



Flow Physics Modelling - An Integrated Approach

*) Instability of an axi-symmetric jet; Van Dyke - An album of fluid motion, 1982

The European project FLOMANIA:

Flow physics modelling as an industrial requirement

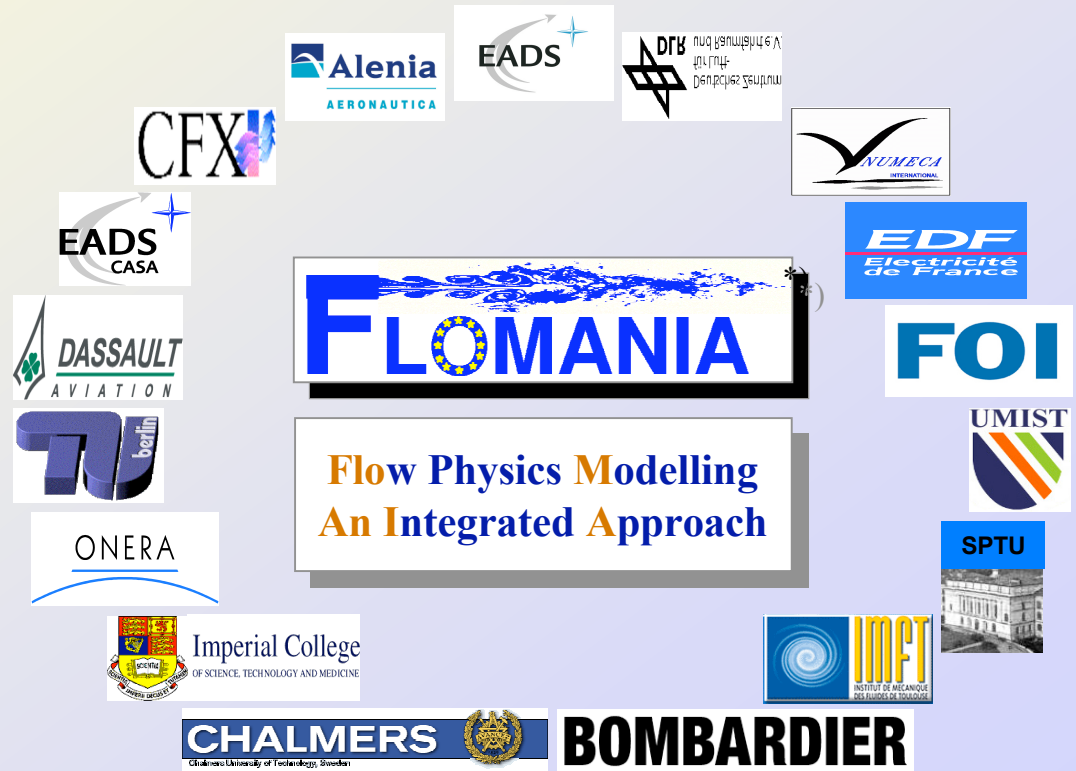
SUMMARY

- Why FLOMANIA ?
- What is FLOMANIA ?
- “Justification” of FLOMANIA
- Some current results around the (industrial) needs
- FLOMANIA and AIAA/DPW-2

What is FLOMANIA ?

The FLOMANIA project is a project funded by the European Union and administrated by the CEC, Research Directorate-General, Growth Programme, under Contract No. G4RD-CT2001-00613

It fosters European collaboration on flow physics modelling between:



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... in order to support industrial needs on :

- Robust, reliable and accurate turbulence models for URANS applications, featuring:
- Complex flows (shock/bl interaction, shock/shock interaction, pressure and shock induced separation, high angle of attack, vortical/vortex flow, vortex-boundary layer interaction, jets, mixing layers, control devices (VGs), Re scaling)
- Complex geometries / full aircraft
- Unsteady - Forced movement / free movements - mesh adaptation/movement
- CFD solutions which also support multi-disciplinary approaches and
- Shape/performance optimisation

Why do we (all) need this support ?

Because of a change in paradigm for CFD ?

