Designing Future Aircraft with Eclipse RCP

EclipseCon Europe 2013

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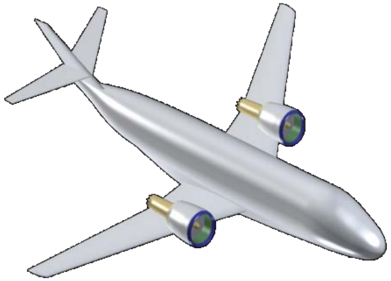
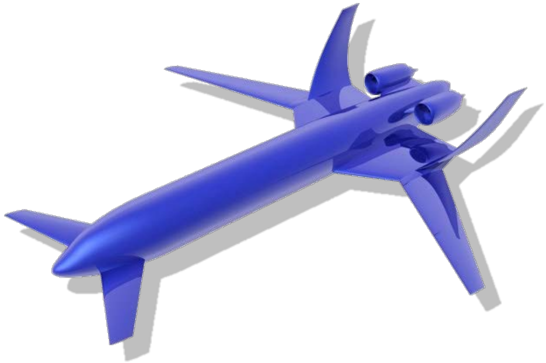
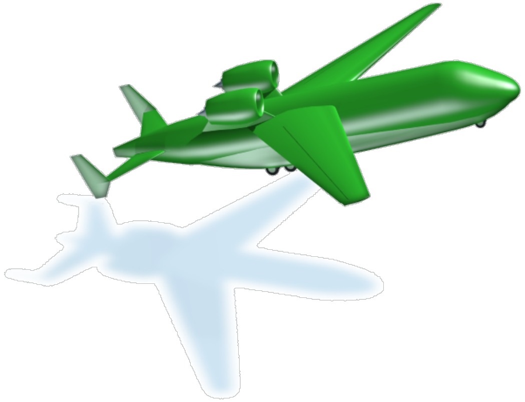
DLR

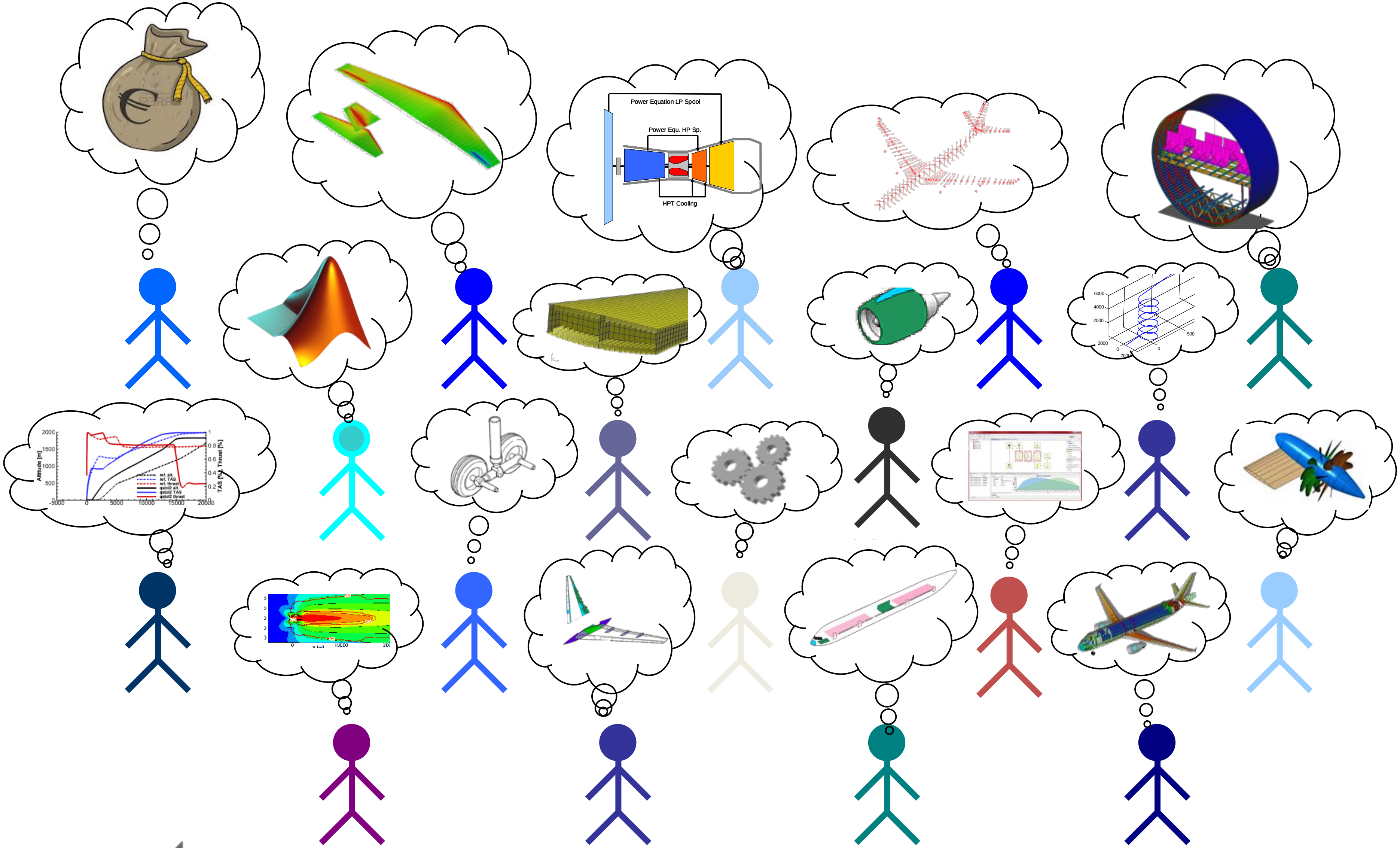
Future Aircraft Design

- Get new aircraft configurations which
  - are more environment-friendly
  - require less operating costs








Power Equation LP Spool
Power Equ. HP Sp.
HPT Cooling
6000
4000
2000
2000
-500
Altitude [m]
2000
1500
1000
500
-5000
0
5000
10000
15000
20000
TAS [%], Thrust [%]
1
0.8
0.6
0.4
0.2
ref. alt.
ref. TAS
ref. thrust
qstol2 alt.
qstol2 TAS
qstol2 thrust

RCE: Software for Future Aircraft Design

- DLR (German Aerospace Center) develops software for future aircraft design called RCE (Remote Component Environment)
- RCE enables multidisciplinary collaboration to help experts from different disciplines to solve overall aircraft design task in common
- We built RCE on Eclipse RCP and made it open source (EPL)

