb. 11:51	17. Feb. 11:51	
stcf10_1.cgns	CGNS	application/octet-stream	135.289 MByte	17. Feb. 11:51	17. Feb. 11:51	
TRACE_control.input	TRACE-Parse	application/octet-stream	3.334 KByte	17. Feb. 11:51	17. Feb. 11:51	
TRACE_entry.input	TRACE-Entry	application/octet-stream	898 Byte	17. Feb. 11:51	17. Feb. 11:51	
TRACE_ext.input	TRACE-Exit	application/octet-stream	25 Byte	17. Feb. 11:52	17. Feb. 11:52	
TRACE_S2.input	TRACE-S2	application/octet-stream	174 Byte	17. Feb. 11:51	17. Feb. 11:51	
Output	Output					
BC_Giles1	Run					
BC_Giles2	Run					
BC_Riemann	Run					

DataFinder Attributes

Name	Value
1 CPUs	5
2 Data Type	TRACE
3 Version	6.3.72

Start Run

Resource

Back-end: UNICORE 6

Machine to run the job: aerogrid.dlr.de:443/AEROGRID

TRACE

Compile from source

Use existing executable

\$HOME/trace_63/TRACE

OK Cancel

Log Search Results Script Output

16:33:35: INFO: Search results for [Data Type == Run]:
16:33:35: INFO:

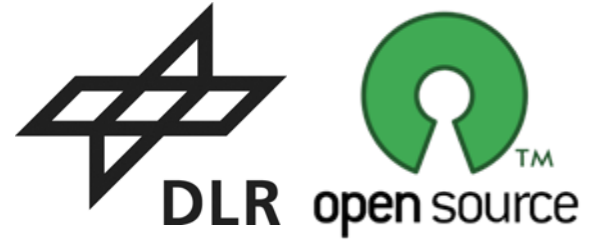
- /datafinder/data/trace/Müller/Verdichter/BC_Fourier
- /datafinder/data/trace/Müller/Verdichter/BC_Riemann
- /datafinder/data/trace/Müller/Verdichter/BC_Giles1
- /datafinder/data/trace/Müller/Verdichter/BC_Giles2

4 item(s) found.

DataFinder OK



Open Source Software from DLR: Catacomb



- Catacomb: WebDAV Server Module for Apache



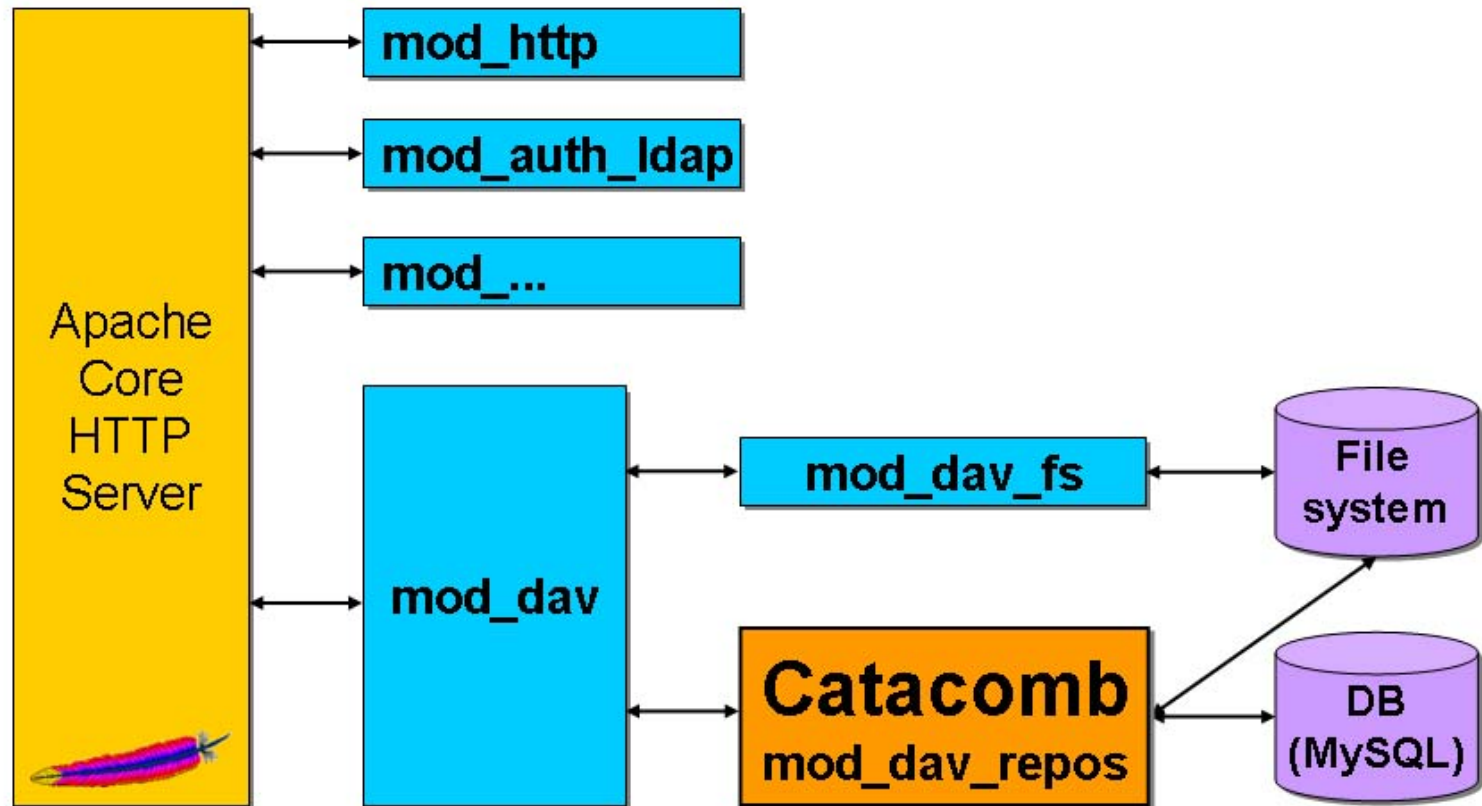
Apache

- Apache License V2.0
- <http://catacomb.tigris.org>



Catacomb

A WebDAV Server Module for Apache



Catacomb

DLR – NASA cooperation

- DLR contributes, but different others fork
- NASA Ames:
 - Early contributor
 - Fork later
- Problem of code property
 - Solved through opening the code



Open Source in Aeronautics and Space Research

Conclusion

- We make our software more and more available as open source
 - Enables contribution
 - Supports cooperation
- We use more and more open source
 - Profiting by stability of open source code
 - Writing less code





Questions?