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CARIC
CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

SUMMARY

Project Number	Project Title
AIARA	Artificial Intelligence Enabled Highly Adaptive Robots for Aerospace Industry 4.0
AUT-1629_TRL4+	An IoT Platform for Disaster Response
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AVIO-1503_TRL4+	ACTIVE HAPTIC TRIM ACTUATORS FOR ROTORCRAFT APPLICATIONS
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ENV-702	Low Power De-icing Systems for Light Weight Helicopters
ENV-708	Optimisation of Fireproof, Pressurized Acoustic Sandwich Structures
ENV-709	Magneto-Rheological Fluid (MRF) Characterization, Optimization and Condition Monitoring for Aircraft Flight Control Actuators
ENV-715	Development and Evaluation of Noise Measurement Techniques in Low- and High-Speed Wind Tunnel
EUCA-AMOS	Additive Manufacturing Optimization and Simulation Platform for repairing and re-manufacturing of aerospace components – AMOS
EUCA-EPICEA	Electromagnetic Platform for lightweight Integration/Installation of electrical systems in Composite Electrical Aircraft
EUCA-PHOBIC2ICE	Super-IcePhobic Surfaces to Prevent Ice Formation on Aircraft (PHOBIC2ICE)
FlawDetect	Flaw detection and damage tolerant design of components produced by laser powder bed metal fusion
IDIR	Novel Quantitive Non destructive Quality Evaluation of Advance Joining and Consolidation Manufacturing Processes
LEAN-702_TRL4+	Machined Part Multifactorial Estimation Demonstrator
LiBio	Lightweight bionic A/C interior
MANU-1613_TRL4+	Manufacturing of A205 components
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MANU-706_TRL4+	Low CTE aluminum alloy for space HW material properties and processing
MANU-710_TRL4+	AAMI - Aerospace Additive Manufacturing Initiative
MANU-711	Advanced thermal protection coatings
MANU-721_TRL4+	Thermal and surface treatments on parts Inconel 625® produced by Additive Manufacturing
MANU-724_TRL4+	Complex Integrated Composites Assemblies for Aero-Engine Shrouds
MDO-1601_TRL4+	Wingbox Multi-Disciplinary Optimization Platform
MDO-1649_TRL4+	Augmented reality immersive simulation for flight deck design and evaluation.
MDO-1650_TRL4+	Wide Area Monitoring System
MDO-710	Next-Generation of Massively Parallel High-Fidelity Computational Fluid Dynamics
MDO-714_TRL4+	Application of Advanced Earth Observation Technologies
OPR-1618	Evaluate and Improve Student Trainee Performance Using Biometrics
OPR-706_TRL4+	Measuring pilot fatigue to manage pilot performance
PLE-P-1652_TRL4+	Adapting Wearable Technology to Monitor Pilot Fatigue
WE ESM	Electromagnetic and circuit simulation models for aircraft electrical wiring

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CHECK OUT OUR PROJECTS

AIARA

PROJECT NAME

Artificial Intelligence Enabled Highly Adaptive Robots for Aerospace Industry 4.0

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In preparation

PROJECT DURATION (years)

3

DESCRIPTION

A slow production rate, rapid growth of air transportation and enormous backlog of new aircraft orders make the aerospace industry linger on traditional practices and prevents it from moving fast enough to adopt more efficient aircraft designs and advanced materials. An increased level of automation via the use of robots both in manufacturing new aircrafts and maintenance, repair and overhaul (MRO) of existing fleet is considered to be a possible solution for not only cost reduction but also improved quality and safety in the aerospace industry. However, traditional industrial robots used in assembly lines of automotive industry and electronic devices is inadequate for the aerospace industry, because of small batch sizes, large components, diversity of products and a high level of complexity and variation in operations. Thus, the current practice of programming or teaching a robot for every specific task is limited, if not futile, in the aerospace industry. In Industry 4.0, robots are intelligent, highly adaptive and can be trained through machine learning to handle different equipment, tools, products and materials without a need for explicit programming. However, machine learning requires a large volume of data for capturing all possible physical experiences to train the robot, which can be too expensive or unavailable. Recent advances in robotics demonstrate the feasibility of learning from synthetic robot experiences and simulations.

In the proposed project, we aim to develop a methodology to use learning results from simulation and virtual environments to train real robots for a wide range of aerospace manufacturing processes and MRO operations. We will evaluate and demonstrate the feasibility of this approach using four benchmarking use cases including a draping robot for composites manufacturing, a multi-arm robot for handling of flexible material in composites manufacturing, and an adaptive robot capable of handling both avionics monitoring instruments and totally different tools for swaging collars. This research partnership brings together the UBC, Element AI and Kinova Inc. from Canada and German Aerospace Center (DLR), Broetje, Fraunhofer IPT and ZAL from Germany to offer a more productive path for the aerospace industry under Industry 4.0.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

AUT-703_TRL4+

PROJECT NAME

MOBILIZING PROJET : Medium-sized VTOL UAV

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

The project CARIC AUT-703 involves four Canadian SMEs supported by two specialized Engineering universities, École Polytechnique de Montreal and the ETS, in order to develop several concepts and technologies in the field of UAVs. The quartet of companies will demonstrate an unmanned helicopter prototype intermediate category.
Located in Saint-Joseph-de-Coleraine in Quebec, the company LAFLAMME AERO demonstrate the expertise and technologies of the young aerospace company offering a revolutionary concept helicopter small size, performance and unmatched versatility.
The company N.G.C. AEROSPACE from Sherbrooke, specializing for his part in the design and deployment of intelligent software for space, aeronautical and land systems, will use its expertise and technologies in developing and integrating a system of navigation, guidance and control with avoidance obstacle to the drone.
For its part, ROY AIRCRAFT AVIONICS & SIMULATION is one of the few companies in the world with the expertise and products needed to develop and implement an integrated test unit for a complete aircraft. RAAS develop during this project extensible test environment and ground control station technologies.
SINTERS AMERICA, located in Boucherville, develops and manufactures automated and maintenance equipment for aerospace test systems. The company wants to develop an acquisition card dedicated to UAV for gauge sensors and also position themselves in the new market for drones.
These four SMEs wanting to use the "technology maturation" program offered by the CARIC to propel each company to greater heights. This project will diversify, develop and improve the expertise of partner companies. This project is also an opportunity to build a strong partnership between the four industrial partners and two universities in the aerospace sector, a first initiative that could lead to short and medium term to substantial business opportunities. Finally, the AUT-703 project will also enable the development and validation of high-tech products that can then be sold on the UAV market is growing rapidly. This project could be a lever that will result in the retention and creation of ten jobs in aerospace in small and medium-sized businesses in the high technology sector.

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CHECK OUT OUR PROJECTS

AUT-1629_TRL4+

PROJECT NAME

An IoT Platform for Disaster Response

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

This project aims to introduce new emerging technologies to the aerospace arena, while also contributing to areas of research. Today, rising trends in the aerospace industry are include in the areas of automation, miniaturization, overall mission cost reduction, reduction of energy footprint. This project will contribute to opening new frontiers in all of those areas mentioned. But more importantly, the project aims to introduce emerging technologies to the aerospace sector. These include technologies such as: collaborative robotics, advanced human interface, and innovative telecommunication architecture. To successfully achieve our aim, we require the collaboration of researchers and industry specialists with strong and diverse subject matter expertise. The project will achieve the successful integration of diverse technologies that have not yet matured, or found practical application. We’re primarily seeking to develop practical application in various emergency situations, employing the aerospace medium.

More specifically, the aim of this project is to develop a novel information technology platform to improve the effectiveness of emergency response in disaster areas, ultimately saving lives. In case of any emergency response, the local communication infrastructure cannot be generally relied upon: therefore, we propose a distributed, self-organizing information system based on off-the-shelf mobile devices, supported by a self organizing self deploying UAVs. This platform is based on 4 research areas: autonomous networking, swarm robotics, Internet-of-Things, and data analytics.

The project is led by the team Humanitas Solutions (HS), a Montreal-based technological solution provider focusing on developing novel solutions to support emergency responders and lead them to improve their performance. The other industrial partners are Bell Helicopter (BH), Dassault Systems (DS), and Elisen & Associés (EA) who see great potential of the mission-critical-solution and its future application scenarios in other sectors.