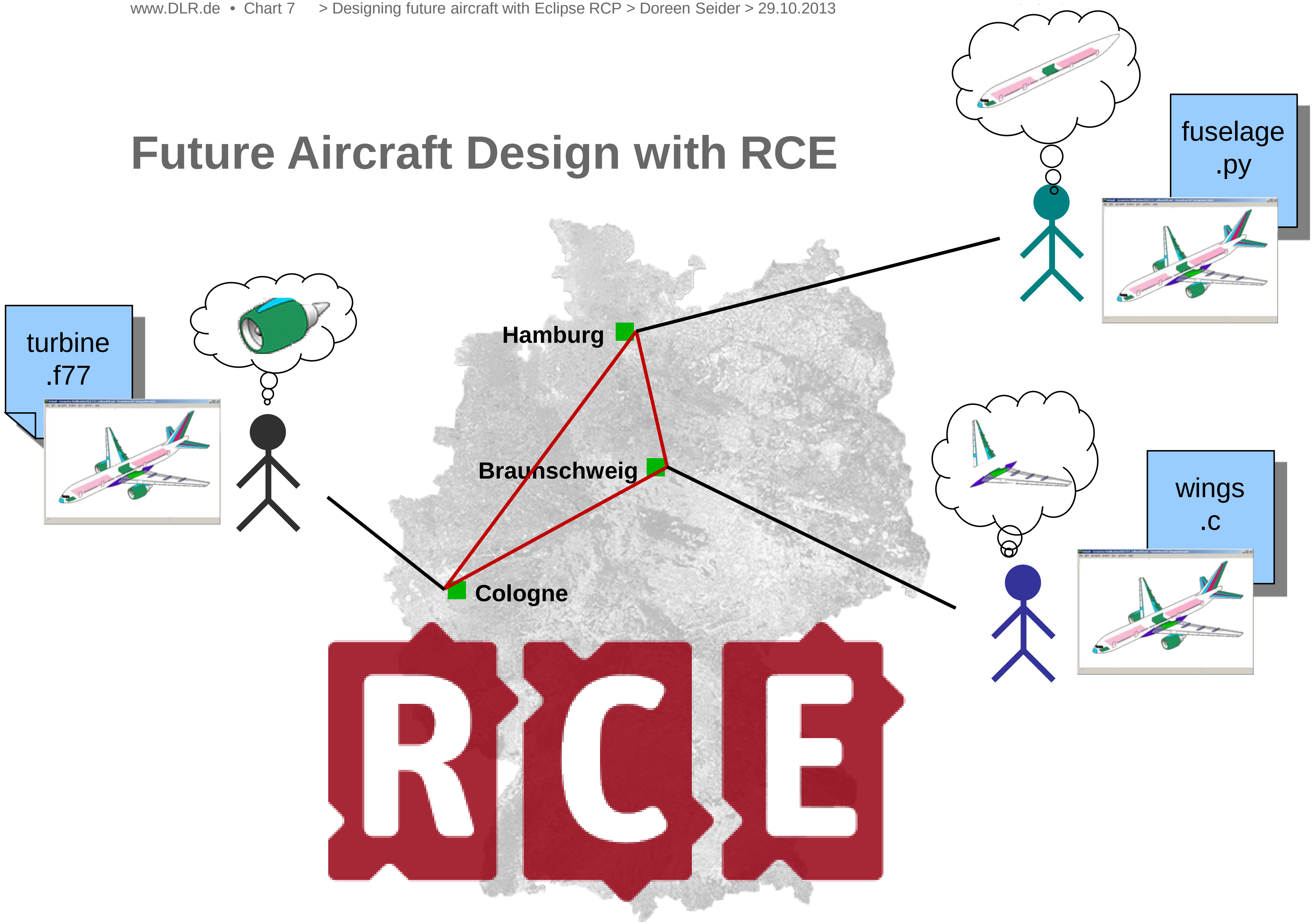
Outline

- Short introduction of RCE
- Selected aspects of RCE regarding Eclipse RCP
  - Modularity
  - Usability
  - Distribution management
- Example projects at DLR using RCE

Why Eclipse RCP?

- Decision was made in 2006 as the development of RCE had started
- Reason was (mainly) OSGi, providing a component model, which
  - Sounded promising
  - Was standardized
- On a second note, it was important that basic „stuff“ can be re-used and don‘t needed to be implemented from scratch

