Background

The mission of STO is to conduct and promote co-operative research and information exchange. STO consists of a three level organization: the Science and Technology Board (STB), the Panels and the Technical teams. The Mission of the Applied Vehicle Technology Panel (AVT) is to improve the performance, affordability and safety of vehicle platforms, propulsion and power systems through the advancement of appropriate technologies. The Panel addresses technology issues related to vehicle platforms, propulsion and power systems operating in all environments, including land, sea, air and space for both new and aging systems.

Theme and Topics

This Symposium is designed to inform NATO audience of the current data acquisition methods and sensors available and of the best practice standards to ensure that the most accurate and relevant data is obtained during gas turbine engine testing. The Symposium will provide guidance to the NATO gas turbine engine test community on how to accomplish affordable gas turbine engine qualification and engine modification re-certification with quality data. The Symposium will set out to detail the routes to transition instrumentation onto Engine Health Management (EHM) systems to ensure that NATO nations glean the most relevant information possible concerning the performance and health of their gas turbine engines in service. There will be papers detailing the recent advances in the area of Distributed Engine Control. A major area of emphasis will be the new engine concepts enabled by advanced sensors, controls, and EHM.

Accurate data is needed to minimize the costs to certify or re-certify gas turbine engines with acceptable system safety risk. However one of the most debated issues concerning use of instrumentation in gas turbine engine test cells is the accuracy and format of the data gathered and transferred. Improved instrumentation, controls, and EHM are vital to validating new concepts in propulsion intended to improve engine efficiency. Advanced instrumentation can additionally uncover errors in design or new modifications early in the engine development stage which are excessively expensive to rectify on an engine late in the development stage or already in service. Ensuring that test cell instrumentation system and test protocols are as advanced as possible will result in significant cost savings to NATO nations, as well as will improve gas turbine engine operational safety and readiness, and also give test cell engineers the tools and processes to produce unequivocally accurate results.

The meeting includes the following sessions: Measurement technologies, application of thermographic phosphor measurements, surface temperature mapping, blade tip timing, blade tip clearance, engine health monitoring, advanced control and future opportunities and standardization.

Enrol Online at: http://www.cso.nato.int

Once your enrolment has been validated, you will receive a General Information Package (GIP) giving you further necessary details about the meeting.

If you are unable to enrol via the internet, please contact the AVT Panel Assistant at:
sandra.cheyne@cso.nato.int

Latest Enrolment Date 27 March 2015

Programme Committee

Programme Co-Chairs

Dr. Wieslaw Beres
National Research Council Canada, Canada
email: wieslaw.beres@nrc-cnrc.gc.ca

Mr. William A. Stange
Wright Patterson Air Force Base, United States
email: william.stange.2.ctr@us.af.mil

Members

Germany
Dr Andreas Zeisberger
MTU Aero Engines AG
email: andreas.zeisberger@mtu.de

Poland
Maj. Dr. Radoslaw P. Przysowa
Air Force Institute of Technology
email: radoslaw.przysowa@itwl.pl

United Kingdom
Dr Rob Jackson
Inter-Connect Plus Limited
email: rob@inter-connectplus.com

United States
Dr. Stephen W. Allison
EMCO
email: steve.allison@emergingmeasurements.com

Mr. Richard J. Hill
Universal Technology Corporation
email: rhill@utcdayton.com
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-229 Symposium

Acknowledgement

The Applied Vehicle Technology Panel expresses its thanks to Poland for the invitation to hold this meeting in Rzeszow, and for the facilities and personnel, which make this meeting possible.
10:00  KN-3  Ten Years of EVI-GTI: Contributions to Gas Turbine Validation for Improvement of Efficiency, Operational Flexibility and Pollutant Reduction
R. Obertacke, Siemens AG, Germany

10:30  BREAK

SESSION 1 - Measurement Technologies – Performance, Operability, Reliability and Emissions
Chair - A. BEHBAHANI, United States

