



SCIENCE AND TECHNOLOGY ORGANIZATION
APPLIED VEHICLE TECHNOLOGY PANEL



Science & Technology Organization
Collaboration Support Office
Applied Vehicle Technology Panel

AVT-374 Research Specialists' Meeting on

More Electric Gas Turbine Engines for Aircraft, Rotorcrafts and UAVs

Ottawa, Canada

21-22 May 2024

This Meeting is open to NATO Nations and Partners.

Theme and Scientific objectives

This meeting is organised as a medium sized two days event with around 60-100 participants that aims to promote the exchange of knowledge among an audience of experts and specialists on emerging technologies for electrification of aircraft using gas turbine engines for propulsion.

The scientific objective of the AVT-374 Research Specialists' Meeting is to analyze and explain the importance of a higher electrification of aircraft gas turbine engines.

In more precise terms, the topic of the electrification of gas turbine engines for aircraft, rotorcrafts and UAVs will be detailed following these lines:

- Why is electrification of some engine sub-systems so useful at the level of the engine and of the aircraft?
- What makes that electrification of some sub-systems is so important in new engine and aircraft configurations (as, for example, the so-called ventless bearing chambers or in geared turbofans)?
- Which sub-systems are the most useful to be electrified? Describe some of these applications and quantify the advantages.
- Analyze and study in detail some of these more electric sub-systems (power generator and conversion systems, electrically-driven fuel and oil pumps, electric de-oilers, new engine sensors, power generation components present in the oil system, health monitoring systems, EMA).

Electrification of some key sub-systems of the aircraft or rotorcraft gas turbine engines offers several valuable advantages for the next generation of aero-engines, as weight reduction, reduced energy consumption, higher efficiency of the sub-systems and of the complete propulsion system, quicker response, faster and easier repair, higher reliability than hydraulic and pneumatic systems, reduced fuel burn, greater payload capability, reduced total life cycle costs, increased maintainability, cleaner engine maintenance and operations, better allocation of the resources on board, real time data for maintenance and customers, higher capability for health monitoring etc.

Electrification of engine sub-systems allows also the development of new and innovative aircraft and engine configurations, as, for example, the removal of the heavy and complex (engine and or aircraft) accessory drive gearbox (ADG) or the introduction and the use of more EMA's (Electro-Mechanical Actuators) for the IGVs, the thrust reverser doors or any other variable geometry item.

Integration of more and clever sensors in the engine and in sub-systems as its lubrication system is another clear advantage (e.g. oil debris monitoring sensors or oil tank level sensors).

Integration of more electric sub-systems will also be discussed, with an understanding of the inherent risks concerning Power & Thermal Management (cf. AVT-RTG-333 'Integration of Propulsion, Power, and Thermal Subsystem Models into Air Vehicle Conceptual Design').

An analysis of the current trends in this electrification of the turbofan and turboshaft sub-systems is therefore proposed, with the organization of a RSM on this topic, with the objective to position the AVT Panel at the forefront of this technology move.

Background

The future of aviation is gas turbine engines, at least for now and the next 15-20-25 years. All electric aircraft concepts are unfortunately still one or two generations away, except maybe for very small all-electric aircraft. Even hybrid electric is a bigger jump than often unrealistically put forward in the specialized press. This option is still indeed extremely heavy for at least a decade and takes up a significant space on board. Even if Rolls-Royce, for example, has different projects (as the E-Fan X or Accel) "to champion electrification in aircraft propulsion", their main focus right now remains and will remain gas turbine engines, and it is the same position for all aero-engine manufacturers worldwide as of today.

This RSM intends to provide a better understanding in the electrification of the "classical" gas turbine engines used in aviation (aircraft, rotorcraft and UAVs) for decades now.

It will partly build up on the AVT-188 Specialists Meeting (RSM) held in Biarritz in October 2012 (organized by the same Activity Chair) and is the follow-up activity of the AVT-ET-208.

The focus of this RSM is on electrification of the gas turbine propulsion systems, sub-systems and components to the advantage of future electric propulsion/aircraft or hybrid propulsion.

It directly supports the AVT mission on "Improve performance, affordability, and safety of vehicle, platform, propulsion and power systems operating in all environments for new and ageing systems through advancement of appropriate technologies".