Future Aircraft Design with RCE



turbine .f77

fuselage .py

wings .c

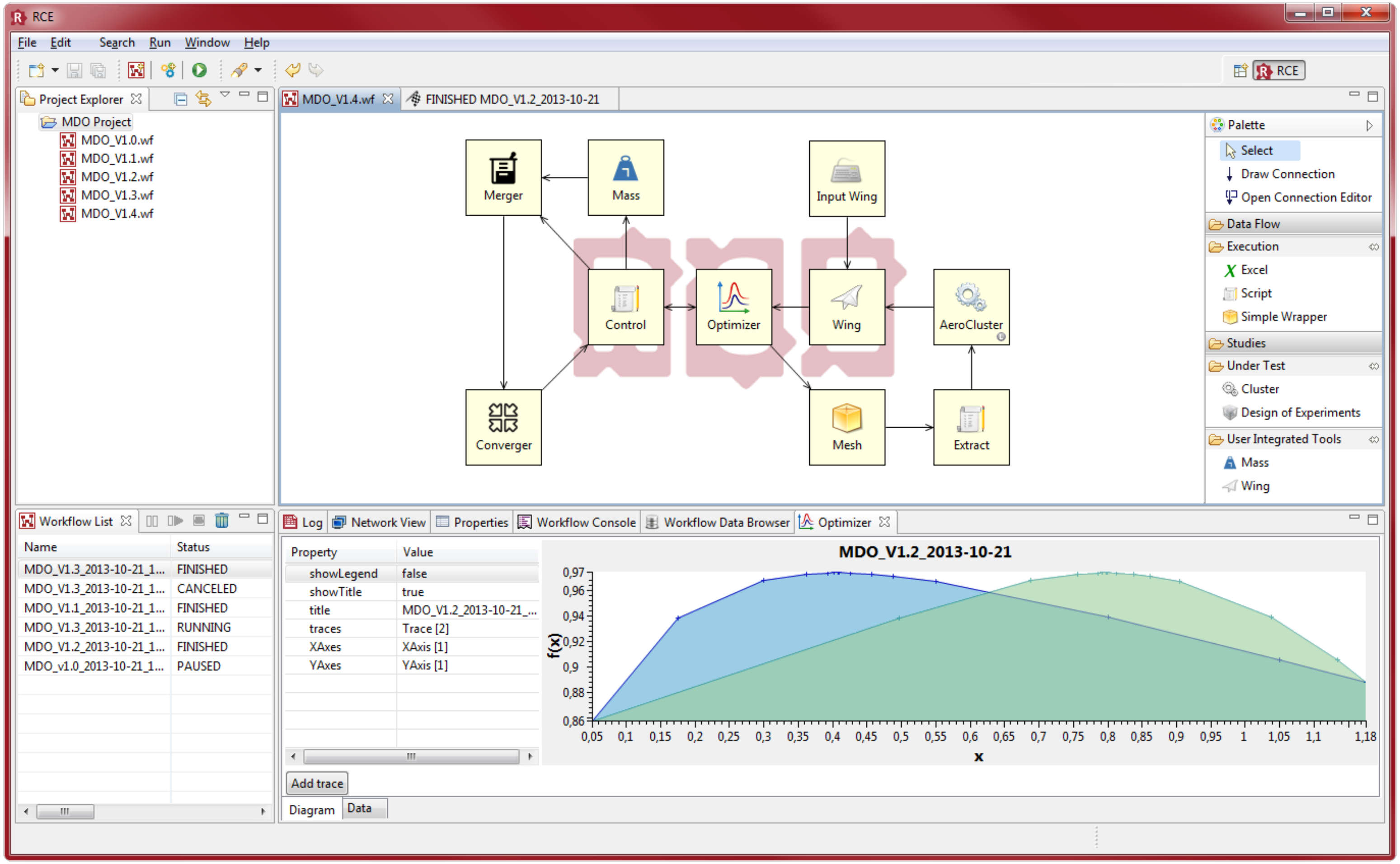
Hamburg

Braunschweig

Cologne

RCE

Graphical User Client of RCE



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MDO_V1.2_2013-10-21_1...	FINISHED
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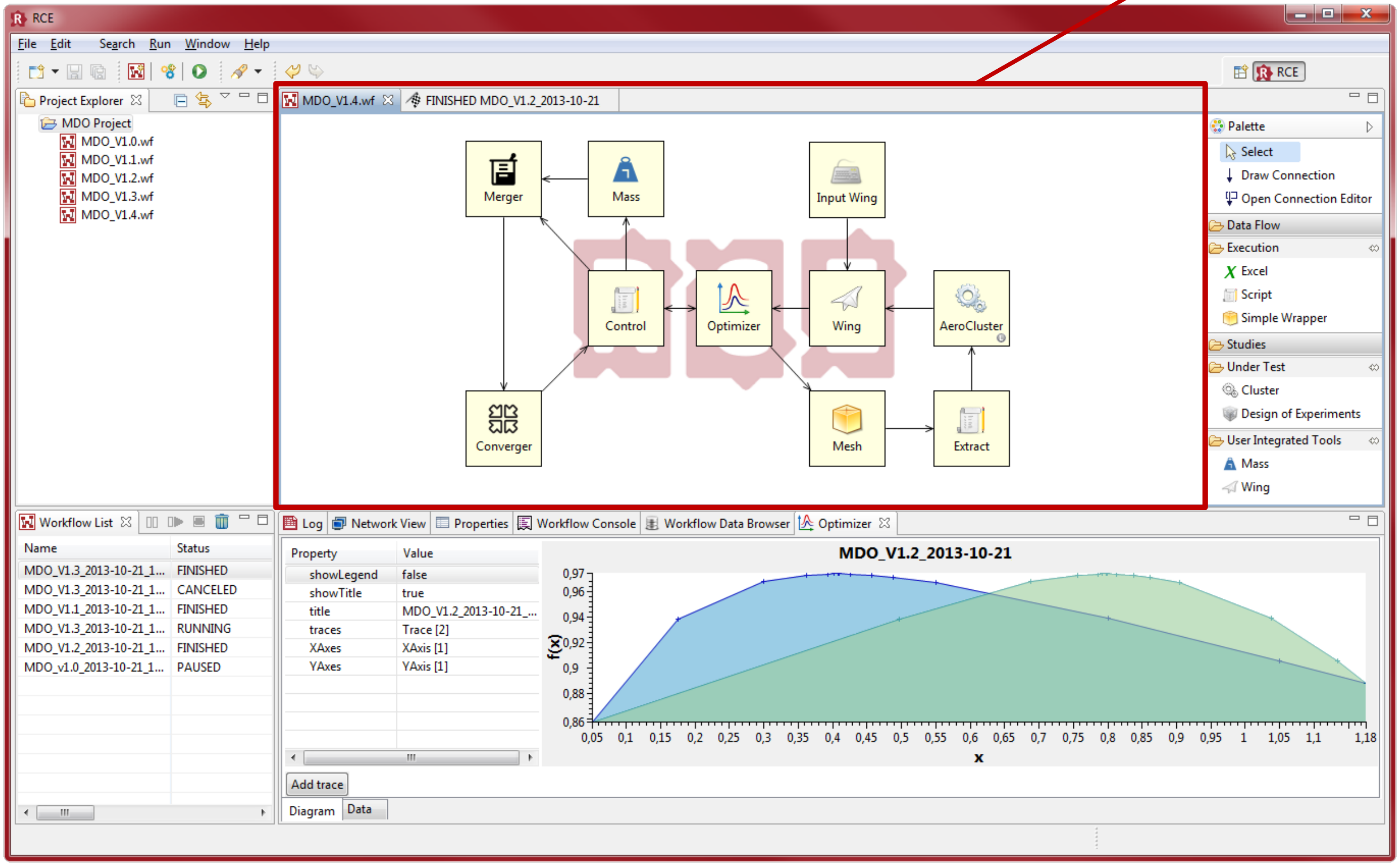
traces	Trace [2]
XAxes	XAxis [1]
YAxes	YAxis [1]