A typical application scenario for the proposed platform can be the establishment of a temporary field hospital in a disaster area: tablets and smartphones of first responders collaborate to establish an ad-hoc network used to exchange messages, multimedia content, or run other collaborative user applications. Some UAVs place themselves in strategic points to increase the performance of the ad-hoc local network and to build long range communication channels with other distant areas. Other UAVs may be involved in other tasks such as search and rescue operations or patrolling. Finally, a secondary ad-hoc network may be established to connect multiple sensors, e.g., bracelets that monitor patient conditions, and to interact, when needed with the primary human-based network. The large amount of data collected by the whole infrastructure can be exploited to further improve the performance of the system, perform troubleshooting and make accurate predictions about future conditions. Both application and system data can be stored and synchronized with the cloud infrastructure, which can be also interrogated on-demand to perform advanced computing operations.

Being the project leader and main developer, HS will take in charge of the project coordination and the final outcome will be in its product range. BH will provide the expertise on helicopter dynamics and will benefit from the helicopter-based platform technology. DS will contribute to the development of a 3D-based human-computer-interface and will integrate its applications on the resulting network layer. EA will provide expertise on the certification of airborne systems, and will benefit by developing strategies for the certification Unmanned Aerial Systems (UASs).

All the industrial partners will be supported by three universities: Polytechnique Montreal, which will provide engineering research efforts for the project in all fields, Carleton University, which will develop the IoT secondary network, and HEC, which will provide analysis capability and research equipment for all the human factors involved in the project (e.g. human behavior analysis, UAV control interfaces). The expected outcome will be a converged self-organizing and self-healing IT platform able to cope in a seamless way with heterogeneous resources, mutable conditions and different quality of service requirements.

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CHECK OUT OUR PROJECTS

AVIO-707

PROJECT NAME

Technologies for Reconfigurable antennas used in Satellite and Terrestrial Links (TRUST)

PROJECT TYPE

Exploring Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

3

DESCRIPTION

The general objective of the proposed research is to investigate the feasibility of implementing electronically reconfigurable antennas with the following desired characteristics: capability to operate under realistic transmit power conditions, flexibility for beam steering and shaping, capability of retuning the frequency of operation, capability to operate under varying temperature conditions and reconfiguration time in the order of microseconds.
To accomplish this, we will investigate the characteristics of tunable components under severe conditions (high power and varying temperature) to determine their limitations. Approaches to mitigate the performance degradation will have to be developed and validated. Concurrently, reconfigurable antenna prototypes demonstrating the enhanced robustness of the design method will be designed and implemented. These prototypes will allow assessment of performance and limitations of the proposed concepts.

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CHECK OUT OUR PROJECTS

AVIO-718_TRL4+

PROJECT NAME

Active haptic sidestick for aircraft applications

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Closed

PROJECT DURATION (years)

1

DESCRIPTION

Since 2013, Design Exonetics (a spinoff from the CAMUS - Conception d’Actionneurs et de Moteurs de l’Université de Sherbrooke – laboratory) has been developing a novel actuation technology for the aerospace industry in collaboration with an aerospace OEM. The technology offers lighter and faster actuation than high-end electromagnetic motors or hydraulic systems, while matching the most stringent aerospace reliability and weight requirements, necessary for critical applications such as primary flight controls. Recently, Exonetics has been investigating new applications for the technology, one of the most promising being active haptic devices. The preliminary study has led to a commercial-product idea revolving around multi Degrees-Of-Freedom joystick actuated by cable mechanisms, which could find applications in a variety of aircrafts. The objective of the CARIC project proposal is thus to design, build, and test a prototype of a cable-mechanism for an active haptic joystick, in order to entice market interest and have the product evolve from TRL3 to TRL4. The main technical challenges of this project are: (1) the integration of electric/electronic and mechanical hardware in a commercially attractive product, (2) the development and implementation of optimal control strategy for cable-driven haptic devices and, (3) the production of the parts with state of the art aeronautical processes. These challenges need to address by partners in each specific field.

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CHECK OUT OUR PROJECTS

AVIO-1503_TRL4+

PROJECT NAME

ACTIVE HAPTIC TRIM ACTUATORS FOR ROTORCRAFT APPLICATIONS

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

Active haptic pilot controls have the capability to generate tactile cueing signals to warn the pilot of approaching flight envelope limitations or hazards. This is particularly of interest for helicopters because they regularly operate near their maximum gross weights and power levels. Active haptic cueing alerts the pilot of an impending aircraft flight limit without requiring supplementary attention. This allows a more efficient usage of the aircraft capabilities while increasing safety by enhancing pilot’s situational awareness.
In order to generate adequate tactile cues, active controls require high‐bandwidth actuators, which typically come with added system complexity, cost and weight. For this reason, active control technology is not currently seen in lighter aircraft. However, the need for increased safety makes the advantages of active controls desirable for all aircraft types.
From 2013 to 2015, following the CRIAQ ENV‐404 project aiming at developing all‐electric actuation technologies for aircraft, Bell Helicopter and Exonetik developed an active haptic trim actuator using Magnetorheological Fluids (MRF) as a form and fit replacement to current passive trim actuators used in light helicopters. The developed MRF active haptic trim actuator can be used with both existing platforms having conventional controls and new fly‐by‐wire aircraft.
The objective of this CARIC project proposal is to design, build and test prototypes, on ground and subsequently in flight, of MRF trim actuators, in order to make the technology progress from TRL4 to TRL6.

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CHECK OUT OUR PROJECTS

AVIO-1601_TRL4+

PROJECT NAME

Degraded Visual Environment Navigation Support (DVENS)

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

o A Degraded Visual Environment (DVE) exists when conditions of low visibility, including conditions caused by rotor downwash in sand/dust (“brown-out”), snow (“white-out”/snowball) or water, obscures both horizon and terrain features. A DVE may also occur when environmental conditions such as fog, precipitation, snow, clouds or smoke adversely impact a rotorcraft operator's abilities to operate safely and effectively. DVE operations are mostly associated with helicopters that are in critical phases of flight (i.e. landing and take-off) however a DVE can occur in any flight profile. The broad range of operational conditions which may lead to a DVE presents hazard across a broad range of current and potential Canadian Forces and civilian operational environments. The impact of DVE conditions on operations can range from a nuisance to a serious hazard jeopardizing aircraft and lives. DVE conditions have resulted in numerous NATO aircraft helicopter crews and vehicles being lost in Afghanistan. Operations in cold climates also experience similar white-out conditions; as such DVE poses a significant risk factor for future Arctic rotary wing operations.

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CHECK OUT OUR PROJECTS

AVIO-1603_TRL4+

PROJECT NAME

Cosmic radiation In-flight Measurement and real-time analysis for Electronic Systems and passenger protection (CIMES)

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

To answer customers concerns and to be compliant with FAA requests on the subject, aircraft and flight systems manufacturers must collect in-flight data for cosmic radiations and develop a global strategy for real-time processing of this data to provide pilots, crew and aircraft operations, appropriate information to help them make the right decisions in case of unusually high cosmic radiation exposure.Researches have started in order to better assess the effect of Cosmic radiation on health. And some data exists for the effect on systems in the literature as well as from previous project AVIO-403. AVIO-403 and its continuum (WP4 of Project EPICEA) are intended to better assess the risk and accordingly adapt electrical system design and integration to the new industry paradigm (lightweight, more electric, manufacturing cost efficiency …). In parallel, AVIO-1603 is intended to develop an in-flight response to the challenge of CR events.

