HADA PROGRAMME

(HELICOPTER ADAPTIVE AIRCRAFT)

ICAS WORKSHOP
24 September 2007. Sevilla
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Call for papers

Venue: ETSII (UPM) Madrid
Dates: 14, 15, 16 November 2007

Requests to attend/present a paper:
BEFORE 31st OCTOBER

Notification of Acceptance of papers to Authors:
BEFORE 1st NOVEMBER

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Under the frame of PLATINO Programme
(Programme financed by the Spanish Ministry of Education and Science & the Spanish Ministry of Defence)

Organised by:
PROGRAMME PLATINO
(Light Aerial Platform for Innovative Tecnologies)

SANAS
MINISARA
HADA
COBOR
SATA
HADA stands for “Helicopter Adaptive Aircraft”. The aim of this original design focusses on improving, by combining, the capabilities of both Helicopter and Fixed-Wing aircrafts.

Though this aim has been tried to be achieved for some nearly 40 years now, sometimes with sound designs, we believe HADA can contribute in a significant manner to produce an effective operational aircraft, based on the actual “state of the art” in light composite materials, microelectronics and Flight Control Systems (FCS) together with light and reliable mechanisms and optimized CFD tools for optimized aerodynamic design.
HADA

BRIEF DESCRIPTION

TECHNICAL CLUES

HADA is a new solution for VTOL operations providing also high efficiency flight in cruise modes (Patent applied)

This design could well be dubbed “Morphing Aircraft” in the sense that it looks as a “standard Helicopter” in Hover and Take-off and Landing modes and as a “standard Aircraft” in Cruise modes.

The basic architecture responds to a conventional Helicopter with all its inherent capabilities (i.e: cyclic, collective modes..)

The Innovations:

Two half span wings are attached to the belly of the fuselage:
They are retracted beneath the fuselage when HADA flies in Helicopter Mode (HC) and are deployed to full span when in Aircraft Mode (AC)

A pusher propeller is attached to the rear end of the fuselage:
Power is transferred to it from the engine when in AC Mode, disengaging Rotor and anti-torque
HADA
BRIEF DESCRIPTION

TECHNICAL CLUES
Operational process:

HADA takes-off as a conventional HC, climbs to operational altitude, achieves horizontal speed up to the “Transition Speed, (TS)” and then deploys the wings, transfers power to the propeller and acquires the cruise speed of the AC configuration.

At any time during the mission, HADA can revert to HC Mode transferring power from the propeller to the main rotor and anti-torque and folding the wings under the fuselage. This process can be executed as many times in flight as required.

On landing (any time during the mission or at the end of it), HADA adopts the HC configuration, allowing the aircraft to land in any unprepared site.
HADA FLIGHT MODES

HOVERING AND LOW SPEED FLIGHT

CRUISE FLIGHT

POWER/WEIGHT

TRANSITION

L/D
PERFORMANCES OF HADA SYSTEM
PRELIMINARY DESIGN FOR UAV SYSTEM

Mass: 380 kg
Power: 130 kw

Required and available Power
L/D helicopter and Aircraft
Power gain

Main rotor Diameter: 6m
Wing span: 6m
Wing Area: 4 m²

TRANSITION
Vstall=V(max L/D)/1.2

POWER SAVINGS (%)
(1-Pav/Phc)*100

vel. unit: 7,332 m/s=26,39 km/h =14,6kt
Power unit: 27,3 kW= 37 hp
WORLD WIDE ONGOING PROGRAMMES
MANNED SYSTEMS

BA-609
V-22 OSPREY
QTR HEAVY LIFT

FLIGHT ENVELOPES
ERICA CONCEPT
MAIN UAV – VTOL PROGRAMMES WORLDWIDE

- FIRE SCOUT MODELO 379
  NORTHROP GRUMMAN

- A-160 HUMMINGBIRD
  BOEING

- DRAGON FLY CANARD Rotorwing
  BOEING

- ORKA
  EADS

- EAGLE EYE
  BELL TEXTRON

- GOLDEN EYE-50
  AURORA FLIGHT SCIENCES
As a first step, a UAV- VTOL aircraft is proposed: The short term aim is to fulfil the requirements of Navies and Civil Agencies of different Countries all over the World. Basically all users require VTOL operation on board small to medium size ships (patrol boats, frigates,..) or easily deployable systems “on the spot” They also require around 5 hours endurance; 40 to 90 Kilograms payload and ranges around 100-200 miles from the Operational Base We believe HADA can fulfill these requirements advantageously over conventional Helicopters or Tilt Rotors, thanks to its unique high performance design
HADA PROJECT PLANNING

- PHASE - B: “LIBÉLULA”: FULL SCALE UAV: 2008-2010

Project Funded by:
PHASE A: “COLIBRÍ”

- THE PROJECT HAS STARTED WITH A FEASIBILITY PHASE LASTING 18 MONTHS
- TWO ACTIVITIES ARE CARRIED OUT IN PARALLEL:
  - FEASIBILITY STUDIES FOR THE FULL SCALE “HADA”
  - PROOF OF CONCEPT: REDUCED SCALE (“COLIBRÍ”)
PHASE A: "COLIBRÍ" CONSORTIUM

- R&D LEADER: INTA
- INDUSTRIAL LEADER: aries complex, s.a.

Institutes and companies involved:
- CTA
- Fundación aiTIIP
- CYD INGENIERÍA
- EESA
- gm
- tecnalia aerospace
- PÍGMALY
- Isdefe Ingeniería de Sistemas
- VTI
- sistplant
- GYM
- DIIA INSTITUT D'INFORMATICA I APLICACIONS
- aicia
- UdG Universitat de Girona
Aries Strategy in UAV

Aries is a Group of companies specialized in designing & manufacturing High Technology Composite Aerostructures.

