

PROCEEDINGS OF THE

1ST INTERNATIONAL WORKSHOP ON AIRCRAFT SYSTEM TECHNOLOGIES

MARCH 29-30, 2007, HAMBURG, GERMANY

EDITED BY OTTO VON ESTORFF



Berichte aus der Luft- und Raumfahrttechnik

Otto von Estorff (Ed.)

Proceedings of the 1st International Workshop on Aircraft System Technologies

March 29-30, 2007, Hamburg, Germany

Shaker Verlag Aachen 2007

Bibliographic information published by the Deutsche Nationalbibliothek The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Copyright Shaker Verlag 2007

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publishers.

Printed in Germany.

ISBN 978-3-8322-6046-0 ISSN 0945-2214

Shaker Verlag GmbH • P.O. BOX 101818 • D-52018 Aachen Phone: 0049/2407/9596-0 • Telefax: 0049/2407/9596-9

Internet: www.shaker.de • e-mail: info@shaker.de

WELCOME

The Hamburg University of Technology is pleased to welcome guests from many different countries to the *I*st *International Workshop on Aircraft System Technologies AST 2007* organized in Hamburg.

Why in Hamburg? The North German metropolitan region ranks alongside Seattle and Toulouse as one of the world's leading centers for civil aviation. Meanwhile, Airbus Deutschland, Lufthansa Technik, Hamburg Airport, and about 300 small and medium-sized supplying companies employ more than 30,000 highly skilled people, many of them holding an engineering degree. On one hand, the range of available industrial apprenticeships and university programs in the field of aviation is continually expanding and every effort is made to nurture young talents. On the other hand, R&D activities are promoted in different ways, for instance, by the joint initiative "Hamburg - The place for aviation".

The two-day event provides an ideal platform to the international family of aviation engineers for fruitful discussions about scientific and technical issues in their field. High level presentations by leading experts will allow each participant to get an in-depth view on the status quo of systems and components in numerous fields of aviation. Aspects of current applications as well as future research and developments will be exchanged.

The proceedings of the event comprise more than 35 high-quality contributions which were selected from a call for papers. The contributions presented at the workshop address the fields of *Airframe Systems and Equipment, Cabin and Comfort, Information and Communication* as well as *Materials and Production*. For practicing engineers and scientists working in one of these areas the proceedings will be a valuable source of information.

As the responsible organizer of the workshop, I am indebted to all the authors for their contributions to the event and their efforts to make the proceedings such a complete work. I also would like to extend my gratitude to the colleagues of the program committee and the organizing team for their great support and cooperation. Finally, I would like to express my sincere appreciation to the sponsoring and supporting companies, institutions, and associations making this workshop possible.

On behalf of the organizers I wish all participants a fruitful meeting, many interesting discussions, and a pleasant stay in Hamburg.

Otto von Estorff Conference Chair AST 2007

ORGANIZATION

Conference Chair: Prof. Dr.-Ing. Otto von Estorff

Hamburg University of Technology

Program Committee: Hamburg University of Technology

Prof. Dr.-Ing. Udo Carl Prof. Dr.-Ing. Klaus Rall Prof. Dr. Hermann Rohling Prof. Dr.-Ing. Gerhard Schmitz Prof. Dr.-Ing. Karl Schulte Prof. Dr. Volker Turau Prof. Dr. Friedrich H. Vogt

Helmut Schmidt University, Hamburg

Prof. Dr.-Ing. Delf Sachau

Hamburg University of Applied Sciences

Prof. Dr.-Ing. Dieter Scholz

Local Arrangements: Dipl.-Ing. Peter Baasch

Rüdiger Bendlin Dr. Johannes Harpenau

Dipl.-Ing. Wulf von Karstedt

Conference Secretariat: Claudia Plötz

Institute of Modelling and Computation

Hamburg University of Technology

Denickestraße 17

21073 Hamburg, Germany

Phone: +49 (0)40 42878-3232 Fax: +49 (0)40 42878-4353 Email: ast@tu-harburg.de

ACKNOWLEDGEMENTS

The 1st International Workshop on Aircraft System Technologies AST 2007 has been

sponsored by Airbus Deutschland GmbH

Flughafen Hamburg GmbH Lufthansa Technik AG

and supported by Deutsche Gesellschaft für Luft- und Raumfahrt DGLR

German Association for Computational Mechanics GACM

Initiative Luftfahrtstandort Hamburg

LMS International NV

Novicos GmbH

Olmos Technologies GmbH.

The financial aid, the general support, and the overall commitment of these companies, institutions, and associations are greatly appreciated.

The organizers are also very thankful for the generous help provided by the Ministry of Science and Research (BWF) and the Ministry for Economic and Labor Affairs (BWA).