Registration

Online registration for the AVT-374 is mandatory for all meeting delegates, programme committee members, authors, presenters and external guests. Participation is free of charge. Due to security restrictions only duly registered and re-confirmed AVT-374 participants will have access to the General Information Package (GIP) with detailed information on conference location and logistics.

For online registration please go to this website:

The registration deadline is 19th April 2024. Thank you for your cooperation.

AVT Executive Office, Collaboration Support Office (CSO), Paris – Points of Contact:

Ms Erin BOLDI
AVT Executive Officer
Tel: +33 (0)1 55 61 22 93
Erin.Boldi@cs0.nato.int

Ms Isavela KONTOLAIMAKI
AVT Panel Assistant
Tel: +33 (0)1 55 61 22 88
Isavela.Kontolaimaki@cs0.nato.int

Programme Committee

CO-CHAIRS

Prof. Patrick HENDRICK (BEL)
Université Libre de Bruxelles (ULB)
Email: patrick.hendrick@ulb.be

Prof. Hany MOUSTAPHA (CAN)
Ecole de Technologie Supérieure Montréal (ETS)
Email: hany.moustapha@ets.montreal.ca

MEMBERS

UNITED KINGDOM

Dr. Neil Martin
DSTL
Email: npmartin@dstl.gov.uk

POLAND

Dr. Radosław PRZYSOWA
ITWL
Email: radoslaw.przysowa@itwl.pl

USA

Daniel THOMSON, PhD
Air Force Research Laboratory (AFRL)
Email: daniel.thomson@us.af.mil

PANEL MENTOR

Dr. Jim MAC LEOD
National Research Council Canada (NRC)
Email: jim.macleod@nrc-cnrc.gc.ca

TECHNICAL EVALUATOR

Albert CORNET (BEL)
SAFRAN Group
Email: albertcornet55@gmail.com

Programme

DAY 1

Tuesday, 21 May 2024, 08:30 - 17:30

8:30 AVT-374: Opening and Introduction, Overview and Objectives
AVT-373 Co-Chairs:
Prof. Patrick Hendrick, ULB, Belgium
Prof. Hany Moustapha, ETS, Canada
Albert Cornet, Technical Evaluator, Belgium

Session 1 – More Electric Aero-Engine Developments

Chair: Prof. Hany Moustapha, ETS, Canada

09:00 KN1 **KEYNOTE**
More Electric Turbofans and Turboshfts
Dr. Jean Thomassin, Pratt & Whitney Canada, Canada

09:45 1 **Decarbonisation of Aerospace Through Electrification of Aircraft Gas Turbines**
Prof. Kash Khorasani, Concordia University, Canada

10:15 2 **Hybrid Propulsive System**
Mr. Guilhem Seize, Safran Aircraft Engines, France

10:45 COFFEE BREAK

11:15 3 **More Electrified Aero-engines Development at Rolls-Royce**
Dr. Jeff Hobday & Mr. Nikhil Bhakta, Rolls-Royce Aviation, United Kingdom

11:45 4 **Hybrid System Architecture Studies**
Dr. Gökhan Bilge, TAI, Turkey

12:30 LUNCH

Session 2 – The needs for more electric gas turbine engines

Chair: Dr. Dan Thomson, USAF – AFRL, USA

14:00 KN2 **KEYNOTE 2**
Electrified Aero-Engines, More Electric, Hybrid-Electric and Fully Electrified Architectures
Prof. Lars Enghardt, DLR Institute for Electrified Aero-Engines & TU, Germany

14:30 5 **The More-Electric Aircraft Perspective**
Dr Philip Abolmoali, USAF, AFRL, USA

- 15:00 6 [EMA \(Electro-Mechanical Actuators\) for Aero-Engines – Reliability and Health Monitoring](#)
Dr. Benjamin Wauthion, ULB & SABCA, Belgium
- 15:30 Coffee BREAK
- 16:00 7 [Engine Electrification, what means electrifying Aero-Engine Accessories](#)
Dr. John Nairus, USAF, AFRL, USA
- 16:30 8 [Small More-Electric Engines for UAVs and Ultra-Light Aircraft](#)
Dr. Radoslaw Przysowa, ITWL, Poland
- 17:00 9 [Integrated Electrically-Driven Oil Pump and Oil-Air Separator for Aero-Engines](#)
Prof. Patrick Hendrick, ULB, Belgium
- 17:30 ADJOURN for the DAY