Graphical User Client of RCE

Couple aircraft design tools to executable workflows



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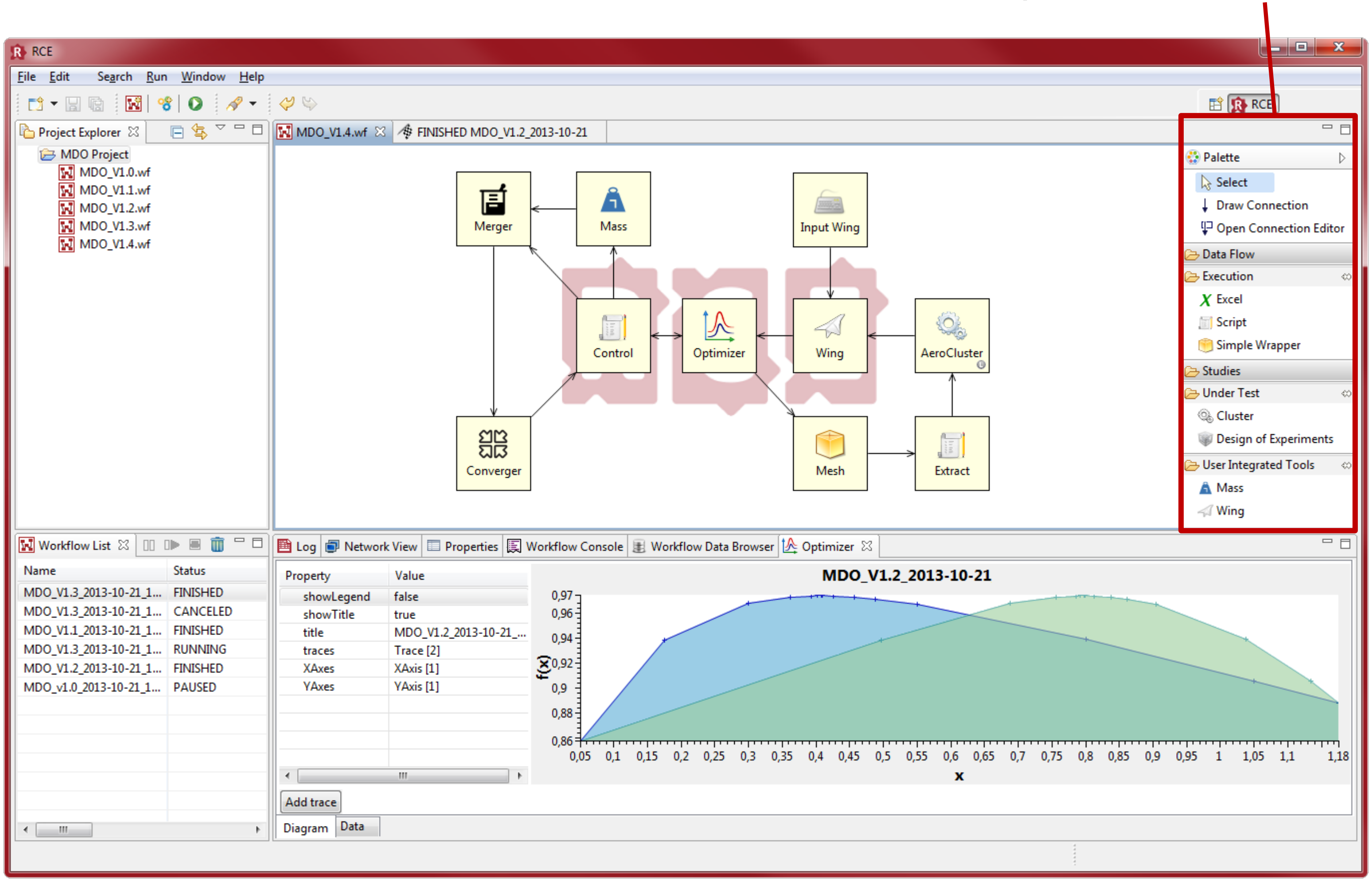
Graphical User Client of RCE

Extend RCE with external aircraft design tools and publish them for others



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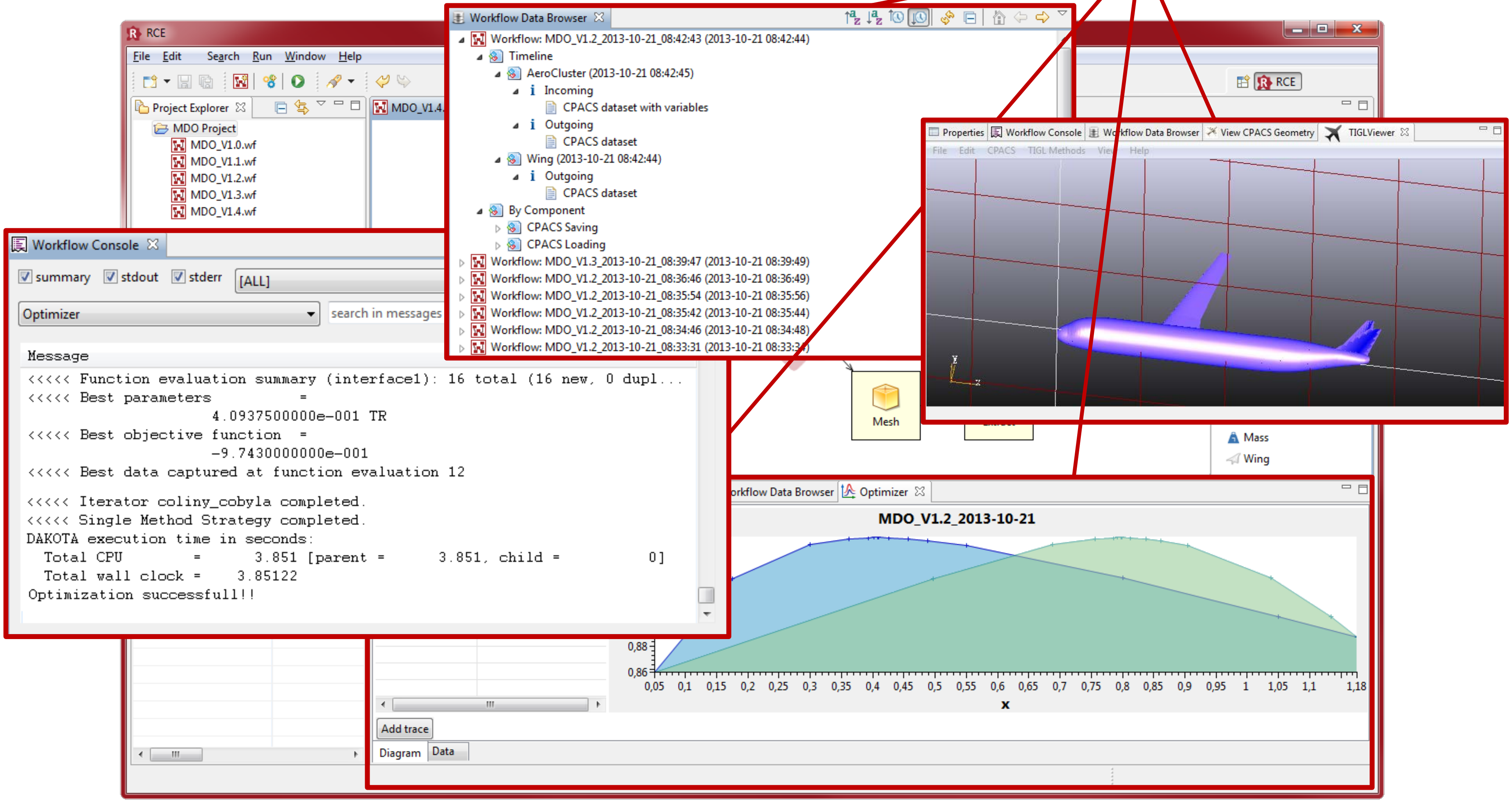
Graphical User Client of RCE