11:00  1  Comparative Analysis of Bio and Fossil Fuel Micro-Droplets Evaporation Rate
G. Wojciechowski, A. Boguslawski, P. Domagała, S. Drobniań, Częstochowa University of Technology, Institute of Thermal Machinery, A. Gnot, WSK PZL Rzeszow S.A., Poland

11:30  2  On the Need to Maintain Homogenous Temperature Field Within the Working Agent at the Intake of a Jet Engine Turbine
W. I. Pawlak, Air Force Institute of Technology (ITWL), Poland

12:00  3  The Testing of Combustion Process in Miniature Turbine Engines
B. Gawron, Air Force Institute of Technology, (ITWL), Poland

12:30  LUNCH

SESSION 2 - Thermographic Phosphors
Chair - J. FEIST, United Kingdom

14:00  4  Status of Thermographic Phosphor Thermometry Applied to Turbine Engines

14:30  5  Accuracy and Precision of Phosphor Thermometry Sensors
B. Heeg, Lumian Precision Optical Measurement Solutions, The Netherlands

15:00  6  Investigation of Lubricant Oil Effect on Time-Transient Properties of Thermographic Phosphors
F. Abou Nada, M. Richter, M. Alden, Lund University- Division of Combustion Physics, Sweden

15:30  BREAK

SESSION 3 - Surface Temperature Mapping
Chair - S. ALLISON, United States

16:00  7  A Luminouscent Glass-Ceramic Thermal History Sensor
B. Heeg, Lumian Precision Optical Measurement Solutions, The Netherlands

16:30  8  High Speed Determination of Piston Surface Temperatures Due to Flame Impingement Using Phosphor Thermometry
C. Ding, C. Litterscheid, A. Dreizler, Technische Universität Darmstadt, Germany

17:00  9  Luminouscent Thermal History Sensors: Fundamentals and Applications for Thermal Profiling

Tuesday 21 April 2015

Keysnotes
Chair - W. STANGE, United States

09:00  KN-1  Propulsion Instrumentation and Measurement Challenges for System Sustainment and Emerging Design Concepts
D. Carlson, USAF Senior Lead for Propulsion, United States

09:30  KN-2  Technology Development Challenges for Advanced Gas Turbine Engine Measurements
H. Niska, Honeywell Engines and Systems, United States

Wednesday 22 April 2015

SESSION 4 - Blade Tip Timing
Chair - K. CHANA, United Kingdom

09:00  10  Inductive Sensors for Blade Tip-Timing in Gas Turbines
R. Przysowa, E. Rokicki, Air Force Institute of Technology (ITWL), Poland

09:30  11  Advantages and Performances of Double Electrode Capacitive Sensor for BTB and BTC Measurements
P. Ruskhard, Rolls-Royce plc, United Kingdom

10:00  12  Overview of the AFRL Damping Test on the F112 Fan Blisk
B. W. Hayes, S. A. Arnold, A. D. Moon, B. C. Crowson, Aerospace Testing Alliance, United States

10:30  BREAK

SESSION 5 - Blade Tip Timing and Tip Clearance
Chair - P. RUSSHARD, United Kingdom

11:00  13  Advantages and Performances of Double Electrode Capacitive Sensor for BTB and BTC Measurements
A. Brierie, CAPAAB, France

11:30  14  Contactless Magnetoresistive Sensor for Tip Timing and Tip Clearance Systems
R. Tomassini, J-F Brouckaert, von Karman Institute for Fluid Dynamics, Belgium, G. Rossi, University of Perugia, Italy

12:00  15  Validation Development of an Eddy Current Sensor for Gas Turbine Hot Section Tip Timing and Clearance Measurements
K. Chana, University of Oxford, J. Sullivan, Rota Scan, A. Karakut, Air & Weapons Systems, DSTL, United Kingdom

