JANUS
High-Energy Supersonic & Low-Cost Aircraft

- Advanced Trainer
- Red-Air/Opponent Simulation
- Support Missions

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Managing Director ALR Aerospace
SMI Military Flight Training Conference
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"Janus" is from Roman mythology and describes the duality in all kinds of expressions. In our case consisting of two elements: “body and mind”, or “air vehicle and avionics”
Dr. Georges Bridel

Since 2011 ALR: Managing Director

1993-2010  Airbus: VP Future Military Air  Systems

- DASA Ranger 2000 FSD Project Lead
- Concept developments: advanced trainer a/c, unmanned air systems, stealth a/c, tools, technology strategy, operational analysis

1978–1993  ALR: Full Scale & Concept Developments

- Piranha\(^2\) Fighter Concept with Boeing (1981-1984)
- The HAL-Tejas LCA concept, won by MBB with participation of ALR (1984)
- Development APP\(^\text{TM}\) aircraft performance program

\(^2\) Jane’s All the World’s Aircraft 80–81 & 83–84, AW&ST 06/79, Air International 02/80 & 11/92
Advanced Training for Today’s Air Forces

**Current Training Aircraft**
- Face Replacement
- Lack Overall Performance
- Training-Use Only

**Current Fighters Require**
- High Performance Trainer
- Equivalent „Red-Air“ & Opponent Simulation

**Current Solution: Legacy Aircraft**
- Use of Outdated Systems
- Reaching End-of-Life
- High Cost of Ownership
- Expensive Tactical Combat Training Program (TCTP)

Cost
ALR’s Solution – JANUS

“The integrated approach of mission analysis combined with application of advanced technologies“

- **High Energy**
  close to operational fighters

- **Supersonic**
  to match AT, Red-Air and air policing requirements

- **Small and Light**
  strict requirements management, low-cost powerplant & equipment

- **Mission Equipment**
  on ground, operated via datalink

- **Low Cost**
  the key benefit!
JANUS Concept – The Basics

**Advanced Training (airborne element)**
- High energy and reheat management
- Fighter-like manoeuvrability, SEP++
- Supersonic speed M=1.3+
- Tight mission sequences and timelines
- Handling qualities
- Embedded simulation equipment datalink

**Support Missions**
- Simulation of opponents, „Red-Air“
- Armed air policing (with a gun pod), unarmed vs. „cooperative“ targets
- Air-tactics experimental, operational incl. technology developments
- Unmanned high-performance simulations

**Requirements**
- Design base for JANUS:
  - Max. sustained g-load of 6.5 g at 10 kft, 80% internal fuel (T-X)
  - Ferry mission requirement of 2000km (EURAC)
  - Supersonic speed M 1.3 at altitude (Advanced Training, „Red-Air“ and Air Policing)
  - Minimum on-board equipment
### JANUS Aircraft Concept: Schematic Three-View

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>m</td>
<td>11.00</td>
</tr>
<tr>
<td>Wingspan</td>
<td>m</td>
<td>8.00</td>
</tr>
<tr>
<td>Clean Takeoff Weight</td>
<td>kg</td>
<td>4’800</td>
</tr>
<tr>
<td>Wing Area</td>
<td>m²</td>
<td>18.00</td>
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<tr>
<td>Max Reheat Thrust</td>
<td>kN</td>
<td>42-45</td>
</tr>
<tr>
<td>Max. Mach</td>
<td>[-]</td>
<td>M &gt; 1.3</td>
</tr>
<tr>
<td>Composite Fraction</td>
<td>[%]</td>
<td>50</td>
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Janus Size Comparison

<table>
<thead>
<tr>
<th></th>
<th>AT Janus</th>
<th>BAE Hawk Mk 65</th>
<th>T-50 Golden Eagle</th>
<th>T-38A Talon</th>
<th>F/A-18C/D</th>
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</thead>
<tbody>
<tr>
<td><strong>Length</strong></td>
<td>11 m</td>
<td>12.4 m</td>
<td>13.1 m</td>
<td>14.1 m</td>
<td>17.1 m</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>18 m²</td>
<td>16.7 m²</td>
<td>23.7 m²</td>
<td>15.8 m²</td>
<td>38 m²</td>
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</table>

*Small Size and Low Weight Means Low Cost!*
Why “JANUS” High-Energy Advanced Trainer?