(Results from EU Julius project)

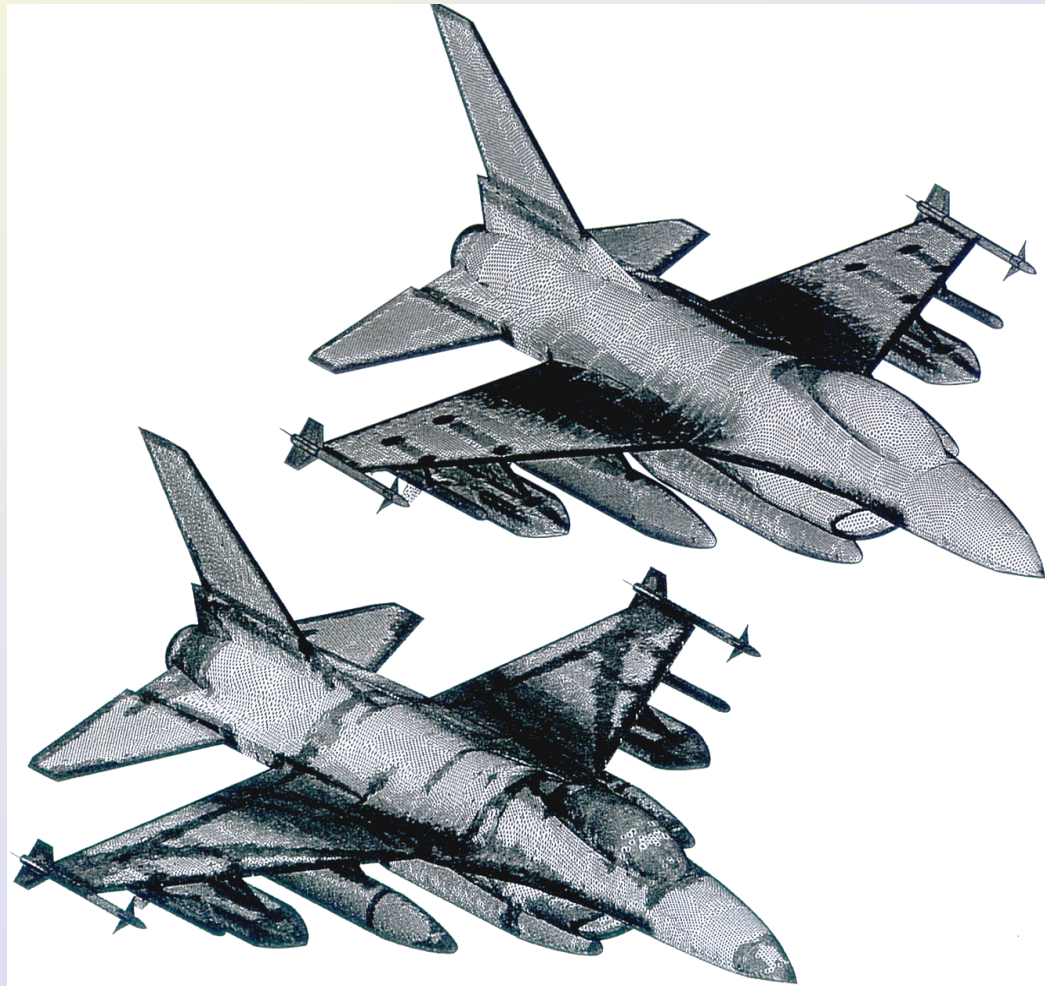
F16:

initial and adapted
unstructured mesh
1.2 -> 3.2
mio. tets

Do we have experience with ?

- Very fine meshes
- Absolute values' prediction
(no "deltas" anymore)
- Pre- not postdiction ...

We then do need ...



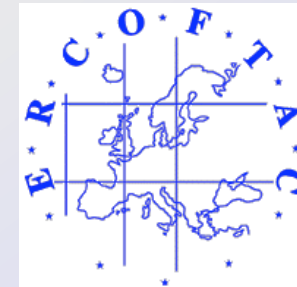
Best Practice Guidelines !