Contents

Opening Talk	1
The German Vision 2020 Research Building the Future Air Transport System	9
Joachim Szodruch	3
Airframe Systems and Equipment	5
Development, Prototype Production and Testing of an Electro-Mechanical Actuator for a Swashplateless Primary and Individual Helicopter Blade Control System	
Daniel Fuerst, Tom Neuheuser	7
Health Monitoring Methods for Dual Parallel Hydraulic Actuators Timo Ruprecht , Frank Thielecke	21
SFCC380 High Lift (Slat/Flap) Control System (SFCS) Walter Endrös	31
Parametric Modelling and Experimental Validation of Multi Body Simulations of Elastic Flap Systems in Transport Aircraft Hauke Gülzau, Udo B. Carl	39
Development and Experimental Validation of Model Based Electronic Torque Limitation for High Lift Systems *Uwe Neumann, Udo B. Carl**	49
A Methodology for Aircraft Power System Architectures Analysis Susan Hanke, Stefan Pufe, Jean-Charles Maré	59
Numerical Simulation of an Aircraft CO ₂ Supplemental Cooling System Jens Vasel, Gerhard Schmitz	69
Optical Fuel Quantity Measurement in Aircrafts Sven Cierullies, Ingo Bebermeier	79
SIVA - A Test Rig for the Validation of High Lift Component Models Timo Ruprecht, Frank Thielecke, Martin Recksiek	89
Hydrogenius Flying with Hydrogen	
Rudolf Voit-Nitschmann, Len Schumann, Steffen Geinitz	101

Cabin and Comfort
Vibroacoustic Impacts Performance and Well-Being of Cabin Crew during Long-Haul Flights Volker Mellert, Ingo Baumann, Sandra Buss, Nils Freese, Roland Kruse, Reinhard Weber, Michael Bellmann
Noise Source Identification and Optimized Active Noise Control in Aircraft Cabins Delf Sachau, Thomas Kletschkowski, Christian. Gerner
Numerical Modelling of the Vibroacoustic Behavior of Aircraft Cabin Components: Computation versus Measurements Sören Callsen, Otto von Estorff, Wolfgang Gleine, Stephan Lippert
FLECS: Functional Library of the Environmental Control System - A Simulation Tool for the Support of Industrial Processes Dieter Scholz, Christian Müller, Tim Giese, Carsten Erdmann
Experimental Investigation of In-Flight Performances for an Aircraft Air-Conditioning Prototype Based on Carbon Dioxide as a Working Fluid Sergio Chiesa, Sabrina Corpino, Nicole Viola, Michele Calì, Pietro Asinari, Achille Mannini
Large Scale PIV for Mixed Convection Investigation in a Full Scale Aircraft Cabin Mock-Up and Attended Numerical Simulation M. Rütten, J. Bosbach, L. Krenkel, M. Kühn, C. Wagner
Development of Mechatronic A/C Cabin Systems Volker Grienitz
Future Technologies for the Maintenance of Aircraft Cabin Systems Sven-Olaf Berkhahn
Dynamic System Simulation of an Aircraft Cabin Climate for Comfort-Improved Climate Control Henning Knigge Andreas Joos Gerhard Schmitz 197

Information and Communication Management	209
The Airbus Approach to Open Integrated Modular Avionics (IMA): Technology, Methods, Processes and Future Road Map Henning Butz	911
Tremming Dutz	211
IMA A380 – Integrated Modular Avionics from the Beginning to the Ideas for the Future	
Roman Mouhlen, Benno Petersen, Enrico Pivetta	223
Cost-Effective Distributed Embedded Computing for Advanced Control Systems in More Electric Aircraft	
Mirko Jakovljevic	231
A Holistic Framework for Optimal Avionics System Resource Planning Thanikesavan Sivanthi, Shu Zhang, Ulrich Killat	245
Car Management on Aprons (CARMA) – Developing Integrated Solutions for Vehicle Management at Mid-Size Airports	
Steffen Loth, Marcus Venzke, Dietmar Möller, Axel Husfeldt, Volker Turau, Christoph Meier	257
Inflight Entertainment (Infotainment) – Trends and Technologies in Transition Bernhard Conrad	267
Concepts for MIMO Channel Measurements in the Aircraft Cabin to Investigate New Wireless LAN Systems	
Oomke Weikert, Udo Zölzer	271
Robust Eye Detection for Cockpit Access Control Using an Appearance Model and Radial Symmetry Transform under Active Near Infrared Illumination	
Shuyan Zhao, Rolf-Rainer Grigat	281
Surface Management (SMAN) Planning and Automation of Airport Traffic Wolfgang Hatzack, Natalie Hammerich	293
Overcoming the Media Breaks in AIS: Dissemination of Operational Change Notifications by x–NOTAM	
Christian Grothe, Siegfried Bauer, Uwe Klingauf	303

Materials and Production
Durability of Fibre Reinforced Composites Karl Schulte, Jörg Petermann, Andreas Gagel, Stephan Hinz, Florian Gehrig, Bodo Fiedler
Automatic Non-Destructive Testing of CFRP Materials **Raymond Schulz, Hermann Rohling
Fatigue Life Assessment of Bonded Joints in Composite Materials Marino Quaresimin, Mauro Ricotta
Flexible and Automated Assembly of Compliant Large-Scale Fuselage Parts Klaus Rall, Patrick Stepanek
Precision of Machined CFRP - The Challenge of Dimensional Accuracy Wolfgang Hintze, Rolf Clausen, Dirk Hartmann, Jörg Kindler, Salvador Santos, Matthias Schwerdt, Enno Stöver
Innovative Energy-Absorbing Concept for Aircraft Cabin Interior M. Pein, D. Krause, S. Heimbs, P. Middendorf
ALLADIN - State of the Art to Assemble, to Integrate and to Test Most Complex Airborne Systems Norbert Peer, Ulrich Schneidereit
Uncertainty Management for Computer-Aided Engineering in Aircraft Cabin Development Dietmar Vogt, Michael Olbert, Josef Schlattmann
Use of Automatic Differentiation for Obtaining Sensitivity Analysis of Flight Loads
Moriz Scharpenberg, Mária Lukáčová-Medvidóvá