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CHECK OUT OUR PROJECTS

COMP-709_TRL4+

PROJECT NAME

CCM10: Design and Technology Development of Optimized Composite Aircraft Structures Using Knowledge Based Iterations

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2.2

DESCRIPTION

The Canadian Composite Manufacturing R&D Consortium project, “Design and Technology Development of Optimized Composite Aircraft Structures Using Knowledge Based Iterations” will further the knowledge, experience and capability of advanced composite design, development, simulation and manufacturing in Canadian industry. Outcomes will be industrial competitive advantages, best practices documents and Highly Qualified Personnel (HQP). This project will focus on the design, development and manufacture of a challenging aircraft geometry, the knife edged 3D closeout structure. This geometry has difficult to fabricate key features with technology gaps, and has high potential for technical and economic benefits. Six industrial partners, two research organizations and two academic partners, coordinated through CCMRD, will collaborate to resolve its key technology gaps, generate knowledge and create innovative solutions. The project will define baseline metrics using ‘similar to’ commercial airplane products and will focus on improvements to cost, weight and manufacturing cycle time. An aggregate improvement of 25-50% is targeted. The knowledge generated, and experience gained during the design, tooling and manufacturing optimization processes will provide for competitive advantages. These advantages will manifest themselves as cost reductions, quality improvements and enable fabrication cycle time reductions though application of lean design and lean manufacturing.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

COMP-1601_TRL4+

PROJECT NAME

Complex composite structure multifunction for aerospace

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2.5

DESCRIPTION

The new generation of complex composites structures that will be developed by Hutchinson and its partners will integrate several functions, including mechanical and robustness contribution brought by the integrated structure, esthetic contribution and more. These new technologies will allow to reduce the amount of parts and the amount of operations required to build an assembly with a one-shot process, generating an energy saving in the global process. The self-stiffened part that will be developed will also allow to replace traditional metal components by composite materials. Combined with design optimization, a weight reduction will be achieved, generating a reduction of aircraft’s fuel consumption. These innovative technologies can be possible by combining a multiple expertise, and by developing specific know-how.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

COMP-1602_TRL4+

PROJECT NAME

Natural Laminar Flow Nacelle Lip in Composite

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

The aviation industry is constantly progressing towards its goal of minimum impact on the environment, with the aim to reduce in half its carbon emission by 2050 (IATA). To reduce the carbon emissions of an aircraft, with the same flying time, the aircraft manufacturer strives to reduce its weight and drag. This project addresses these two levers by creating a Natural Laminar Flow Nacelle Lip (low drag) that is made of Composite materials (low weight).
To reduce the engine fuel consumption, the trend with the turbofan engine manufacturers has been to increase the bypass ratios for greater propulsion efficiency. To push this efficiency higher implies larger fans and therefore larger exposed nacelle surfaces, and thereby increased drag. Reducing the friction drag on such surfaces would therefore have a noticeable impact on the overall aircraft drag.
In this scenario, research on composite materials and technologies are ongoing to avoid autoclave curing in order to achieve required mechanical performance and geometric complexity, avoiding a high energy and time consumption. As composite parts grow in size and number, the need for faster and more cost-effective manufacturing comes into conflict with the limitations of traditional processing methods. Given the predicted market growth for composites and the economic and time limitations of autoclave processing, out-of-autoclave manufacturing techniques with special regards to thermoplastic composite are becoming very interesting. In this project a Nacelle Composite Lip will be realized after a down selection between Thermoforming and Automated Fiber Placement manufacturing processes with the aim to obtain good surface quality, concerning laminar requirements, generated by these out-of-autoclave technologies: particular attention has to be spent to obtain a good surface waviness and roughness through Consolidation-in-Situ (CiS) due to difficulties to control the crystallization.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

COMP-1633_INTL

PROJECT NAME

Flame retardant FRP systems for aircraft interior applications

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

Due to aircraft manufacture volume increase there is a dramatic need for economic fibre -reinforced composite materials and processing technologies that fulfil - besides high mechanical properties and reliability - also specific fire, smoke and toxcity characteristics (FST). As inherent flame retardant composite resins are very expensive this projects will optimise the FST characteristics of existing resin types like epoxy and vinylester by flame retardant fillers. Consequently the processing technologies have to be adapted not to wash out the solid fillers by impregnation processes. To compensate the increase of density due to the high filler content, the reinforcing fibre amounts will be partly substituted by light nanocellulose fibres.
The developed materials and processes will lead to the manufacture of three different demonstrator parts. All materials and processes show a high potential for immense cost cutting. The materials and processes will be evaluated mechanically by the universities first as coupon and later as demonstrator part. In addition Comprisetec and the HSU will evaluate the cost benefit by process cost analyses and the ecological impact by a life cycle assessment.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

DPHM-702_TRL4+

PROJECT NAME

Diagnostic and Prognostic system for aircraft systems

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Closed

PROJECT DURATION (years)

2

DESCRIPTION

The reduction of aircraft life-cycle cost and the reduction of environmental footprint of aerospace industry trigger innovative ideas not only at design level but also at maintenance level. Operators are looking for highly reliable equipment, nevertheless when a failure occurs, they want to be able to identify and replace as quickly as feasible the faulty unit. Operators are looking for user-friendly tools to reduce time dedicated to maintenance on their fleet.
An effective aircraft health management integrates all system components into a monitoring strategy consisting in diagnosis and prognosis technologies that addresses failure mode mitigation and life cycle costs. While current signal processing and experienced-based approaches to diagnosis have proven effective in many aircraft applications, knowledge and model-based strategies can provide further improvements and are not necessarily more costly to develop or maintain. Using these new technologies shall enable an improved detection accuracy associated with the capability to identify the failure's root cause. They also will introduce the capability to monitor components degradation in order to better predict maintenance checks, and so doing to reduce life cycle costs. In this research project the consortium will experiment health monitoring technologies on a secondary flight control system. The project first objective is to design, develop and test real-time diagnosis algorithms to detect and isolate failures and identify the root-cause. The project second objective is to design develop and test prognosis algorithms for mechanical units based both on models and on hydraulic bench data. Thales define the objectives and expected results and provide their operational expertise. Thales provide the system and components models as well as operational scenarios. Thales also provide bench test data and perform all representative testing. GlobVision provide its expertise in diagnosis and prognosis on complex systems. They provide the consortium with their know-how in terms of process and algorithms to efficiently provide solutions on fault detection and prediction. Universities of Concordia and Windsor provide their expertise on prognosis advanced algorithms and perform tests using models to measure algorithms efficiency.
Providing aircraft manufacturers with intelligent diagnosis and prognosis capabilities will lead to more intelligent aircraft, enabling to increase aircraft availability and reduce maintenance cost for operators. These competitive advantages will translate into aircraft offer that will be well positioned to win new markets while also meeting environmental concerns identified by the air travel user community. Commercial success of this highly efficient aircraft product would lead to increase manufacturing activities in Canada and a more favorable trade balance to exports.

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CHECK OUT OUR PROJECTS

DPHM-711_TRL4+

PROJECT NAME

Evaluation of Advanced Fusion Welding Technologies in the Structural Repair of Aluminium and Magnesium Alloys

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

The airframe and engine structural components of today’s aircraft make extensive use of light alloys to provide the necessary strength while minimizing weight. The fabrication, maintenance and repair of these components require welding processes that maximize strength at low distortion. The high tolerance nature of these components does not typically allow for full solution heat treatment after welding. Aluminium and Magnesium alloys have higher coefficients of thermal expansion (approximately 60%) and thermal conductivity (approximately 200%) than nickel, titanium, stainless steel, and cobalt based aerospace alloys. These material characteristics, in addition to lower melting points and the tendency for both materials to form stable oxides make these alloys very challenging to weld. Consequently, conventional welding processes (TIG, GTAW) used in aerospace manufacturing and repair typically do not offer sufficient repeatability, post weld strength or control of distortion to meet acceptance standards with minimal heat treatment.
This project will evaluate and demonstrate the introduction of innovative high performance welding technologies to the difficult applications of weld repair of light alloys in aerostructures and components. The development of these new technologies will provide competitive advantage and market opportunities to both the companies that supply them and those that use them. The performance of selected advanced fusion welding methods will be evaluated to identify as-welded properties of each method in typical light aerospace structural alloys.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

ENV-702

PROJECT NAME

Low Power De-icing Systems for Light Weight Helicopters

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

Le projet vise à poursuivre les travaux du projet ENV-414 dans les domaines suivants:
- Dégivrage piézo-électrique de pales rotor: optimisation du système et identification d’actuateurs «robustes»
- Revêtements anti-givre: évaluation de revêtements avec faible adhérence au givre pour application potentielle sur hélicoptère
- Physique du givrage: poursuite de la recherche de ENV-414
- Développement d’un système de contrôle sans fil pour transmission sans contact de courant électrique aux pales rotor
- Modélisation du transfert de chaleur convective sur pales rotor

Expertises recherchées
- Partenaires avec les expertises suivantes:
- Conception de systèmes de dégivrage piézo-électrique et l’évaluation de concept d’actuateurs commerciaux
- Évaluation et tests de revêtements anti-givre évolués
- Recherche dans la physique du givrage
- Contrôle sans fil de systèmes / composantes embarqués

CARIC
CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

ENV-708

PROJECT NAME

Optimisation of Fireproof, Pressurized Acoustic Sandwich Structures

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

The use of composite and aluminum materials in the aeronautic industry has the potential to significantly reduce the weight of aircrafts and hence their fuel consumption. The primary purpose of the project presented here is to focus on the fire protection of acoustic sandwich panels made of composite materials for use in bypass ducts of aircraft engines. The secondary purpose is the fire protection of acoustic sandwich panels made of aluminum materials for use in fan cases of aircraft engines. The objectives of the project are to identify the failure modes of current sandwich structures and quantify the benefits that can be incurred through the use of various fireproofing strategies. The parameters of importance for this evaluation are weight, cost, ease of manufacturing, mechanical and acoustical properties in service and mechanical properties under flame attack.