Guide to avoid the most common pitfalls

by providing:

essential information for the novice user,
advice that can also help the experienced expert user.
Guidelines not specific to individual codes, methods or applications

Not exhaustive: 20% of rules to cover 80% of aspects



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Price per copy:

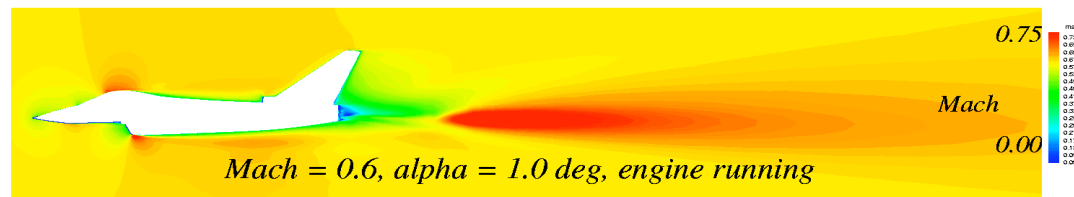
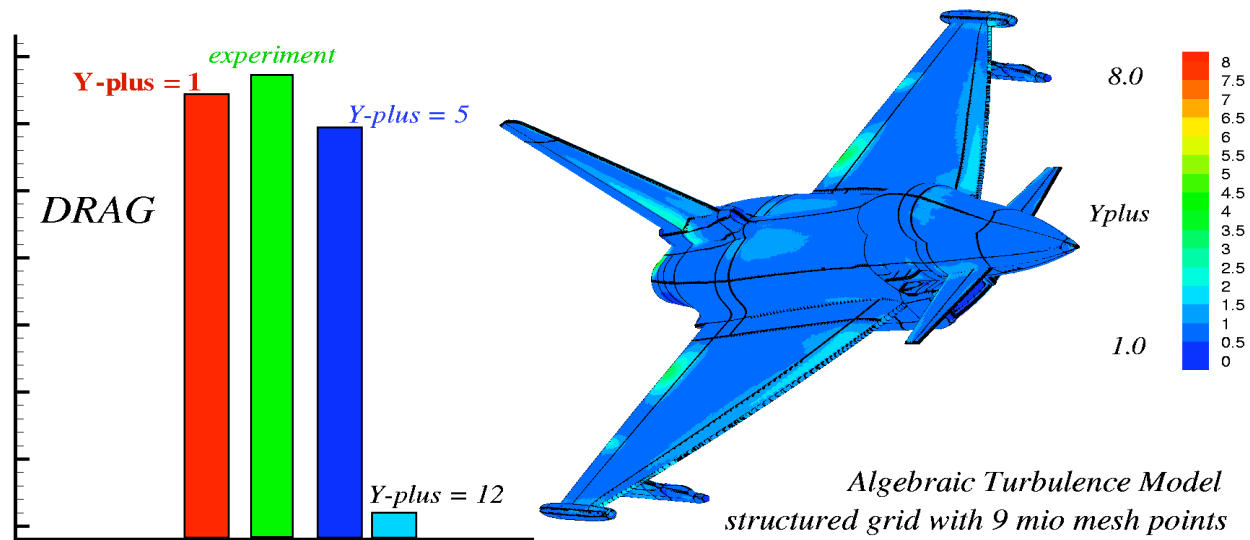
Non ERCOFTAC Members: 150EUR (Academics 75EUR)

ERCOFTAC Members: 100EUR (Academics 50EUR)

Special Prices for Students (via institutes/professors)

An examples for applying BPGs (complex/full A/C)

*Drag-dependence on Y-plus Resolution
in Navier-Stokes Simulations around Complex Configurations*

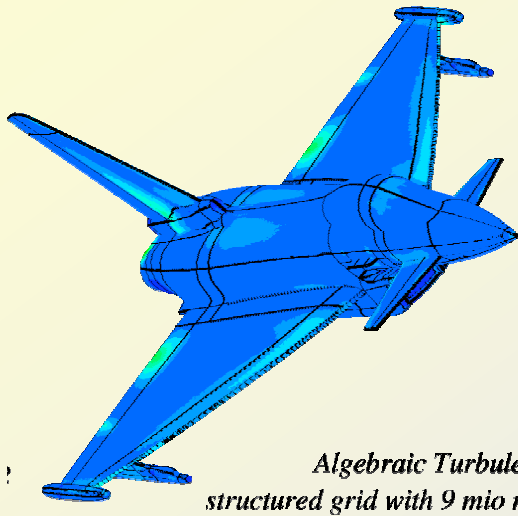


iff taking care of BPGs, then we can be sure that ...

