

Science & Technology Organization
Collaboration Support Office
Applied Vehicle Technology Panel

**AVT-306 Research Specialists' Meeting on
Transitioning Gas Turbine Instrumentation
from Test Cells to On-Vehicle Applications**

Athens, Greece

10-12 December 2018

This Workshop is open to NATO Nations, Australia and all Partnership for Peace Nations

Theme and Topics

The AVT-306 Specialists' Meeting will explore advances in gas-turbine instrumentation and recommend routes to transition onto platforms. It will have the objective to recognize new capabilities required by military operators of manned and unmanned platforms in terms of health management and active control of propulsion systems, to inform the wider audience of the technologies that can be readily transitioned into on-vehicle applications and to identify and promote best practices for maturing and ruggedizing instrumentation for key applications.

The Specialists' Meeting is organized as a three-day event consisting of several sessions and plenty of time for discussions. Papers were invited in the areas of:

- Lessons learned from the implementation, certification and exploitation of recent EHM/PHM, Blade Health Management (BHM) and active control systems,
- New capabilities enabled by advanced non-intrusive sensors,
- Instrumentation and EHM/PHM technologies for unmanned platforms powered by gas-turbines,
- Technologies for active control of components in the gas path to enhance performance and reduce emission and noise,
- Standardization of on-vehicle instrumentation, including common ports, requirements and calibration methods for transducers,
- Models, algorithms and data analysis methodologies used for active control of components, prediction of remaining life and performance enhancement,
- High temperature electronics and instrumentation technologies,
- Sensor reliability and performance
- Advanced control architecture concepts such as distributed engine control.

Background

The mission of the Science & Technology Organization is to conduct and promote co-operative research and information exchange. STO consists of a three level organization: the Science and Technology Board, the Panels and the Technical Teams. The Applied Vehicle Technology (AVT) Panel, comprising more than 1000 scientists and engineers, strives to improve the performance, reliability, affordability, and safety of vehicles through advancement of appropriate technologies. The Panel addresses platform technologies for vehicles operating in all domains (land, sea, air, and space), for both new and ageing systems.

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Programme

Monday, 10 December 2018

Registration

- 10:00 Registration
13:00 Opening Ceremony

Session 1 – Control Systems

Chair: Ruth Sikorski, Air Force Research Laboratory, United States

- 14:00 Innovative Instrumentation for Prognostics Health Management and Control in Turbine
Alireza R. Behbahani, Air Force Research Laboratory, United States
- 14:30 Control of Bearingless Electric Machines Dedicated for Aviation
Mariusz Żokowski, Air Force Institute of Technology, Maciej Henzel, Krzysztof Falkowski, Paulina Mazurek-Kurnyta, Military University of Technology, Poland
- 15:00 Regularized Identification in Engine Models Matching with Measured Data
Sergiy Yepifanov, Roman Zelenskyi, Zhukovsky National Aerospace University "Kharkiv Aviation Institute", Aleksandr Khustochka, "Ivchenko-Progress" State Enterprise, Ukraine
- 15:30 COFFEE BREAK

Session 2 – Inlet Systems

Chair: Jim MacLeod, National Research Council, Canada

- 16:00 Real Time Gas Turbine Engine Particulate Ingestion Sensor for Particle Size and Composition
George Papadopoulos, Daniel Bivolaru, Jiaji Lin, Innoveering, LLC, United States
- 16:30 NRC's Particle Detection Probe: Transition from Test Cell to Flight Operation
Craig R. Davison, Dan Fuleki, Brian Galeote, Jennifer L.Y. Chalmers, National Research Council, Canada
- 17:00 Development of laser velocimetry for turbofan engine inlet distortion applications
K. Todd Lowe, Virginia Tech, United States
- 17:30 END OF DAY 1

Tuesday, 11 December 2018

Session 3 – Blade Health Monitoring

Chair: Wieslaw Beres, National Research Council, Canada

- 09:00 Combined Blade Vibration and Surge/Stall Sensor for Gas Turbine Blade Health Management
Kam Chana, University of Oxford, United Kingdom
- 09:30 Implementation of the new inlet protection system into HEMS fleet
Bartosz Przybyła, Polish Medical Air Rescue (LPR), Radosław Przysowa, Air Force Institute of Technology (ITWL), Zbigniew Zapałowicz, West Pomeranian University of Technology (ZUT), Poland
- 10:00 Vibration Diagnostics Methods of Marine Diesel Engines with Turbocharger
Roman Varbanets, Sergey Rudenko, Vladimir Yarovenko, Yurii Kucherenko, Oleksiy Yeryganov, Ievgen Bilousov, Varvara Piterskaya, National Maritime University, Ukraine
- 10:30 COFFEE BREAK