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CHECK OUT OUR PROJECTS

ENV-709

PROJECT NAME

Magneto-Rheological Fluid (MRF) Characterization, Optimization and Condition Monitoring for Aircraft Flight Control Actuators

PROJECT TYPE

Exploring Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

4

DESCRIPTION

The proposed ENV-709 research program builds upon the promising results from the CRIAQ project ENV-404 (round 4) where novel architecture designs for electromechanical actuators were developed around MagnetoRheological Fluid (MRF) clutches maintained in slippage. The ENV-404 project demonstrated that such MRF actuators have to potential to meet and even surpass the reliability and performance requirements of helicopter primary flight control actuation. The ENV-404 project indentified that MRF aging is a key issue that must be clearly understood and addressed to improve reliability and maintainability of MRF actuators and push the technology to further TRL. In the proposed CRIAQ ENV-709 project, Bell Helicopter and UdeS joint efforts towards reliable MRF technology will be emphasized by key partners in the name of GasTOPS and McGill University. GasTOPS joins as a leader in Condition Monitoring (CM) of machinery systems including fluid life monitoring in aerospace applications, while McGill joins as a top of the line chemistry laboratory with expertise in advanced fluid formulation. All partners have strong commitment to bring this CRIAQ-born innovation to the market by establishing knowledge on MRF aging and developing new monitoring technologies. The collective and synergistic development of the MRF actuator technological platform would position Canadian aerospace industry as a world leader in electromechanical actuators, which would be a strategic asset in today’s realm of More Electric Aircraft.

CARIC
CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

ENV-715

PROJECT NAME

Development and Evaluation of Noise Measurement Techniques in Low- and High-Speed Wind Tunnel

PROJECT TYPE

Exploring Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

3

DESCRIPTION

The proposed project aims to investigate various measurement techniques of wall-pressure fluctuations induced by turbulent flow and of noise in wind tunnel environments. It will enable the development and evaluation of various acoustic measurement techniques in low- and high-speed wind tunnels. Carleton University has a High-Speed Wind Tunnel, a unique facility non-existent elsewhere in Canada. This facility is fundamental for this project, providing air flow speeds up to supersonic regime, a necessary capability to replicate airflow conditions similar to those of cruise flight. Bombardier is interested in minimizing the number of extensive and expensive flight tests required for noise measurements, and in reducing the noise levels in their aircraft fleet. MDS Aero is interested in investigating and minimizing the noise generation inside their engine test cell exhaust system. Through this project, both Bombardier Aerospace and MDS Aero Corporation will be able to optimize their product designs.

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CHECK OUT OUR PROJECTS

ENV-1601_TRL4+

PROJECT NAME

Next Generation Combustor for Small Gas Turbine Engines

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

Evolve current low emissions technology developed for large turbofan engines to the next generation turboprops by a new combustor system. This new combustion system is an enabler for greenhouse gas reduction on the engine and has the potential to deliver significant reductions of NOx and particulate matter while improving component life.

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CHECK OUT OUR PROJECTS

ENV-1605

PROJECT NAME

Cabin Noise Modeling

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

When designing a new aircraft, it is a challenge to develop a model of the structure-born noise that will be generated by systems like engine, transmission and oil pump. Such model or analytical tool would serve to assess such noise during the development process to work on mitigation solutions upstream of the design.
This project aims to address the following key areas:
- Improve knowledge of structure-born noise for specific systems
- Develop models and/or analytical tools to be used during the design phase of a new aircraft

Expertise sought:
- Industrial partners who design aircraft or design/supply noise attenuation solutions

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CHECK OUT OUR PROJECTS

ENV-1648_INTL

PROJECT NAME

New Acoustic Insulation Meta-Material Technology for Aerospace

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

OEMs intention is to push the industrialization of the acoustic meta-material (AMM) principles for either primary or secondary insulation. The insulation today is used for thermal and acoustical insulation and its design is driven mainly by the thermal requirements. In the past years companies have looked from time to time at the AMM technology with multi-tonal or narrow band pronounced noise spectra in the frequency range between 150Hz and 500Hz. Several approaches have been developed over last years: layered material configuration, embedded resonator inclusions, porous materials. The main goal of the project and the most important requirement for an industrial application is the compatibility of AMM with currently existing insulation blankets.

CARIC
CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

EUCA-AMOS

PROJECT NAME

Additive Manufacturing Optimization and Simulation Platform for repairing and re-manufacturing of aerospace components AMOS

PROJECT TYPE

PROJECT STATUS

Completed

PROJECT DURATION (years)

4

DESCRIPTION

This research project is a Canada and European collaborative project. It focuses on several key Direct Energy Deposition (DED) Additive Manufacturing (AM) processes that have great potential to be used as cost-effective and efficient repairing and re-manufacturing processes for aerospace components such as turbine blades and landing gears. This project aims to conduct fundamental research to understand the material integrity through chosen DED AM processes, the accuracy and limitations of these deposition processes, effective defect geometry mapping and generation methods, and automated and hybrid DED and post-deposition machining strategies. This project intends to connect repair and re-manufacturing strategies with design through accurate DED process simulation and novel multi-disciplinary design optimisation (MDO) methods to ultimately reduce the weakness of aerospace component at design stage and prolong their the lifecycles. Both powder-based and wire-based DED systems will be investigated to establish an across-the-board comparative study.
The data collected through this comprehensive comparative study will be extremely valuable for the OEMs of this project (i.e. GKN, PWC, and HDI) to understand the pros and cons of these DED systems and will help them to select suitable repair and re-manufacturing strategies. The tests conducted in this research are also extremely beneficial for the SMEs in this project (i.e. Liburdi, AV&R, DPS) to validate their existing repairing systems and techniques. Common DED processes are controlled either by a CNC controller or a robotic controller depending on the type of machine that carries the deposition nozzle system. In the proposed research, both CNC controlled and robotic controlled DED systems are going to be studied. There are three aerospace alloys to be investigated in this research: Ti-6Al-4V, Inconel 718, and 300M alloy steel. The research team is multidisciplinary and complementary in expertise and research facilities. The Canadian research team includes academics from McGill University and University of Ottawa. The European research team includes academics from Ecole Centrale de Nantes in France and University of Sheffield in UK.