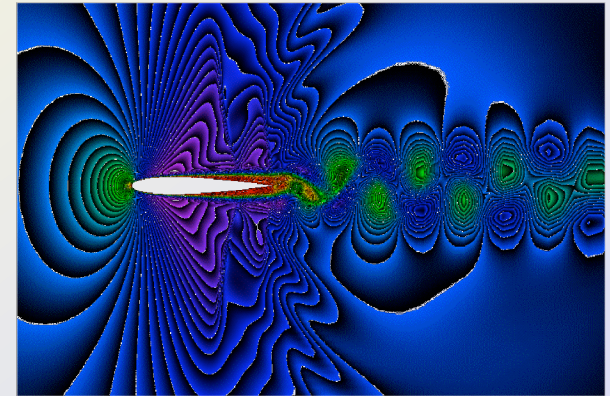
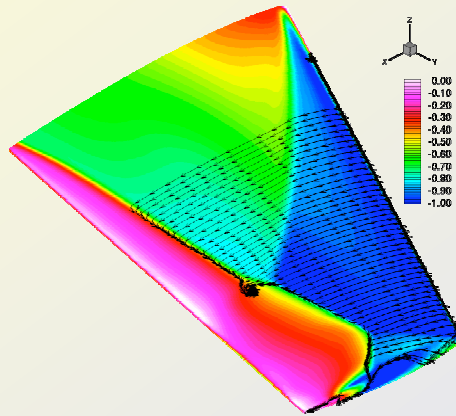
Multi-disciplinary applications are mature ! (EU Julius project)



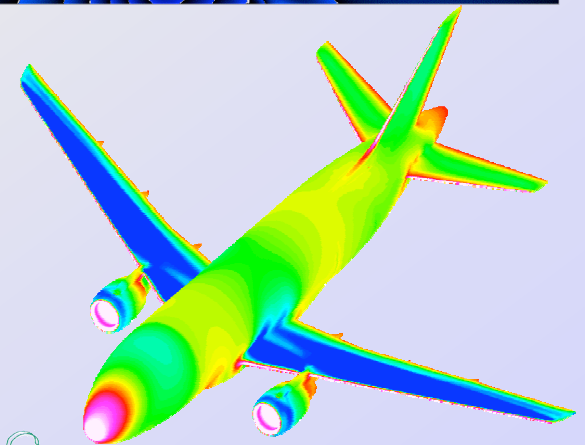
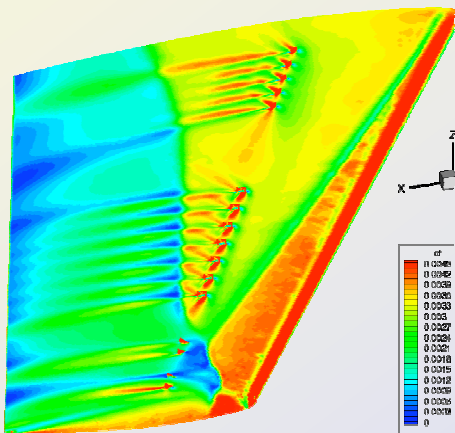
X31 5g pull-up manoeuvre



Algebraic Turbulence structured grid with 9 mio n



Can one model handle all this?



Main FLOMANIA objectives

- **Short-term goal**

Robust, reliable and accurate turbulence models for RANS (URANS) applications (with effort on both structured/unstructured/hybrid meshes and methods)

- **Medium-term goal**

Overcome still existing weaknesses in turbulence modelling by closing the gap between currently available RSM and industrially used 2-equ. models (using expertise from FLOMANIA “technology providers” - for common and comparable implementation of model(s))

- **Long-term goal**

Upstream research taking into account DES method(s) for validation and for evaluating range of validity of RANS methods

