The Thematic Network KATnet: Overview

Project No: GTC 2-2001-53003

Coordinator: Airbus Deutschland Germany

Contractors:  
Airbus UK United Kingdom  
Airbus France France  
BAE Systems United Kingdom  
Alenia Aeronautica Italy  
DLR Germany  
FOI Sweden  
ONERA France  
QinetiQ United Kingdom  

Duration: September 2002 – December 2005

DRAGNET → KATnet → KATnet II (will start in September 2006)
The Thematic Network KATnet: Overview

WP0: Network Management (Airbus D)
WP1: KATnet Strategy & Exploitation (Airbus UK)
WP2: KATnet Website & Newsletter (BAE-S)
WP3: KATnet Conference & Workshops (QinetiQ)

AREA 1: Low-Speed Performance (Airbus D)
- A 1.1 Multidisciplinary Design (DLR)
- A 1.2 Design Tools (FOI)
- A 1.3 WT & Flight Testing (Airbus UK)

AREA 2: High-Speed Performance (Airbus UK)
- A 2.1 Multidisciplinary Design (Airbus UK)
- A 2.2 Design Tools (ALENIA)
- A 2.3 WT & Flight Testing (Airbus F)

AREA 3: Active Flow Control Technologies (ONERA)
- A 3.1 Laminar Flow Technology (Airbus D)
- A 3.2 Turbulence & Separation Control (BAE-S)
- A 3.3 Adaptive Wing Concepts (Airbus D)
European Aeronautics: A Vision for 2020

- 50% reduction of fuel consumption
- 80% reduction of NO$_X$
- 50% reduction of perceived noise
- Reduction of environmental impact of aircraft manufacturing, maintenance and disposal
Rotterdam Jet Fuel Spot Price

28 Sep 2005
210 ct/gal

1986-2001 average
59ct/gal

Source: US Dept. of Energy
DOC Shares for 6000 nm Mission

60 US-ct/US-gallon

180 US-ct/US-gallon
KATnet Workshops & Conferences

Workshop on High Lift Aerodynamics        Sep 2002        Stockholm, Sweden

Workshop on High Speed Aerodynamics       Sep 2003        Bath, U.K.

Workshop on Flow Control                   Oct 2004        Poitier, France

KATnet Conference                           Jun 2005        Bremen, Germany
KATnet/GARTEUR Workshop
on
High Speed Aerodynamics
3-4 September 2003
University of Bath, U.K.

Contributing projects:
HiReTT, Aeroshape, M-DAW
GARTEUR AG 26, 28, 31, 34
National Programmes
Reduce drag
Reduce weight
Reduce airframe costs (simpler structure with less maintenance)
Specific Range as Performance Measure

Specific range $SR$ measures performance of aircraft

$$SR = \frac{1}{TSFC} \cdot V \cdot \frac{L}{D} \cdot \frac{1}{W}$$

- More efficient engine $\Rightarrow$ increase bypass ratio, intercooler, …
- Lighter structure $\Rightarrow$ advanced materials
- Better aerodynamics $\Rightarrow$ improve $M \cdot \frac{L}{D}$
  $\Rightarrow$ reduce drag

$TSFC$ = thrust specific fuel consumption
  $= \frac{\text{weight of fuel consumed during time increment}}{(\text{time increment} \times \text{thrust})}$
Drag Breakdown of Transport Aircraft in Cruise

- Total Drag [%]

<table>
<thead>
<tr>
<th>Drag Breakdown</th>
<th>Technology Opportunities</th>
<th>Drag Reduction Potential</th>
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<tr>
<td>Parabolic Drag</td>
<td>Shock Control</td>
<td>- 3%</td>
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<tr>
<td>Wave Drag</td>
<td>Novel Configurations</td>
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<tr>
<td>Interference Drag</td>
<td>Shape Optimisation</td>
<td>- 7%</td>
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<tr>
<td>Lift Induced Drag</td>
<td>Adaptive Wing Devices</td>
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<td>Viscous Drag</td>
<td>Wing Tip Devices</td>
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<td></td>
<td>Load Control</td>
<td></td>
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<tr>
<td></td>
<td>Laminar Flow Technology</td>
<td>- 15%</td>
</tr>
<tr>
<td></td>
<td>Turbulence &amp; Separation</td>
<td></td>
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<tr>
<td></td>
<td>Control Technologies</td>
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</tbody>
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Total: - 25%
Cruise Drag Reduction

Reduce friction drag

Delay lam./turb. transition

\{ Natural laminar flow (shaping) \\
Hybrid laminar flow control (suction) \\
Active flow control (wave cancellation) \}

Reduce lift-dependent drag

Elliptic lift distribution has minimal vortex drag

Use advanced materials and optimise installation to shift the overall optimum towards an elliptic lift distribution

(reduces drag and weight)
Cruise Drag Reduction

Reduce lift-dependent drag (cont.)

Novel configurations
Other Cruise Technologies

Reduce design constraints using new materials

Shape optimisation
Wing tip devices
Adaptive wing devices
   Multi-functional control surfaces
   Mini trailing edge devices
Load control
Gust / manoeuvre load alleviation
TA1: Low-Speed Performance

KATnet/GARTEUR High Lift Workshop
17 - 19 September 2002
Stockholm, Sweden

Contributing projects:
GARTEUR AG 25, 36
EUROLIFT, Helix, EPISTLE, HiAer
National Programmes
TA1: High-Lift Design Drivers

- **Aerodynamics**: improve high-lift performance
  - maximum lift
  - low take-off drag
  - improve ice accretion prediction capability
- **Systems**: simplify high lift system
  - low system complexity with acceptable handling quality
- **Structure**: reduce weight
- **DOC**: reduce airframe costs
  - simpler structure with less maintenance
- **Airport capacity**: increase landing and take-off rates
  - wake vortex separation
- **Aeroacoustics**: reduce community noise
  - target: leave noise footprint in airport area
  - reduce noise of high-lift components and landing gear
TA3: Flow Control Technologies

KATnet Flow Control Workshop
12 - 13 October 2004
Poitiers, France

Contributing projects:
AWIATOR, ALTTA, HYLTEC,
AEROMEMS I & II, HELIX, M-DAW
ERCOFTAC SIG,
National Flow Control Programmes

The Flow Control Workshop is organised by KATnet – the Thematic Network on Low Aerodynamic Technologies for Aircraft Performance Improvement. KATnet is funded by the European Commission.

Internet: http://www.kat-net.com

5th Community Aeronautics Days 19-21 June 2006
TA3: Research Needs for Drag Reduction

Drag reduction by laminar flow
- simplified suction systems
- in-flight skin friction sensors
- anti-contamination surface coatings
- active control of Tollmien-Schlichting instabilities / microroughness

Drag reduction by turbulent flow manipulation
- dimples, riblets
- compliant surfaces
- active manipulation of near wall turbulent flow structures by MEMS
- low energy plasma technologies
Research needs for separation control

- air-jet vortex generators
  steady, unsteady, positive & zero mass flux

- tangential and pulsed blowing
Enable universities to evaluate their technologies by providing baseline configurations (short range, long range, supersonic) including

- top-level aircraft requirements
- basic aerodynamic data
- estimated weight break down
- simplified performance spread sheet
KATnet website will be maintained and updated in KATnet II
Outlook to KATnet II

KATnet II structure
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