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CHECK OUT OUR PROJECTS

EUCA-EPICEA

PROJECT NAME

Electromagnetic Platform for lightweight Integration/Installation of electrical systems in Composite Electrical Aircraft

PROJECT TYPE

PROJECT STATUS

Completed

PROJECT DURATION (years)

3

DESCRIPTION

This three-year EU-Canadian joint research venture called “EPICEA” is to release, validate and verify a unique computer environment (i.e. the EPICEA platform) assimilating a complete understanding of electromagnetic (EM) issues on Composite Electric Aircraft (CEA – i.e. aircraft with composite and electric technologies combined and operating at higher altitude/latitude). EM on CEA includes EM coupling, interconnects, and Cosmic Radiations (CR) on electrical systems together with new concepts of antennas designed to maintain performance in composite environment without modifying aircraft aerodynamics. In EPICEA, CR, as parts of the EM spectrum, are considered as part of the EM environmental hazards such as lightning or HIRF (High Intensity Radiated Fields). The targeted computer platform will support a decision making process for selection of the best strategy for the integration of electrical systems. Starting at a TRL3, the consortium will demonstrate a TRL4 at the end of the project.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

EUCA-PHOBIC2ICE

PROJECT NAME

Super-IcePhobic Surfaces to Prevent Ice Formation on Aircraft (PHOBIC2ICE)

PROJECT TYPE

PROJECT STATUS

Completed

PROJECT DURATION (years)

3

DESCRIPTION

PHOBIC2ICE will develop technologies and predictive simulation tools to avoid or mitigate the accretion of ice on aircraft, a significant problem for aircraft. Accretion of ice on aerostructures poses challenges for both aircraft security (as flying is restricted to only certain atmospheric conditions or to aircraft equipped with certified anti-icing technologies) and sustainability (by increasing the aerodynamic drag and thus increasing fuel burn). Several ice protection technologies are presently in use, however most of them have inherent negative effects such as high energy consumption, weight, environmental impact, high costs, and frequent reapplication need among others. PHOBIC2ICE will create a suite of innovative surface engineering solutions to reduce or eliminate ice accretion, including the development and evaluation of ice accretion simulation tools; novel protective coatings using green manufacturing processes; and sensors to detect the onset of ice formation on aircraft.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

FlawDetect

PROJECT NAME

Flaw detection and damage tolerant design of components produced by laser powder bed metal fusion

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

In this project, a combination of non-destructive inspection techniques and fatigue testing procedures will be used to characterize the defects induced during 3D printing of load-bearing metallic components of aircraft engines and structures and assess their impact on the fatigue life of these components. The results of these tests will provide the data supporting numerical simulations of the fatigue damage propagation and the development of advanced material/structural analysis methods aiming at predicting the fatigue life of AM components and offering clear guidelines for their quality control.

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CHECK OUT OUR PROJECTS

IDIR

PROJECT NAME

Novel Quantitive Non destructive Quality Evaluation of Advance Joining and Consolidation Manufacturing Processes

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

The overall goal of the proposed project is the development of ultrasonic nondestructive testing methodology and portable systems for material joints quality characterization and in-process monitoring based on new approaches, and the application of new generation of NDE systems to two types of material bonded structures:
(i) Resistance Spot Weld (RSW) formed joints of steel, aluminum and dissimilar metals, and
(ii) Low Pressure Cold Spray (LPCS)-formed structures: metal-matrix composite coating/substrate.

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CHECK OUT OUR PROJECTS

LEAN-702_TRL4+

PROJECT NAME

Machined Part Multifactorial Estimation Demonstrator

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

3

DESCRIPTION

The manufacturing of aerospace parts presents several important challenges, including time and cost of production. In today’s changing the economical context of today `doing well the first time 'is imperative to maintain the competitiveness of companies in the sector. The search for efficiency is today fueled by various opportunities from emerging technologies such as 3D metrology and additive manufacturing (AF), which offer a multitude of opportunities possibilities with significant potential. As an example, the AF allows the creation of complex geometry parts and multiple functions that are not feasible by traditional methods. That said, although these new technologies make it possible to envisage a revolution in the manufacturing process of aerospace parts, they are not applicable in all circumstances. Indeed, the criterion of profitability remains essential to the implementation of any new technology. As a result, several studies are underway to consider hybrid processes that combine the so-called conventional technologies with the new ones in order to obtain competitive solutions that respect the quality criteria and the standards imposed by the clients. More specifically, this project will focus on the design and manufacture of the tools used for the production manufacture of aeronautical components (e.g. positioning template for machining, drilling template, etc.).
Considering that any activity other than that the one leading to the creation of production parts does not represent a real added value to the overall process, . Iit can be seen that the design and manufacture of manufacturing production tools can be regarded as a 'badly needed'. Nevertheless, this activity has a significant importance on the challenges mentioned. As an indication, it is very common for tools to represent several tens of thousands of dollars and generate delays of the order of 60 days and more depending on the case. The purpose of the proposed project is to consider this activity differently. In other words, how can the design and manufacture of tooling be adapted to take advantage of the technological potential offered by the FA, 3D metrology and new manufacturing processes in general? Although the introduction of these new options offers concrete alternatives of manufacturing improvement, it is also necessary to consider the constraints and challenges associated with this assumption. To name just a few, the size of the parts that can be produced, as well as the homogeneity, cost and environmental sensitivity of the materials used in the FA, the modularity of the tools, the determination of dimensional requirements, Identification of the capabilities of a numerically controlled machine-tool-tool assembly, etc.
As a premise of the project presented in this proposal, the team identified categories of tools with significant potential for improvement in order to secure a realistic potential for the creation of competitive advantages through the creation of design strategies, bBased on hybrid technologies. These strategies will then be applicable in order to extend their impact on the overall practices of the manufacturing companies involved. After an exhaustive inventory of the state of the art, the approach chosen is to value and combine the new manufacturing technologies within the tried and true strategies by rethinking the creative approach and, in an ideal world, to replace certain technologies tTools or certain internal practices. This vision makes it possible to envisage that the strategies generated are applicable and profitable under the conditions of the market. In addition, we argue that the use of existing technologies and materials (high TRL) will significantly reduce the time required for the industrialization phase. The innovation targeted by this project is based on several interesting advances made in the last decade in terms of materials and the diversity of families of available technologies. Our team has a solid experience in the aerospace parts manufacturing environment as it integrates all the typical players in the supply chain.
The project we propose will enable us to implement several innovative strategies in a highly industrialized demonstration (preliminary) form. Implementing a synergy in the supply chain involved through the implementation of a joint design-manufacturing process as well as a better understanding of the financial factors will only increase the success rate of the Group in commercial proposals to the prime contractors. The harmonization of best industrial practices with the advances proposed by the technologies (FA, CNN, 3D metrology) offers the group the opportunity to develop reflexes of tailored adaptations to the various technical problems presented, which translates into a pragmatic enhancement of Local technical competitiveness. Finally, the "Industry-Academy" matching in this representative industry environment will enhance the quality of the learning and publications produced by the researchers, students and trainees involved.

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CHECK OUT OUR PROJECTS

LiBio

PROJECT NAME

Lightweight bionic A/C interior

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In preparation

PROJECT DURATION (years)

3

DESCRIPTION

The LiBio project wants to enhance the passenger experience and comfort in business jets through the bionic design and functions integration of interior aircraft components.

Combining additive manufacturing with topological optimization will lead to the fabrication of a prototype with a unique design. This technology enables the mix of textures and colors thanks to the mix of thermoplastic and metal parts while easing the integration of elements like speakers or screens.

An international consortium was built to lead this project. The partners, based in Germany, Austria and Canada, cover the entire supply chain, including initial design, topological optimization, manufacturing, assembling and testing in an integrator.

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CHECK OUT OUR PROJECTS

MANU-706_TRL4+

PROJECT NAME

Low CTE aluminum alloy for space HW material properties and processing

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

Satellite on-board antennas and payload RF components use extensively aluminum 6061 alloy, e.g. waveguides, filters, antenna feed chain components.
Thermal control of highly dissipative units is a challenge in space, and aluminum CTE is a drawback, leading to higher mechanical stresses in assemblies and modification of internal RF cavity dimensions (i.e. unstable electrical performances over temperature)
Al-Si alloy systems exhibit low CTE, low density and high strength properties.
Tha project objective is to evaluate existing Al-Si low CTE alloys in regards of the following objectives of research :
- Identify best processing and machining techniques for accurate parts,
- Characterize selected alloys mechanical and electrical properties, - Demonstrate compatibility with silver plating,
- Demonstrate the feasibility on a test case. A typical RF unit qualification program to be run on a unit built with low CTE alloy, e.g. microwave filter.