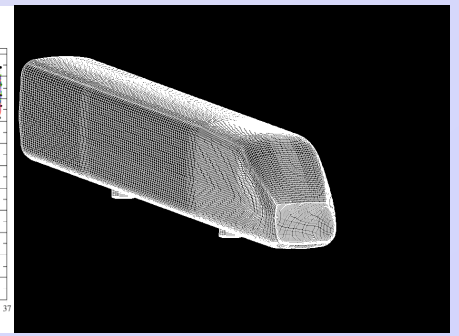
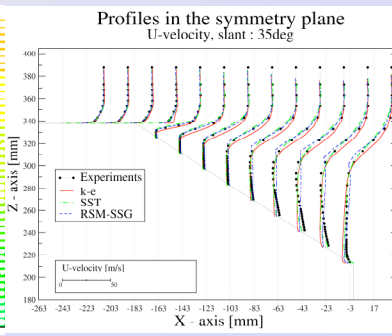
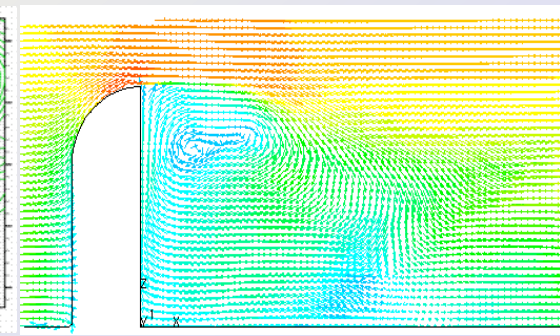
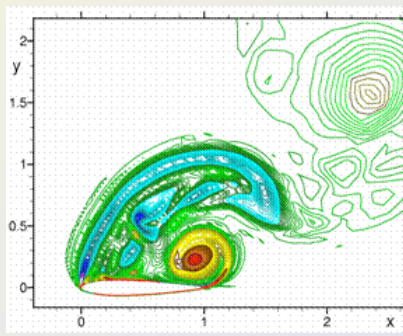
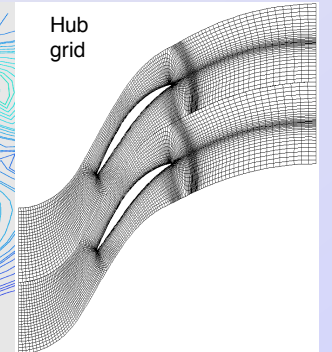
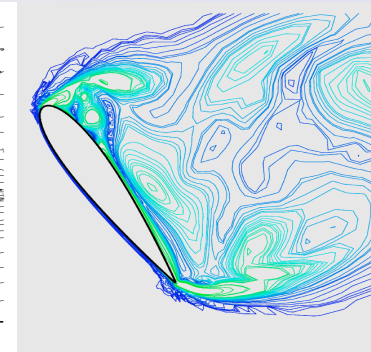
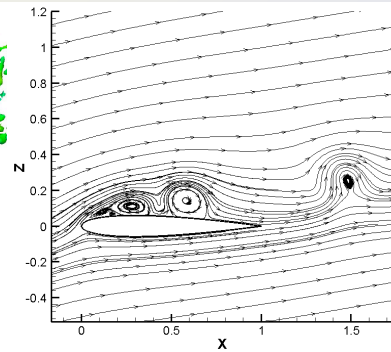
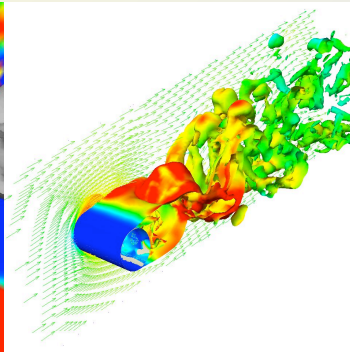
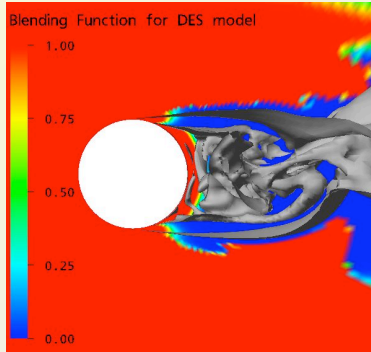
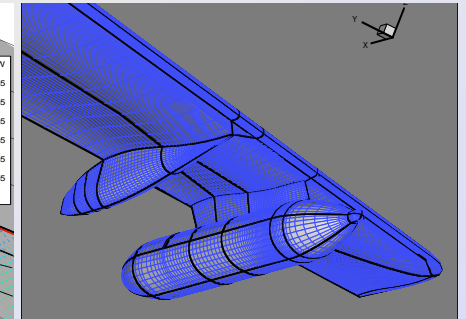
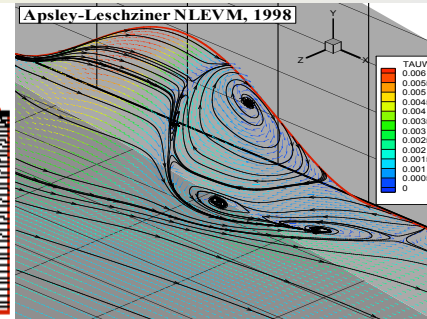
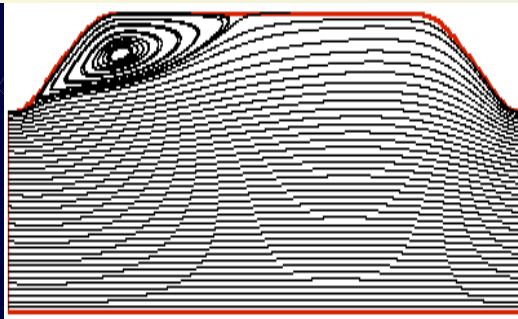
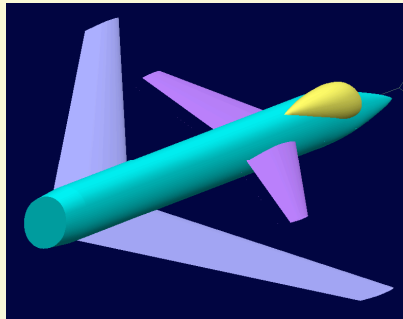
A set of generic DES test cases will be carried out - also providing models for DES approaches