- Establish in 1965.
- Participating in aerospace projects since 1986
- Manufacturing Plants at Madrid & Valladolid
- 450 employees
- $50 million revenues 2006
Aries Strategy in UAV

Aries participation in UAV projects allow us to apply all our experience in aerospace.
Aries Strategy in UAV

Aerospace Projects Management

• Aerospace Specialist
• Wide Experience in Aerospace Projects
• Industrialization Capabilities
• High Technology Products.

Industrial Capacity

• Industrial Organization
• Assembly & Manufacturing plants
• Capacity
• Competitive Costs.

Technological Capacity:

• Strong R& D Commitment
• Engineering Capabilities
• Flexibility
• Large investment in equipment and technology.

Company Strategy:

• Technology & Growth
• Develop new Products line: UAV Strategic Development
• Increase participation on Military Programmes and Collaboration with MoD.
• Strategic Agreement with Spanish INTA for UAV development
HIGH COMPOSITE TECHNOLOGY ALLOWS to OPTIMIZE AEROSTRUCTURES for COMPETITIVE COSTS & EFFICIENCY IMPROVING PERFORMANCES.
PROGRAM PHASES

PHASE B

PROJECT PHASE A

• EXTERNAL INPUTS
  • CUSTOMER REQUIREMENTS
  • MARKET ANALYSIS
  • AIRWORTHINESS RULES
• REDUCED SCALE FLIGHT PROTOTYPE (COLIBRI)
  • FLIGHT TESTS
  • TUNNEL TESTS
• FEASIBILITY STUDIES/DEVELOPMENT ANALYSIS
• INDUSTRIAL ORGANIZATION
WP#1. Program Management
WP# 2. User Requirements Analysis: Actual and Future needs.
WP# 3. Alternative systems analysis in the market.
WP# 4. Requirements/Specification/Certification Rules. ISDEFE
   4.1 Technical, Logistic and Operative Requirements
   4.2 Functional specifications
   4.3 Technical specifications
WP# 5. Preliminary Configuration. ARIES COMPLEX- INTA
WP# 6. Basic technologies Flight Segment.
   6.1 Mechanisms.
      6.1.1 Wing Folding. ARIES COMPLEX.
      6.1.2 Folding/Alignement Rotor. CESA
   6.2 Powerplant. INTA / UNIVERSIDAD LEÓN, PIGNALY.
   6.3 Aerodynamics and Flight Mechanics. Loads. INTA./ARIES, MEDIA, CYO.
   6.4 Performances. Transition mode. INTA/ ARIES, MEDIA y CYO.
   6.5 Electrical and electronic systems. CTA/ Aries, INTA.
   6.6 Structural engineering Aries/MEDIA.
   6.7 Manufacturing Engineering. Aries/AITIIP, CTA
   6.8 Weights engineering. Aries.

WP# 7. Onboard Systems Technologies
   7.1 Navigation Guidance and Control. INTA/UPC, CTA, AICIA.
   7.2 Data link. (9/07-30/11). INTA/ CTA, INASMET, AICIA.
   7.3 Support to onboard systems.
      7.3.1. Ground Control Station. INTA.
      7.3.2. Automatic Landing/Takeoff. INTA/ CTA, AICIA, GMV.
      7.3.3. Auxiliary equipment. INTA/ CTA, VTI, GMV.
WP# 12. Technological Demonstrator
  12.1 Modifications
    12.1.1 Configuration
    12.1.2 New Mechanisms. ARIES COMPLEX
    12.1.3 Electrical and Propulsion mechanisms. INTA
    12.1.4 Design and Manufacturing of Components
      Fenestron. INTA
      Wing Folding Mechanism. Aries / AITIIP.
      Wing. Aries / AITIIP
      Powerplant. INTA
      Control Surfaces. ARIES
  12.2 Navigation, Guidance and Control system INTA. AICIA.
  12.3 Aerodynamic Characterisation. INTA/ARIES, MEDIA, Tech Cons.
  12.4 Flight Test. INTA.
  12.5 Wind Tunnel Tests. INTA.
ARIES INVOLVEMENT

ARIES HAS TAKEN THE LEAD IN

• PROJECT MANAGEMENT
• STRUCTURAL AND MECHANISMS ENGINEERING AND MANUFACTURING
• SYSTEM INTEGRATION.
• RELIABILITY, ACCESSIBILITY, MAINTAINABILITY. VEHICLE AIRWORTHINESS
• FINAL INTEGRATION AND DELIVERY
• PRODUCT SUPPORT

ARIES PROVIDES SUPPORT IN

• AERODYNAMICS AND FLIGHT MECHANICS
• SYSTEMS ENGINEERING
REDUCED SCALE FLIGHT MODEL
DETAIL OF FOLDING WINGS MECHANISM
CONCLUSIONS FOR HADA

- **HADA PROJECT** HAS BEEN APPROVED BY THE SPANISH MINISTRY OF EDUCATION AND SCIENCE (M.E.C) AND M.O.D AND WILL RECEIVE FUNDING FOR THE DURATION OF THE PROGRAMME

- **INTA/AC INVITE INTERNATIONAL PARTNERS TO JOIN HADA FROM 2008 AND BEYOND:**
  - OPPORTUNITIES: “SECURITY” 7th E.U PROGRAM AND “TRANSPORT INCLUDING AERONAUTICS”
  - BILATERAL AGREEMENTS WILL BE SOUGHT (EREA, EADS, EUROCOPTER, ETC..)