- Energy & Manoeuvrability close to operational aircraft, the volume shows the energy in terms of SEP (vertical) over Mach and altitude (plane)
- Generic cost relations are extremely advantageous for JANUS
- Dedicated design, no armament and related avionics

**Energy Envelope**

(SEP / Altitude / Mach)

**Cost**

(per flight hour)

- Subsonic AT (single engine)
- JANUS Concept
- 4th/5th-Gen. Fighter

*High Performance and High Energy at very low Cost*
Key Performance Data

Max. SEP Comparison
(at 10 kft, 50% fuel, reheat where applicable)

Max. Sustained Loadfactor
(at 10 kft, 50% fuel, reheat where applicable)

Ferry Range (no external tanks)

- High Performance Red-Air Aircraft
- EURAC\(^3\) air combat mission
- Undergraduate Pilot Training Missions\(^4\)
- Fighter Fundamentals Training Missions\(^4\)

Provided data depending on assumptions and conditions.
3) EURAC - European Air Chief Conference
4) Equivalent to T-X Requirements
Air Combat & Ground Attack Training (1)

- Energy & Manoeuvrability close to operational fighters
- Real JANUS aircraft to represent operational fighters and opponents

Legend

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
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<tbody>
<tr>
<td>🛣️</td>
<td>Training Aircraft</td>
</tr>
<tr>
<td>🛣️</td>
<td>Fighter-Target</td>
</tr>
<tr>
<td>↔️</td>
<td>Data Link (all relevant data)</td>
</tr>
</tbody>
</table>
Air Combat & Ground Attack Training (2)

- JANUS aircraft vs. simulated targets
- Target simulation embedded or via datalink
- Manned Ground Simulators
“Red Air” Operational Fighter Training

- Multiple JANUS aircraft in the air (against 5th gen., e.g. F-22, F-35)
- 5th generation fighters need multiple real targets (cost!)
Today’s „Red Air“ Solutions

- More than 150 aircraft in use worldwide, also by civil operators (ATAC, Discovery Air, Draken, ….)
- Mis-use of combat force at high cost!

It is Time for a Dedicated Aircraft!
Operational: Air Policing
(live operations: “non-combat” or for training)

JANUS Aircraft 1

JANUS Aircraft 2

Approach via Datalink & Visual identification

Airliner

Legend

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Data-Link

Ground Station

Radar

QRA

JANUS armament option: gun pod


JANUS Aircraft Concept - SMI Conference 2016 - Dr. G. Bridel - ALR Aerospace
JANUS
Conceptual Reference

The air vehicle, „the body“:
- High energy (SEP, Turn-Rate)
- Two seat, IFR cockpit
- Minimum airframe and powerplant
- On-board mission equipment only where not met by datalink-capabilities
- Structure: 50% composite material
- „Minimum cost“ as prime target in procurement and operation

Pilot and avionics, „the mind“:
- Integrated „man-machine“ like combat a/c, but simulated, advanced technologies
- Mission relevant capabilities: provided via datalink(s) from:
  - External: ground, AWACS, fighters, or
  - „on-board“ simulations
- Technology developments: operational test-bed for optionally piloted high performance UCAVs
Thank you for your attention
Backup

\[ \phi = \frac{(C_\phi - C_{\phi,0})^2}{\phi_{\text{steer}} C_{\phi,0}} \]

\[ C_D = \frac{\Delta S_{\text{max}}(M) + \Delta S_{\text{max}}(C_{z, \text{min}} M) + \sum \Delta S_{\text{max}}(\text{airframe})}{S_{\text{ref}} S_{\text{config}}} + \frac{\Delta S_{\text{drag}}}{S_{\text{ref}} S_{\text{config}}} \]

\[ D = \frac{\rho v^2 C_D S_{\text{ref}}}{2} \]

\[ n_l = \frac{(\sqrt{\text{mass}})^2}{g} - 1 \]

\[ m\dot{v} + D - T \cos(\alpha + \sigma) + mg \sin(\gamma) = 0 \]

\[ -m\dot{v} + L + T \sin(\alpha + \sigma) - mg \cos(\gamma) = 0 \]
ALR
ARBEITSGRUPPE FÜR LUFT- UND RAUMFAHRT
GROUPE DE DEVELOPPEMENT DE PROJETS AEROSPATIAUX
AEROSPACE PROJECT DEVELOPMENT GROUP

Press and Web

- Corriere del Ticino - March 30 2016
- AVIATION WEEK - May 11 2016