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CHECK OUT OUR PROJECTS

MANU-710_TRL4+

PROJECT NAME

AAMI - Aerospace Additive Manufacturing Initiative

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

Bell Helicopter Textron Canada Limited and Pratt & Whitney Canada have all initiated research projects on Additive Manufacturing processes. Although applications are different, all companies are facing the same challenges including the lack of a mature Canadian supply chain.
In order to accelerate the maturation of this technology, we are proposing the first Canadian industry-led R&D program on additive manufacturing (AM). The purpose is to bring together the whole value chain (Certification authorities, OEMs, Suppliers, Universities & Research Centers) to collaborate on common tasks for the development of the capability to design, produce, inspect and certify parts using AM processes.
The end goal is to reach TRL/MRL 6 on selected parts for primary and secondary aircraft/helicopter structures as well as aircraft engines and pave the way for usage in the production of parts for repair, retrofit or new products development. Additive manufacturing is a new industrial domain, not a single technology, which is also particularly well aligned to new design approaches like topology optimization.
The expected benefits are: CO2 emissions reduction via weight reduction and cost reduction through part assemblies integration, lead time reduction, reduced buy-to-fly ratio, reduced inventory and optimized batch size.

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CHECK OUT OUR PROJECTS

MANU-711

PROJECT NAME

Advanced thermal protection coatings

PROJECT TYPE

Exploring Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

3

DESCRIPTION

Thermal barrier coatings have been used in aircraft gas turbines since several decades. The initial deposition method of thermal barrier coatings (TBCs), i.e. air plasma spray (APS), is still being used today for producing TBCs made of yttria stabilized zirconia (YSZ). This project consists in exploring new deposition techniques and feed materials for the thermal protection of components exposed to high service temperatures. The main objective of the project is to reduce the thermal conductivity and increase the stability and resistance of TBCs as compared with the presently used ones, without affecting the other characteristics of the deposited coatings. The explored directions comprise assessing both new TBC materials compositions and microstructures in order to maximize the resulting benefits.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MANU-721_TRL4+

PROJECT NAME

Thermal and surface treatments on parts Inconel 625® produced by Additive Manufacturing

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

FusiA Impression 3D métal Inc. et Pratt & Whitney Canada ont initié des projets de recherches sur de la fabrication additive de pièces pour le secteur aéronautiques. Ces projets ont permis de mettre en avant les capacités de cette technologie à garantir les requis dans le domaine aéronautique, notamment pour des systèmes de propulsion. S’inscrivant dans la continuité de leurs projets précédents respectifs, FusiA Impression 3D métal Inc. et Pratt & Whitney Canada souhaitent désormais avancer encore plus loin dans l’intégration de la technologie en regardant les aspects de finition de ces pièces, notamment en ce qui concerne les traitements thermiques et surfaciques. L’objectif est d’étudier, de développer et de mettre en place les techniques et méthodes de traitements de surface et thermiques adaptés à la fabrication additive métallique, sur des cas concrets de pièces dans les environnements fortement contraints que sont les systèmes de propulsion. Ce développement se fera en partenariat avec l’École de Technologie Supérieure et l’École Polytechnique qui possèdent à elles deux de solides expertises dans l’analyse des matériaux, notamment métalliques, les traitements thermiques et de surface. Le but est d’atteindre le niveau TRL 6 en démontrant, sur les cas sélectionnés, la pertinence technique et économique des méthodes développées selon les standards requis par le domaine aéronautique.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MANU-724_TRL4+

PROJECT NAME

Complex Integrated Composites Assemblies for Aero-Engine Shrouds

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

2

DESCRIPTION

The main objective of this project is to attempt to reduce the weight and manufacturing costs of complex integrated assemblies, such as aero-engine shrouds, by replacing Aluminum with composite materials. The secondary objective is also to extend the state-of-the art on three selected manufacturing processes: Resin Transfer Moulding (RTM, Compression Moulding of Long Discontinuous Fibres (LDF) and Thermo-Forming. Currently, aero-engine shrouds are generally machined from one block of aluminum to create a geometrically complex component with a variety of airflow control functions. In order to reduce the part weight and its manufacturing costs while maintaining performance, it is proposed to replace this part with multiple composite material panels, bonded and bolted together to create a geometrically complex assembly, following the same functional and dimensional requirements of the existing aluminum part. In order to validate and manufacture the novel design, several composite material and manufacturing options will be investigated. Due to the assembly’s complexity, performance requirements, and the integration with other metallic components, manufacturing this part with composite materials is a significant technical and scientific challenge, and multiple materials and processes may be needed. Therefore, a partnership was established between P&WC, Dema Aeronautics, Hutchinson Aerospace Industry LTD, McGill University, and Concordia University, in order to study three main candidate manufacturing processes: Resin Transfer Moulding (RTM), compression moulding and Thermo-Forming. Dema Aeronautics has strong capability for the Thermo-Forming process and will provide technical advice and in-kind contribution to the project. Hutchinson has strong capability for the RTM process and will provide technical advice and in-kind contribution to the project. A variety of other processes will also be required to complete the assembly, such as joining and compression moulding of selected subcomponents. The McGill University Structures and Composite Materials Laboratory has extensive scientific knowledge of all three main processes, while Concordia University brings extensive expertise in cost modeling and testing to the project. Post-Graduate Students will also be involved in this project to assist in the process simulations, process development, and prototype testing.

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CHECK OUT OUR PROJECTS

MANU-1613_TRL4+

PROJECT NAME

Manufacturing of A205 components

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

- Determine thermal, physical and mechanical properties of parts manufactured in investment casting, sand casting and / or additive manufacturing
- Evaluate and compare component manufacturability and economic viability of the different processes
- Determine effect of long term temperature exposure on alloy behavior
- Evaluate alloy compatibility with current surface treatments, surface cleaning and component repair techniques

Expertise sought:

- Investment casting
- Sand casting
- Powder-based additive manufacturing
- Aluminum surface treatment
- Microstructure
- Basic mechanical testing

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CHECK OUT OUR PROJECTS

MANU-1615

PROJECT NAME

Additive manufacturing assemblies comparison

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

To minimize Buy-to-Fly ratio, adding complex features to simple shapes can be an optimized scenario. However, too many unknowns remain with regards to the impacts and performance of the different methods available. A selected superalloy will be the subject of this study.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MANU-1622_TRL4+

PROJECT NAME

Robotic Liquid Polymer Transformation

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

1.5

DESCRIPTION

Elasto Proxy Inc. plans to develop unique and advanced compounds to extrude, pour and cure in place using an adapted robotic cell to automate the process of delivering various designs and shapes of seals.The vision is to develop creative designs and shapes to fill the gap that the current technology does not fulfill the requirements of the industrial market. Our objective will be to accelerate to the market various elastomeric compounds paired with diverse designs and shapes while maintaining consistency and quality through out the innovative process.We aim to leverage our current market share by adapting advanced manufacturing processes to compete against international competitors.
The partnership is established between two industry partners (Elasto Proxy and GÉNIK) and three academic partners (Université Laval, CRIQ and CRVI). The projected impact and benefits include producing innovative advanced materials to markets v.s. building to print (job shop), creating jobs for engineers and technicians, transforming from manual to automated process.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MANU-1625

PROJECT NAME

Post-processïng of laser powder bed-fused 1N625 components for better mechanical properties,surface finish and tolerances

PROJECT TYPE

Exploring Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

3

DESCRIPTION

The proposed research will develop and validate a set of bulk- and surface- post-processing technologies applicable to high-temperature IN625 components produced by laser powder-bed fusion (L-PBF). In the framework of this project, an extended study of the post-processing-microstructure-properties interrelations will be carried out. As a result, an original sequence of heat and HIP treatment will be developed to avoid precipitation of intergranular carbide particles reducing material ductility at high temperatures. Moreover, significant data on the high temperature mechanical properties of IN625 alloy, including creep resistance, will be generated. Moreover, a set of finishing technologies capable of significantly decreasing internal surface roughness of L-PBF tubular components will be developed, validated and prepared for industrial deployment. Three finishing technologies will be tested comparatively and in combination: electropolishing, abrasive flow machining and chemical-mechanical polishing. Finally, multifaceted metrics of the surface topology assessment and geometrical tolerancing of L-PBF components with finishing technologies will be developed to allow for reliable design and certification of IN625 components for aerospace applications.