See results of workflow runs



Workflow Data Browser

- Workflow: MDO_V1.2_2013-10-21_08:42:43 (2013-10-21 08:42:44)
  - Timeline
    - AeroCluster (2013-10-21 08:42:45)
      - Incoming
        - CPACS dataset with variables
      - Outgoing
        - CPACS dataset
    - Wing (2013-10-21 08:42:44)
      - Outgoing
        - CPACS dataset
  - By Component
    - CPACS Saving
    - CPACS Loading
- Workflow: MDO_V1.3_2013-10-21_08:39:47 (2013-10-21 08:39:49)
- Workflow: MDO_V1.2_2013-10-21_08:36:46 (2013-10-21 08:36:49)
- Workflow: MDO_V1.2_2013-10-21_08:35:54 (2013-10-21 08:35:56)
- Workflow: MDO_V1.2_2013-10-21_08:35:42 (2013-10-21 08:35:44)
- Workflow: MDO_V1.2_2013-10-21_08:34:46 (2013-10-21 08:34:48)
- Workflow: MDO_V1.2_2013-10-21_08:33:31 (2013-10-21 08:33:34)

Workflow Console

☑ summary ☑ stdout ☑ stderr [ALL]

Optimizer — search in messages

```
Message
<<<<< Function evaluation summary (interface1): 16 total (16 new, 0 dupl...
<<<<< Best parameters          =
                     4.0937500000e-001 TR
<<<<< Best objective function  =
                    -9.7430000000e-001
<<<<< Best data captured at function evaluation 12

<<<<< Iterator coliny_cobyla completed.
<<<<< Single Method Strategy completed.
DAKOTA execution time in seconds:
  Total CPU        =      3.851 [parent =      3.851, child =          0]
  Total wall clock =    3.85122
Optimization successfull!!
```

RCE Enables Multidisciplinary Collaboration

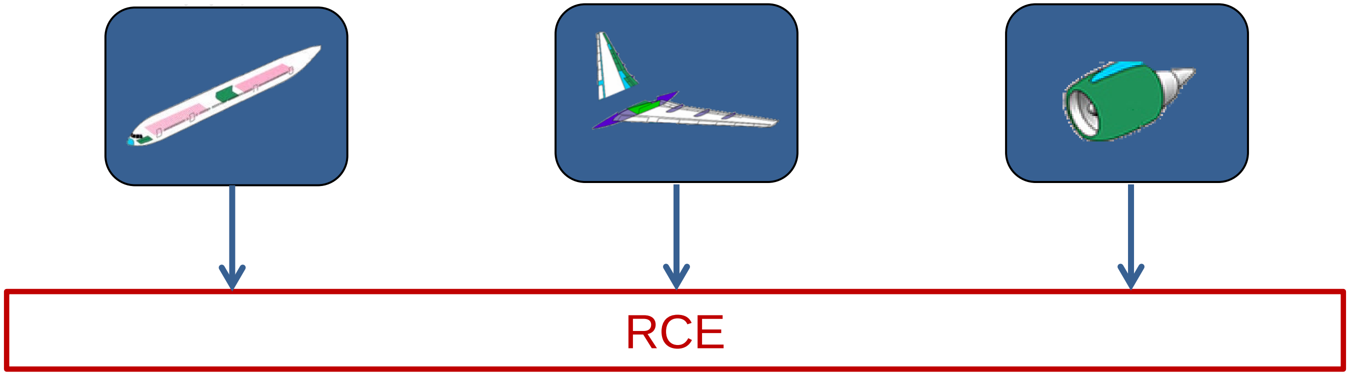
- RCE enables coupling of distributed aircraft design tools to a workflow
- Requires integration of aircraft design tools into RCE at runtime

→ Modularity and dynamic

→ OSGi: “Set of specifications that define a dynamic component system for Java”

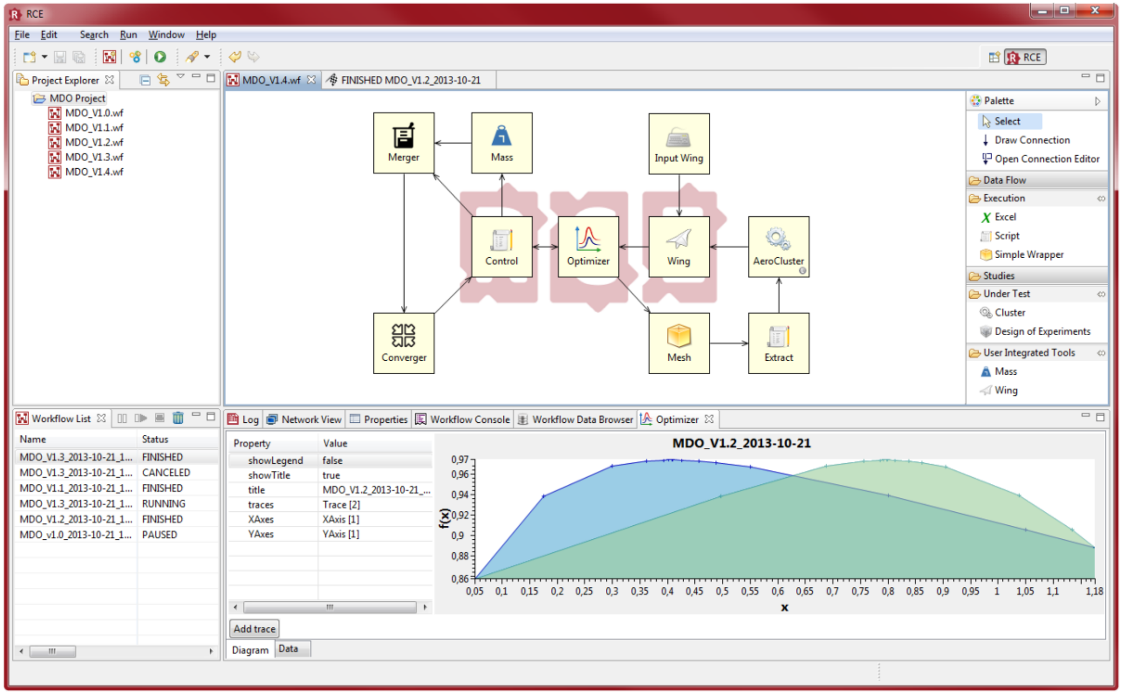
Using OSGi to Integrate Tools at Runtime

- A tool is (un-)registered as OSGi service once a specific configuration file is dropped into (removed from) a pre-defined folder
- OSGi service registry serves as aircraft design tool registry



Experiences with Usability Regarding Eclipse RCP

- Rich Client Platform helps us to make RCE more usable by adopting existing design decisions made for Eclipse RCP



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Who uses RCE?