12:30  LUNCH

Thursday 23 April 2015

SESSION 6 - Engine Health Monitoring/Management I
Chair - A. ZEISBERGER, Germany

09:00  16  Tip Timing and Tip Clearance Technique in Diagnostic of Middle Bearing of Aircraft Engine
E. Rokicki, R. Szczepanik, J. Sypychala, Air Force Institute of Technology, R. Rzadkowski, Polish Academy of Sciences, Poland

09:30  17  Detecting Turbine Blade Impacts from Foreign Object Debris Using Triboluminescence
W. A. Hollerman, R. S. Fontenot, University of Louisana, United States

10:00  18  Statistical Approaches to Online Prognostics of Turbine Engines
S. Zein-Sabatto, Md M. Alam, M. Bodruzzaman, Tennessee State University, A. Behbahani, AFRL/RQTE, United States

10:30  BREAK

SESSION 7 - Engine Health Monitoring/Management II
Chair - W. BERES, Canada

11:00  19  Development of Particle Detection Probe for Engine Health Monitoring
J. Chalmers, B. Galeote, P. Canteenwalla, C. Davison, National Research Council Canada, Canada
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Presenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30</td>
<td>20</td>
<td>Transitioning from Test Cell Instrumentation to Engine Health Monitoring Systems</td>
<td>R. Sikorski, United States Air Force, United States</td>
</tr>
<tr>
<td>12:00</td>
<td>21</td>
<td>Multiparametric Approach to Gas Turbine EHM Using Vibration Signal</td>
<td>S. Fabry, Technical University of Kosice, Slovakia</td>
</tr>
<tr>
<td>12:30</td>
<td></td>
<td>LUNCH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22</td>
<td><strong>SESSION 8 - Advanced Controls</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chair - R. PRZYSOWA, Poland</td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td>22</td>
<td>Bearingless Electric Machines for Aviation</td>
<td>M. Henzel, M. Zokowski, Military University of Technology, K. Falkowski, P. Mazurek, Air Force Institute of Technology, Poland</td>
</tr>
<tr>
<td>14:30</td>
<td>23</td>
<td>New Approaches for Engine Controls and Instrumentation Systems and Components Requirements at Turbine Engine Test Cell Stands &amp; Facilities</td>
<td>A. Behbahani, A. Von Moll, United States Air Force, United States</td>
</tr>
<tr>
<td>15:00</td>
<td>24</td>
<td>On the Need to Maintain Homogenous Temperature Field Within the Working Agent at the Intake of a Jet Engine Turbine Part II</td>
<td>W. I. Pawlak, J. Szymczak, Air Force Institute of Technology (ITWL), Poland</td>
</tr>
<tr>
<td>15:30</td>
<td></td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td><strong>SESSION 9 - Future Opportunities &amp; Standards/ Technical Evaluator Report</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chair - H. NISKA, United States</td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>25</td>
<td>High Temperature Telemetry Techniques for Test Cell and Controls Instrumentation</td>
<td>J. Fraley, Arkansas Power Electronics International, Inc., A. Behbahani, USAF, G. W. Hunter, NASA, United States</td>
</tr>
<tr>
<td>16:30</td>
<td>26</td>
<td>Fiber Optic Instrumentation for Gas Turbine Engines: Control, EHM, and Test Cell Applications</td>
<td>M. Pakmehr, B. Moslehi, J. Costa, R. J. Black, V. Sotoudeh, Intelligent Fiber Optic Systems Corporation, A. Behbahani, AFRL/RQTE, United States</td>
</tr>
<tr>
<td>17:00</td>
<td>27</td>
<td>An Overview of Propulsion Instrumentation Working Group (PIWG) Efforts to Develop New Instrumentation and Standards</td>
<td>W.A. Stange, UTC/USAF, United States</td>
</tr>
<tr>
<td>17:30</td>
<td></td>
<td>Symposium Evaluator’s Report</td>
<td>T.G. Fecke, United States</td>
</tr>
</tbody>
</table>