THE PROJECT

The CROP project introduces an innovative propulsion system for aircraft based on the cycloidal rotor concept, using an integrated approach that includes the electric drive train, airframe integration and an environmentally friendly energy source.

The CROP system is supported on a multi-physics approach:
1. The high thrust is obtained by unsteady-based cycloidal rotor operation;
2. The development of low-weight electric power drives for the system;
3. Airframe re-design to accomplish optimum integration of the cycloidal propulsor;
4. Environmentally friendly energy source based on hydrogen and photovoltaic cells.

The strengths of the CROP concept are:
- **High thrust levels** by using unsteady airflows
- **Low weight** by using an integrated design approach between airframe and cycloidal propulsor

EXPECTED RESULTS

The revolutionary CROP propulsion concept will introduce new air-vehicle concepts, overcoming traditional limitation on short take-off and landing, including hovering capability.

The results to be expected from this project are:
- improvement in aerodynamic efficiency of the cycloidal rotor for application in large vehicles
- integration of low-weight electric drives into the cycloidal propulsion system
- analysis of the more promising configurations for airframe cycloidal propulsion integration
- assessment and optimization of energy necessities for the novel propulsion system
POTENTIAL APPLICATIONS TO AERIAL TRANSPORT SYSTEMS

The possibilities opened by the development of an air vehicle that is capable to attain high subsonic velocities and also capable of VTOL without the need to make a radical reconfiguration of its geometry are enormous:
- more convenient commercial transportation
- rapid disaster/rescue response
- flexible multi-mission military defense vehicles
- green friendly vehicles able to be powered by renewable or photovoltaic electricity

To achieve these goals, it is proposed that an air vehicle incorporating the cyclorotor concept must make use of unconventional aerodynamic and structural innovations, leading to the creation of a revolutionary subsonic aircraft. It is considered adequate that a cyclorotor based air vehicle will make use of symmetrical blades with unlimited controllable pitch in relation to the airframe. This vehicle can make a smooth transition from low speed and vertical flight to high speed forward flight by reducing the rotor angular velocity, so that the blades rotational speeds drop below the forward vehicle flight speed.

The cyclorotor introduces several potential advantages in comparison with traditional VTOL or fixed wing air vehicles. It uses common surfaces to achieve lift and thrust along the full range of flight speeds. This can be helpful in eliminating wing drag at high speed.

The use of a wing rotating around the axial axis creates lift and thrust, when the blades move backward in relation to the vehicle’s direction of flight. This enables the use of the intermittent but very high lift value, generated by the unsteady pitching of the blades. Furthermore, the rotational speed and pitch of the cyclorotor does not need to increase with vehicle speed, since the achievable thrust increases with forward airspeed for a constant rotor angular velocity.

Moreover, the cyclorotor lifting area is related to its VTOL efficiency and that required area is less than for helicopters and jet vectored thrust.

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PROJECT CONTENT

WP 1  Project management
D1.1  Kick-off meeting presentation
D1.2  Periodic report
D1.3  Final report

WP 2  Scientific coordination, design and implementation
D2.1  Organisational guidelines and general rules
D2.2  Dissemination quality report
D2.3  Bibliography analysis
D2.4  Preliminary design
D2.5  Mathematical models
D2.6  Design methodologies report
D2.7  Design methodologies final report
D2.8  Study of integration into aircraft
D2.9  Performance viability assessment of the integrated vehicle

WP 3  System simulations
D3.1  CFD analysis report
D3.2  CFD analysis final report
D3.3  Vehicle CFD analysis report
D3.4  Vehicle CFD analysis report

WP 4  Experimental validation
D4.1  Experimental activity plan
D4.2  Experimental intermediate report
D4.3  Experimental final report

WP 5  Technology evaluation
D5.1  Technology evaluation report
D5.2  Technological evaluation of global concept

WP 6  Proof of concept
D6.1  Multimedia proof of concept
D6.2  Proof of concept

WP 7  Dissemination and exploitation
D7.1  Website and upgrades
D7.2  Leaflet
D7.3  Dissemination plan
D7.4  Newsletter
D7.5  Exploitation plan evaluation
D7.6  Evaluation of scientific dissemination
D7.7  Final newsletter

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