DAY 2

Wednesday, 22 May 2024, 08:30– 18:00

- 8:30 [AVT-374: Introduction and Wrap-up of Day 1, Overview and Objectives](#)
AVT-373 Co-Chairs:
Prof. Patrick Hendrick, ULB, Belgium
Prof. Hany Moustapha, ETS, Canada
Albert Cornet, Technical Evaluator, Belgium

Session 3 – Electric components development for more electric GTE

Chair : Dr. Pierre Hauty, Airbus Propulsion Systems, France

- 09:00 KN3 [KEYNOTE 3](#)
[Electrification Technology Enablers](#)
Dr. Ana Garcia Gariga, Collins Aerospace, Ireland
- 09:45 10 [Electrification of Gas Turbines and Aircraft Propulsion](#)
Dr. Peter Connor, University of Nottingham, United Kingdom
- 10:15 11 [E-Pumps and High Temperature Electronics Needs in More Electric GTE](#)
Nicolas Raimarckers, Safran Aero Boosters, Belgium
- 10:45 COFFEE BREAK

- 11:15 12 [E-Valves in More Electric GTE](#)
Joëlle Vincké, ULB, Belgium
- 11:45 13 [More electric journey on military engines at GKN Aerospace Sweden](#)
Dr Eric Blidmark, GKN Aerospace, Sweden
- 12:30 LUNCH BREAK

Session 4 – New components for more electric aero-engines

Chair: Prof. Patrick Hendrick, ULB, Belgium

- 14:00 14 [High Voltage Insulation Management and Testing](#)
Prof. Ian Cotton , University of Manchester, United Kingdom
- 14:30 15 [Component Design and Developments for more Electric GTE](#)
Prof. Jonathan Gladin, GATech, United States
- 15:00 16 [More Intelligent Gas Turbine Engines – after 15 years](#)
Prof. Ion Stiharu, Concordia University, Canada
- 15:30 COFFEE BREAK
- 16:00 17 [E-Sensors and Debris Monitoring for More Electric GTE](#)
Dr. Laurent Ippoliti, ULB, Belgium
- 16:30 18 [Hybrid-Electric Propulsion at Airbus Helicopters](#)
Dr Stéphane Cerqueira, Airbus Helicopters, France
- 17:00 KN4 [KEYNOTE 4](#)
[Perspectives for More Electric Propulsion Systems for Civil Aviation](#)
Dr. Pierre Hauty, Airbus, France
- 17:30 TE [Technical Evaluator Comments](#)
Albert Cornet, SAFRAN Group, Belgium
- 18:00 ADJOURN for the DAY

Science and Technology Organization in NATO

In NATO, Science & Technology (S&T) is defined as the selective and rigorous generation and application of state-of-the-art, validated knowledge for defence and security purposes. S&T activities embrace scientific research, technology development, transition, application and field-testing, experimentation and a range of related scientific activities that include systems engineering, operational research and analysis, synthesis, integration and validation of knowledge derived through the scientific method.

In NATO, S&T is addressed using different business models:

- The Collaborative business model where NATO provides a forum where NATO Nations and partner Nations elect to use their national resources to define, conduct and promote cooperative research and information exchange.
- The In-House delivery business model where S&T activities are conducted in a NATO dedicated executive body, having its own personnel, capabilities and infrastructure.

The Science and Technology Organization - STO

The mission of the NATO STO is to help position the Nations' and NATO's S&T investments as a strategic enabler of the knowledge and technology advantage for the defence and security posture of NATO Nations and partner Nations, by:

- Conducting and promoting S&T activities that augment and leverage the capabilities and programmes of the Alliance, of the NATO Nations and the partner Nations, in support of NATO's objectives;
- Contributing to NATO's ability to enable and influence security - and defence-related capability development and threat mitigation in NATO Nations and partner Nations, in accordance with NATO policies;
- Supporting decision-making in the NATO Nations and NATO.



AVT-374 Research Specialists' Meeting

Acknowledgement

The Applied Vehicle Technology Panel expresses its thanks to Canada for the invitation to hold this meeting in Ottawa and for the facilities and personnel, which make this meeting possible.