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CHECK OUT OUR PROJECTS

MANU-1707_TRL4+

PROJECT NAME

Creation of demonstrating strategies of hybrid conception and manufacturing for aerospace tooling

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

The manufacturing of aerospace parts presents several important challenges, including time and cost of production. In the economic context of today `doing well the first time 'is imperative to maintain the competitiveness of companies in the sector. The search for efficiency is today fueled by various opportunities from emerging technologies such as 3D metrology and additive manufacturing (AF), which offer a multitude of possibilities with significant potential. As an example, the AF allows the creation of complex geometry parts and multiple functions that are not feasible by traditional methods. That said, although these new technologies make it possible to envisage a revolution in the manufacturing process of aerospace parts, they are not applicable in all circumstances. Indeed, the criterion of profitability remains essential to the implementation of any new technology. As a result, several studies are underway to consider hybrid processes that combine the so-called conventional technologies with the new ones in order to obtain competitive solutions that respect the quality criteria and the standards imposed by the clients. More specifically, this project will focus on the design and manufacture of the tools used for the manufacture of aeronautical components (eg positioning template for machining, drilling template, etc.).

Considering that any activity other than that leading to the creation of production parts does not represent a real added value to the overall process, it can be seen that the design and manufacture of manufacturing tools can be regarded as a 'badly needed'. Nevertheless, this activity has a significant importance on the challenges mentioned. As an indication, it is very common for tools to represent several tens of thousands of dollars and generate delays of the order of 60 days and more depending on the case. The purpose of the proposed project is to consider this activity differently. In other words, how can the design and manufacture of tooling be adapted to take advantage of the technological potential offered by the FA, 3D metrology and new manufacturing processes in general? Although the introduction of these new options offers concrete alternatives of manufacturing improvement, it is also necessary to consider the constraints and challenges associated with this assumption. To name just a few, the size of the parts that can be produced, as well as the homogeneity, cost and environmental sensitivity of the materials used in the FA, the modularity of the tools, the determination of dimensional requirements, Identification of the capabilities of a numerically controlled machine-tool-tool assembly, etc.

As a premise of the project presented in this proposal, the team identified categories of tools with significant potential for improvement in order to secure a realistic potential for the creation of competitive advantages through the creation of design strategies, Based on hybrid technologies. These strategies will then be applicable in order to extend their impact on the overall practices of the manufacturing companies involved. After an exhaustive inventory of the state of the art, the approach chosen is to value and combine the new manufacturing technologies within the tried and true strategies by rethinking the creative approach and, in an ideal world, to replace certain technologies Tools or certain internal practices. This vision makes it possible to envisage that the strategies generated are applicable and profitable under the conditions of the market. In addition, we argue that the use of existing technologies and materials (high TRL) will significantly reduce the time required for the industrialization phase. The innovation targeted by this project is based on several interesting advances made in the last decade in terms of materials and the diversity of families of available technologies. Our team has a solid experience in the aerospace parts manufacturing environment as it integrates all the typical players in the supply chain.

The project we propose will enable us to implement several innovative strategies in a highly industrialized demonstration (preliminary) form. Implementing a synergy in the supply chain involved through the implementation of a joint design-manufacturing process as well as a better understanding of the financial factors will only increase the success rate of the Group in commercial proposals to the prime contractors. The harmonization of best industrial practices with the advances proposed by the technologies (FA, CNN, 3D metrology) offers the group the opportunity to develop reflexes of tailored adaptations to the various technical problems presented, which translates into a pragmatic enhancement of Local technical competitiveness. Finally, the "Industry-Academy" matching in this representative industry environment will enhance the quality of the learning and publications produced by the researchers, students and trainees involved.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MANU-1708

PROJECT NAME

Additive Manufacturing of Aerospace Components - II

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

Additive Manufacturing (AM) refers to an emerging class of technologies that build 3D objects by the controlled addition of materials in a layer-by-layer fashion to produce objects at or near their final shape. Design limitations from subtracting processes are significantly reduced and parts with a higher degree of complexity now become possible. This disruptive technology is forecasted to have a Canadian market for AM products reaching ~$14B/year by 2025 , market to be significant in the aerospace and biomedical industry, where a series of examples are emerging: commercially used GE LEAP fuel nozzle, Boeing optimised structural brackets, etc.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MANU-1712_TRL4+

PROJECT NAME

Automated Visual Inspection, Sentencing & Dressing for Aerospace Components

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

Within the aerospace sector, aftermarket services account for over 50% of revenue generated by aero engine manufacturers. Central to this is the ability to inspect and repair high unit cost components. Many processes are manual but given the ever-increasing quality, cost and delivery requirements, and the safety critical nature of these rotating parts, there is a strong drive towards process automation.
The objective of this project is therefore to productionise and validate the automation of inspection, sentencing and removal of defects present on service-run components such as gas turbine discs, shafts, blisks and fan blades. The automation of each aspect of the process will need to be capable of being applied to complex geometries and accommodate component and feature variation resulting from service operation.
As this capability only exists in a proof of concept state, a project consortium has been assembled to develop this technology over a period of three years. Bringing it’s numerous years of knowledge in both automated visual inspection and robotic finishing, AV&R will lead this project to success with the contribution of strong partners into their field of excellence. For its strong knowledge into lean manufacturing for engine maintenance, it’s desire to lead introduction of new technologies for the whole Rolls-Royce network and its center of excellence for fan blades reparation, Rolls-Royce Canada is the pefect OEM partner. For their development over the past 15+years on OCT technologies, the NRC at Boucherville is key to one of the biggest challenges for the inspection. Complementary to the data generated in 3D, Université Laval will provide strong technical knowledge to execute the proper software manipulations to extract the defect and its characteristics. Finally, Polytechnique Montréal will provide an insight into Industrial engineering to work on workflow optimization, system uncertainty and human factors.
Each of the partners are expected to be advantageous to the project because of their reputations preceeding them. For AV&R, the potential for future system deployment is huge through Rolls-Royce sites and joint ventures. It will also be possible to offer the solution to other aerospace clients. The technological impact will go beyond the current project and allow AV&R to provide it’s clients solutions for more complex polishing and deburring applications.

CARIC
CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MDO-710

PROJECT NAME

Next-Generation of Massively Parallel High-Fidelity Computational Fluid Dynamics

PROJECT TYPE

Exploring Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

3

DESCRIPTION

For the past five years, massively parallel hardware architectures such as NVIDIA's general purpose graphical processing units (GPGPUs) and Intel's Xeon Phi accelerators have gained traction in the scientific and high performance computing (HPC) community due to the combination of their low cost, high power efficiency and high computational throughput. Thanks to their parallel architecture, simpler processors and low clock frequencies, these accelerators consume less power per teraflops of computations, and their computational throughput is increasing at a greater rate than that of traditional CPUs.
The goal of this proposal is develop novel parallel algorithms and implement them into Bombardier's Full Aircraft Navier-Stokes Code (FANSC) analysis code to fully exploit the computational power of the next generation of massively parallel hardware architectures. Bombardier's objective is to upgrade the FANSC code to take advantage of these new hardware architectures. CRAY Inc. will benefit from having their in-house high-level programming architectures tested in an industrial setting, while Calcul Quebec will contribute to hardware and software expertise.

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CHECK OUT OUR PROJECTS

MDO-714_TRL4+

PROJECT NAME

Application of Advanced Earth Observation Technologies

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

1.5

DESCRIPTION

UrtheCast has recently announced plans to develop and deploy the world’s first fully integrated Synthetic Aperture Radar (SAR) and optical satellite constellation of sixteen satellites arranged as eight tandem pairs.The primary goal of this project is to investigate and develop the technologies to extract the high value information from this unique and unprecedented sensor suite, in particular the combination of the dual-band SAR and the dual mode high resolution multi-spectral optical camera that can acquire data at near coincident times and geometries. Additionally, this project will allow for making some adjustments to the spacecraft and sensor designs to optimize these primary information products.

CARIC
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CHECK OUT OUR PROJECTS

MDO-1601_TRL4+

PROJECT NAME

Wingbox Multi-Disciplinary Optimization Platform

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

2.5

DESCRIPTION

Over the past 10 years, the commercial aircraft (<150 passengers) market has seen almost a tripling in the number of players while business aircraft manufacturers around the world have filled or narrowed segment gaps with clean sheet or major derivative products. In this new reality, product differentiation is becoming extremely challenging and gaining a distinct advantage in aircraft performance, through weight in particular, is paramount. By targeting the multidisciplinary optimization of a major weight contributor – the wing box, up to 50% of the wing weight – the proposed CARIC project addresses the heart of the need.