- Scientists and aerospace engineers
- Persons who are
  - no software developers but develop software
  - smart and love their work
  - wearing suits at conferences and workshops ;)

Who uses RCE?

Experiences with Usability Regarding Eclipse RCP

- In terms of usability, users are divided into Eclipse IDE users and Non-Eclipse IDE users

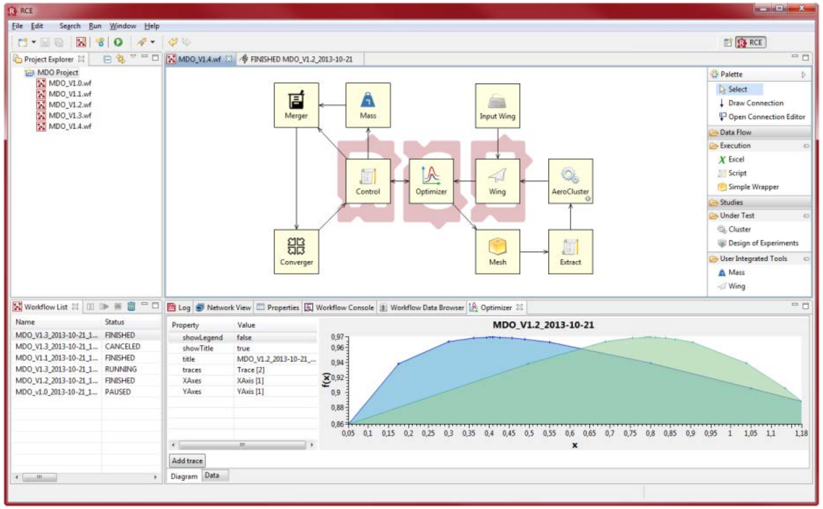
- Some usability concepts we started with, worked out well for first user group and didn't work out at all for second one

- Two examples…

Views and Perspectives Concept

- Non-Eclipse IDE users get confused and lost, the others like the power of perspectives
- May be a question of training courses

- Our approach: We reduced the perspectives to exactly one and open all relevant views by default



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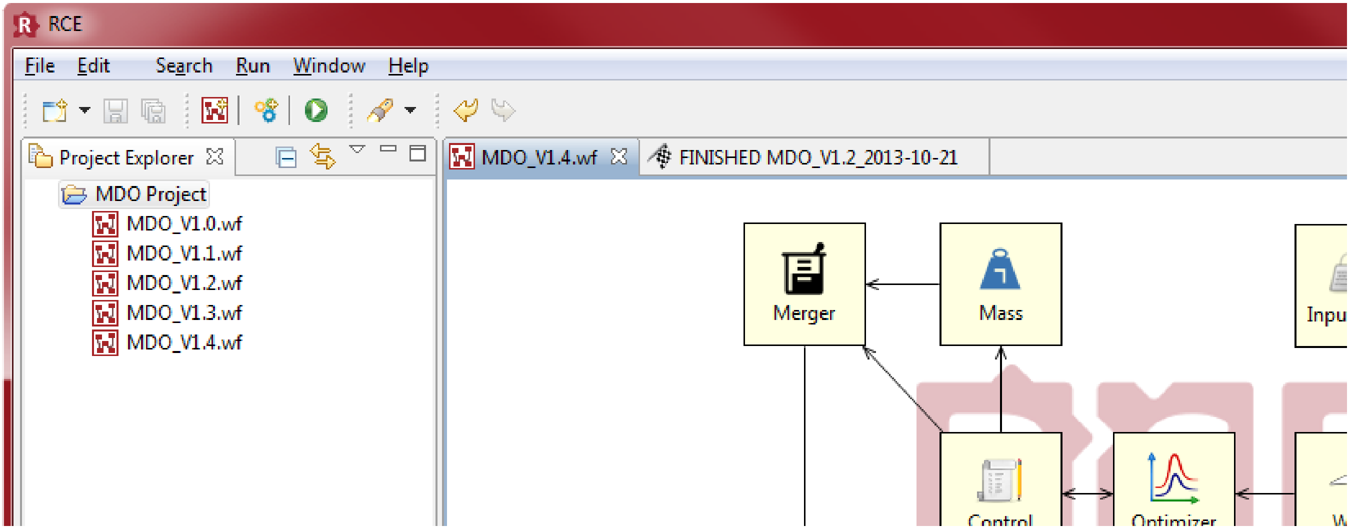
Project-based Concept

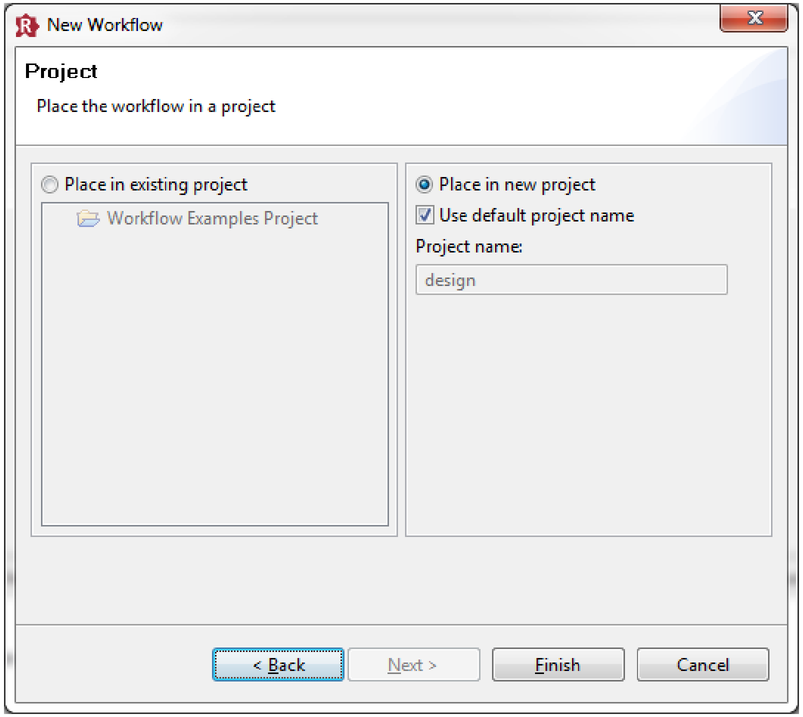
- Every workflow is a .wf file in the project explorer

- Non-Eclipse IDE users get lost if they want to create a workflow for the first time – why must I create a project (first) if I want a workflow?