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Session 4 – Transitioning Methodologies

Chair: Kam Chana, University of Oxford, United Kingdom

- 11:00 Efficient and Reliable Surge Prevention for Centrifugal Compressor
Grzegorz Liśkiewicz, Łódź University of Technology, Poland
- 11:30 Digital Bus Based Vibration Sensors “Migrating the Test Cell Inflight”
Dave Change, Denis Varak, Dytran Instruments, Inc, Paul Grabill, Chuck Kemp, Sage Machinery
Diagnostics, LLC, United States
- 12:00 The Precision Analysis of a Relative Phase-Difference Torque Measurement Unit
Sergiy Yepifanov, Feliks Sirenko, Roman Zelenskyi, Zhukovsky National Aerospace University
“Kharkiv Aviation Institute”, Kostyantyn Podgorsky, Motor Sich JSC, Ukraine
- 12:30 LUNCH BREAK

Session 5 – Hot Section Technologies

Chair: Paul Seccombe, nVent Technical Solutions UK Ltd, United Kingdom

- 14:00 Strategies to Enhance Signal Validity and Extend Reliability of High Temperature Sensors
Especially for Pressure and Acceleration
Christian Röthel, Dietmar Kröger, Alexander Schrickler, Piezocryst Advanced Sensorics GmbH,
Austria
- 14:30 Instrumentation for Gas Turbine Engines
Kevin M. Rivera, Matt Ricci, Otto J. Gregory, University of Rhode Island, United States
- 15:00 COFFEE BREAK

Session 6 – Exhaust Systems

Chair: Raymond Harvey Niska, United States

- 16:00 Toward In-flight Thrust Monitoring: Demonstration of an Acoustics-Based, Non-Intrusive Exhaust
Thrust Sensor
Raul Otero, K. Todd Lowe, Wing Ng, Virginia Tech, United States
- 16:30 Exhaust Toxicity Evaluation in Gas Turbine Engine Fueled by Aviation Fuel Containing
Synthesized Hydrocarbons
Bartosz Gawron, Tomasz Białecki, Air Force Institute of Technology, Anna Janicka, Maciej
Zawiślak, Aleksander Górniak, Wrocław University of Technology, Poland
- 17:00 Optical Exhaust Gas Temperature (EGT) Sensor and Instrumentation for Gas Turbine Engines
Mehrdad Pakmehr, optoXense, Inc, Alireza R. Behbahani, Air Force Research Laboratory,
United States
- 17:30 END OF DAY 2

Wednesday, 12 December 2018

Session 7 – Fuel Systems

Chair: Radosław Przynowa, ITWL - Air Force Institute of Technology, Poland

- 09:00 Sensing for Aerospace Fuel Systems and Combustor Health Monitoring
Andrew Mills, Visakan Kadirkamanathan, University of Sheffield, United Kingdom
- 09:30 Practical On and Off-wing Applications of a Thermal Product Measurement Sensor for Detection
of Contaminants in Fluids
Kam Chana, University of Oxford, United Kingdom
- 10:00 Technical Evaluation Report
William Stange, Universal Technology Corporation, United States
- 10:30 COFFEE BREAK

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Session 8 – Joint Session AVT-305 & AVT-306

Chair: Afzal Suleman, Instituto Superior Tecnico, Portugal

- 11:00 KEYNOTE:
Using Additive Technology to Enable Design and Manufacturing of Instrumentation
Mohammad Ehteshami, General Electric, United States
- 11:30 KEYNOTE:
Test Cell Instrumentation Challenges Then and Now: AVT-126 to AVT-306
Robert Jackson, Inter-Connect Plus Ltd, United Kingdom
- 12:00 Laser Deposited High Temperature Thin Film Sensors for Gas Turbines
Dongfang Yang, Vladimir Pankov, Linruo Zhao, Prakash Patnaik, National Research Council,
Canada
- 12:30 LUNCH BREAK and END OF AVT-306

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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-306 Research Specialists' Meeting

Acknowledgement

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