Although FLOMANIA is NOT a validation program, it features a quite big list of test cases ...

Test Cases, Coordinators and Mandatory Meshes

<u>Test case</u>	<u>Co-ordinator</u>	<u>Mand. Mesh</u>
Rotor 37 <i>Asym. plane diffuser</i> ONERA M6	NUMECA <i>ICSTM</i> DLR (B)	NUMECA <i>ICSTM</i> (EADS)
OAT15A NACA0012 beyond stall	Alenia DLR (G)	Alenia SPTU
MRTT Generic train model	EADS-CASA Bombardier	EADS-CASA Bombardier
Generic car mirror	Bombardier	Bombardier
Forward swept wing A/C	EADS-M	EADS-M
TUM delta wing 3D circular cylinder	Dassault IMFT	EADS-M SPTU
AS28 w/b	ONERA	ONERA
Generic air intake	ONERA	ONERA
Ahmed car body <i>3D low hill with complex sep.</i>	AEA <i>Chalmers</i>	UMIST <i>ICSTM</i>
Separation behind 2D hills	UMIST	UMIST
Aerospatiale A-airfoil	EADS-M	EADS-M
NACA0012 - DNS	IMFT	IMFT
DLR-F6	DLR	DPW
NACA64A010 pitch (SSC)	DLR	DLR

An "impression" of results



FLOMANIA and AIAA/DPW-2

Why?

- DLR-F6 has been adopted as an additional test case because of participation of at least three FLOMANIA partners in the DPW-2
- Offers a possibility for (FLOMANIA and DPW-2 people) to provide new and/or advanced results (continuously) until mid of 2004
=> “prolongation of DPW-2”
- Utilisation of DPW-2 results for validation work in FLOMANIA
- Thus: Cross-fertilisation between AIAA/DPW-2 and FLOMANIA
=> “linking US and European effort”

FLOMANIA and AIAA/DPW-2

How?

- • Web link FLOMANIA / AIAA-DPW-2
- • Presentation of FLOMANIA at AIAA-DPW-2 workshop
- • Access of DPW-2 participants to DLR-F6 data base as part of FLOMANIA Web **cfd.me.umist.ac.uk/flomania** and direct link to test case - password-protected
- • **DLR** is taking over FLOMANIA co-ordination for DLR-F6
 - Attendance of (interested) DPW-2 participants at FLOMANIA “Open Workshop”
=> Final FLOMANIA meeting - Likely to take place in the second half of June 2004

FLOMANIA and AIAA/DPW-2

Whom to contact ?

- **DLR** has taken over FLOMANIA co-ordination for DLR-F6 test case
(Dieter.Schwamborn@dlr.de)
- **EADS-M**, FLOMANIA co-ordinator
(Werner.Haase@m.eads.net)

FLOMANIA and AIAA/DPW-2

Interested ?

How to proceed ?

- Visit FLOMANIA Web site for extended information
- Get password for DLR-F6 test case from FLOMANIA co-ordinator
(**send an email with your co-ordinates**)
- Check FLOMANIA site for new results and/or provide your own new results
- Final Meeting will have separate session on DLR-F6
... thus you can bring new results

The FLOMANIA partners are welcoming you