Project-based Concept

- We conducted a user study within a master thesis regarding the workflow creation task
- It was fun and very helpful
- Result: Dedicated workflow wizard „hiding“ the project creation



New Workflow

Project

Place the workflow in a project

○ Place in existing project

Workflow Examples Project

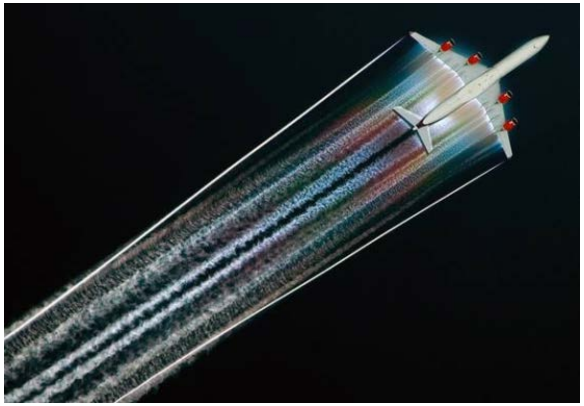
● Place in new project

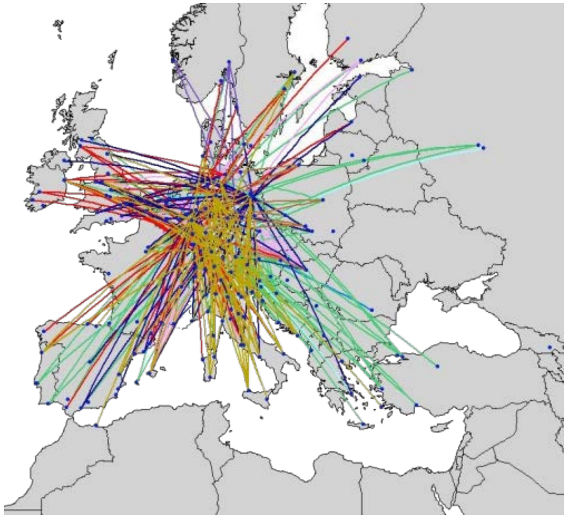
☑ Use default project name

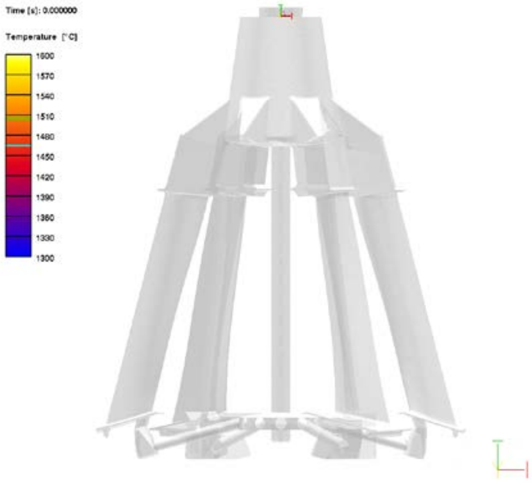
Project name: design

Managing different Distributions of RCE

- RCE has different applications with wide range of requirements

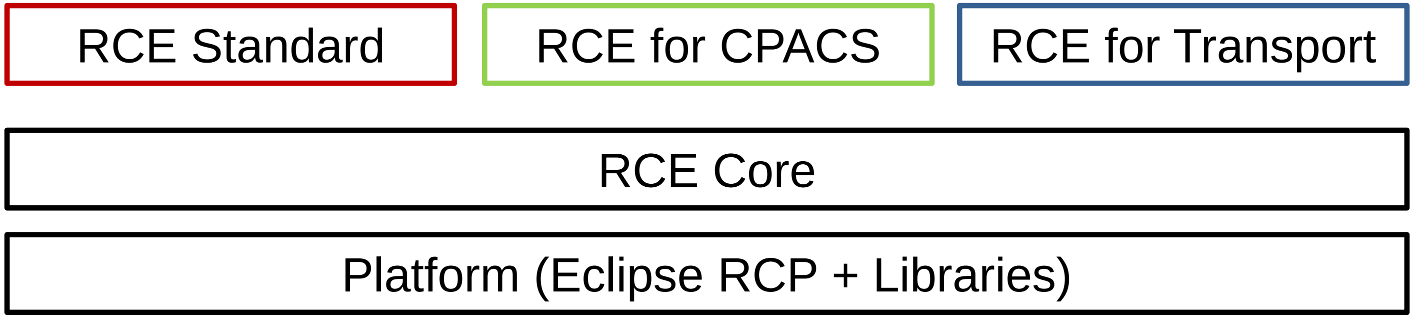






Managing different Distributions of RCE

- We release three different distributions of RCE to have a minimalist distribution for each application
- We used Eclipse IDE distributions as guide line, but: no release train



RCE Standard

RCE for CPACS

RCE for Transport

RCE Core

Platform (Eclipse RCP + Libraries)

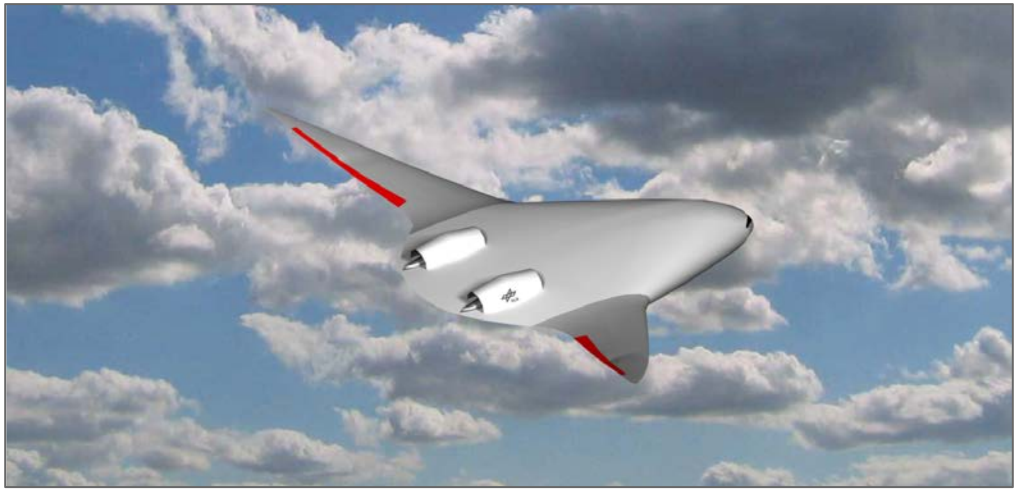
Managing different Distributions of RCE

- p2 infrastructure helps us
  - to compose the distributions, which share common code base
  - to provide a built-in update mechanism with less effort
- We build with Tycho
- Setting up all the stuff was a process…