Aircrafts are composed of highly complex systems and their design puts great strain on engineers’ creativity. Existing CAD systems can help them to a certain extent; but they remain passive tools relying mainly on the engineering designer’s knowledge. Therefore, new intelligent solutions that assist engineers using design automation are highly desirable. However, the inherent complexity of aircraft designs translates into high complexity in design automation models and hence lowers the performances of the solution-search algorithms. In order to achieve effective design automation at the conceptual design level, along with the synthesis strategies, the proper specific assumptions and simplifications need to be set.

The project aims to deliver an automated and collaborative set-up for wingbox structural definition in preliminary design, for either a metallic or a composite structure, using a best in class wing design (Bombardier Challenger 300) as a test case. This preliminary design phase, where the main parameters driving weight are set, requires several loops to define the best compromise at aircraft level. To achieve best performance, the project will not only address automation and optimization of such a process, but aims to improve the definition and usage of the simulation model at the core the key disciplines involved: the global finite element model of the entire aircraft. Besides the potential wingbox weight reduction targeted (5 to 10%), the approach is expected to minimize or avoid costly rework in late design stages, for a component that is seldom if ever redesigned in the life of an aircraft program.

Academic partners (École Polytechnique, Carleton University) will identify which simplifications can be performed without compromising the essence of the discipline and capture the key interactions. Stelia brings an important expertise in topological optimization, which has the potential to dramatically open up the typical design space, while Bombardier brings the aircraft OEM expertise across the spectrum of disciplines considered and lessons learned from recent and on-going aircraft development.

The strength of the proposal not only resides in the quality of the University-Industry team gathered to tackle this highly multidisciplinary engineering challenge, but also in the innovative and collaborative approach set to achieve ambitious results. Whereas traditionally, the preliminary wingbox design would be executed by an aircraft OEM, the solution resulting from this CARIC project will transform the task into a truly collaborative work between an aircraft OEM (Bombardier) and a major structure supplier (Stelia), thereby taking advantage of both players expertise to bring wingbox design optimization to another level.

CARIC
CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MDO-1649_TRL4+

PROJECT NAME

Augmented reality immersive simulation for flight deck design and evaluation.

PROJECT TYPE

Maturing Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

2

DESCRIPTION

This project aim is to develop a Flight Deck Human Machine Interface tools allowing specialists to design, develop, assess and operate user interfaces in an augmented reality immersive environment. The HMI tool should allow for evolution of the simulation fidelity throughout a flight deck development project from conceptual to detailed design phases. The virtual HMI tool must be more cost effective to build and operate compared to the Engineering mock-up and Full-Flight Simulator devices. Other Engineering design and analysis applications may be evaluated using this tool such as Pilot-In-the-loop Aircraft performance studies in a virtual flight deck with the out of the view world environment.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

MDO-1650_TRL4+

PROJECT NAME

Wide Area Monitoring System

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

1.5

DESCRIPTION

The overall goal of this project is to develop and improve the technology needed for large scale motion mapping with Inteferometric Synthetic Aperture Radar (InSAR). Ground displacement caused by groundwater extraction, mining, oil & gas, urban development and other phenomena is a global problem, but is extremely costly and inefficient to monitor using the currently employed ground instruments over large areas. InSAR provides the most cost efficient method for monitoring wide-spread land surface deformation ; however, existing InSAR technology lacks the speed and scalability for large scale operational monitoring. The proposed project aims to eliminate these technological gaps and develop superior tools for InSAR as a wide-spread operational monitoring tool.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

OPR-706_TRL4+

PROJECT NAME

Measuring pilot fatigue to manage pilot performance

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Closed

PROJECT DURATION (years)

1.5

DESCRIPTION

The nature of safety in aerospace has focussed in main part on detecting and preventing failure of technology, and today’s aircraft report in real-time detailed data to aid in this effort. However, experience has shown that while failures in maintenance and engineering have been greatly reduced, aircraft accidents related to pilot performance is an area of research that has great potential to improve and enhance safety.

While aircraft components have been measured and are wired with sensors to monitor various critical components, the most critical component of the flight system – the pilot, has not been. Given the potential for fatigue to impact a pilot’s performance and safety, a means of measuring and analysing that performance against fatigue-inducing elements has potential to fill that gap in aviation safety.

This project is a partnership between Conair Group Inc., the University of British Columbia – Okanagan, Camosun College, and Latitude Technologies, which was developed in recognition of the fact that there does not appear to be a relevant body of knowledge regarding pilot fatigue management in non-typical aircraft operations, in particular as it relates to the unique nature of the flying carried out during aerial firefighting.

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CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

OPR-1618

PROJECT NAME

Evaluate and Improve Student Trainee Performance Using Biometrics

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In progress

PROJECT DURATION (years)

3

DESCRIPTION

Flight safety requires effective pilot training, which aims to equip pilot trainees with the capabilities to make correct decisions in different flight scenarios. The effectiveness of pilot training depends largely on an instructor's ability to maintain a detailed awareness of the training situation. Armed with this information, instructors can adapt a student's training to his/her specific needs in order to maximize the training benefits. This awareness relies on the quantification of pilot trainee's cognitive (thinking) and affective (emotion/feeling) states in relation to decision making and performance.
Human cognitive/affective states can be inferred from biometric data. For instance, brain waves and eye movements can measure cognitive states. Mental workload can be estimated from brain wave measurement, pupil diameter, skin conductance, cardiac measures and respiration rate. Affective state such as mental stress and other emotions can be inferred from body movements, facial expressions, and other biometric data. The objective of this proposed project is to develop biometric approaches for the quantification of pilot trainee's cognitive and affective states during the pilot training process. The deliverable from this proposed project will be an integrated solution to quantify pilot trainee's cognitive and affective states. As a result, a novel framework will be developed to bring advanced biometric measurement technologies and algorithms from the laboratory setting into the simulator-based pilot training environment. This framework can be easily extended to other complex yet critical field applications such as medical and military mission training. This proposed project team will include three universities: Concordia University, University of Montreal, and McGill University, on national research lab: National Research Council Canada, three companies: CAE, Marivent, and GlobVision, and one research consortium: CRIAQ (Consortium for Research and Innovation in Aerospace in Québec).

CARIC
CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

CHECK OUT OUR PROJECTS

PLE-P-1652_TRL4+

PROJECT NAME

Adapting Wearable Technology to Monitor Pilot Fatigue

PROJECT TYPE

Maturing Technology

PROJECT STATUS

Completed

PROJECT DURATION (years)

1.5

DESCRIPTION

Current Canadian aviation regulations do not address pilot workload factors in the determination of rest requirements. These regulations are in adequate and costly to administer. Duplicate monitoring systems necessary to insure proper rest requirements are met are inaccurate and costly to manage. The phase 2 project proposed will develop a real-time Fatigue Risk Management System that measures the fatigue level of individual pilots using wearable technology will be developed in consultation with Transport Canada. This proactive approach will enhance safety save operators over $100,000.00 each per season in reduced training costs, lost productivity and additional pilot costs by optimize pilot fatigue management. The project will also introduce an exciting new technology to manage pilot fatigue with a host of potential applications outside of the Aerial Firefighting domain. The project goal is to develop wearable technology, data streaming process and an inference engine capable of determining the fatigue level of an airtanker pilot.

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CHECK OUT OUR PROJECTS

WE ESM

PROJECT NAME

Electromagnetic and circuit simulation models for aircraft electrical wiring

PROJECT TYPE

Exploring Technology

PROJECT STATUS

In preparation

PROJECT DURATION (years)

3

DESCRIPTION

On a More Electric Aircraft, many large Variable Frequency Drives are used. Voltage rise times cause reflective wave issues and EMI issues due to high frequency switching and could also cause corona discharges.
Project Objective:

- Develop wiring electrical and finite element simulation models for different wire configurations.
- Perform analysis, for different non-linear loads generating high frequency current pulses, to understand the losses, the generated electromagnetic interference and the risks of corona discharges.