Current Projects at DLR: FrEACs

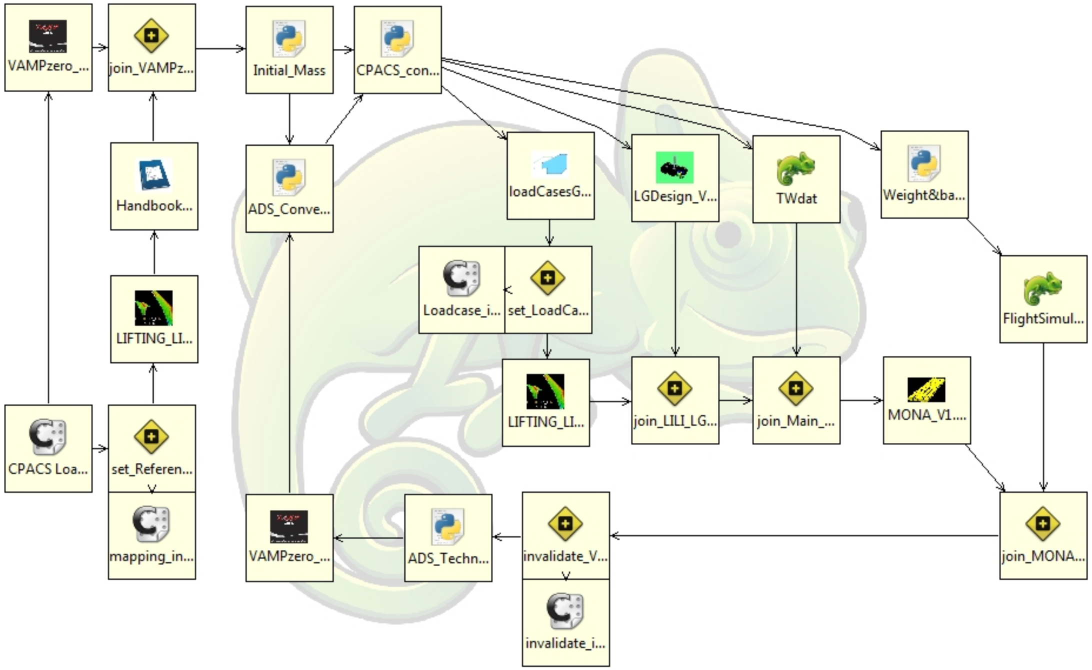
- Future Enhanced Aircraft Configurations

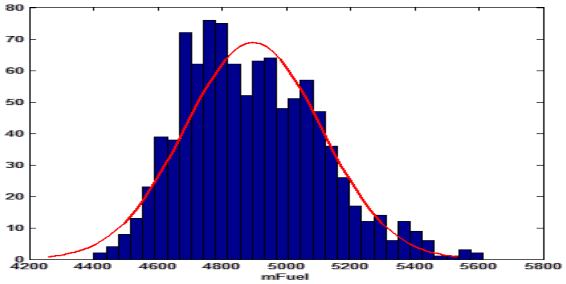
- Evaluate new aircraft configurations such as the blended wing body aircraft

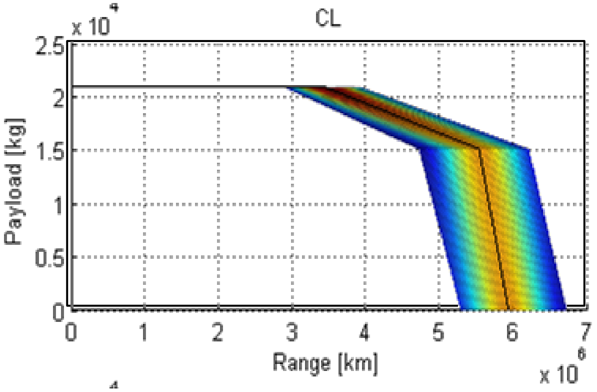


Current Projects at DLR: FrEACs

- Consider uncertainties in the workflow: How reliable are the results?

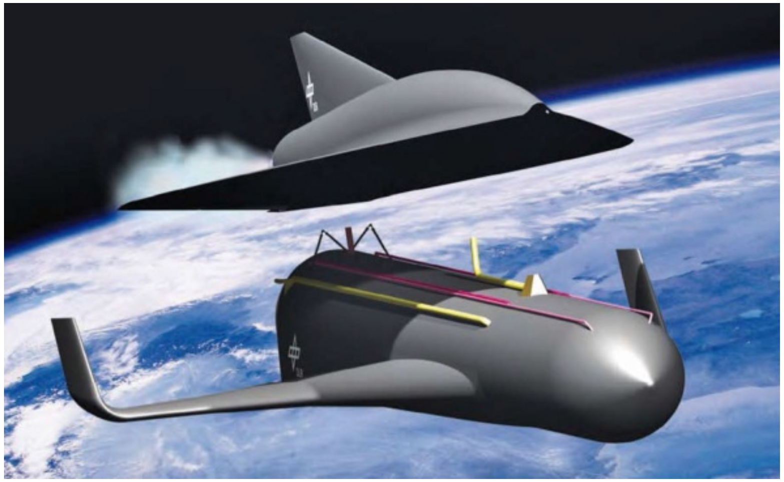


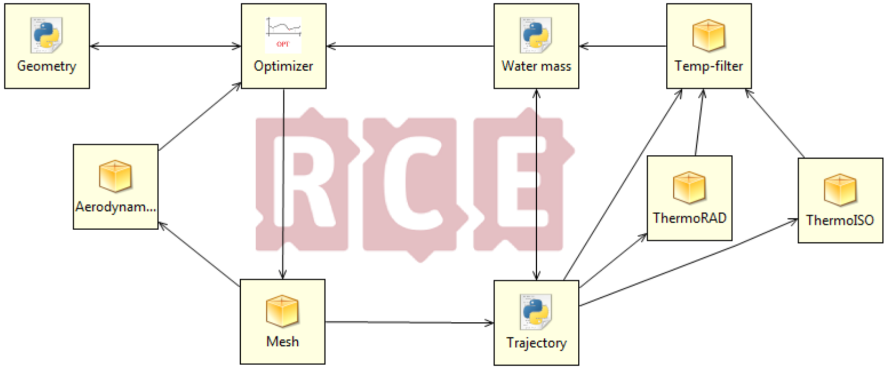




Current Projects at DLR: THERMAS

- Device thermal protection system of the SpaceLiner during atmospheric re-entry
- SpaceLiner is innovative concept between aviation and space travel for ultra fast passenger transport: Europe - Australia in 90 min





Summary

- Eclipse RCP helps significantly to design future aircraft

- Underlying OSGi enables the integration of external aircraft design tools
- Eclipse RCP enforces the development of usable software
- Extensible character, p2, and Tycho allows minimalist distributions

- Not all good concepts of the software engineering world can be adopted for scientists and aerospace engineers
  - …but that makes developing RCE so interesting :)

Doreen Seider

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