39th European Rotorcraft Forum 2013

(ERF 2013)

Moscow, Russia
3-6 September 2013

Acoustics

1. DESIGN AND PERFORMANCE EVALUATION FOR FINALIZED ACTIVE TAB DRIVE MECHANISM INSTALLED IN MACH SCALED MODEL BLADE ..... 1
KOBIKI Noboru
e-mail: kobiki.noboru@jaxa.jp
Japan Aerospace Exploration Agency, JAXA
7-44-1, Jindaijihigashi-machi, Chofu, Tokyo, Japan
Abstract

2. SIMULATION OF MAIN ROTOR NOISE EMISSION GENERATED DUE TO BLADE THICKNESS ..... 7
R. M. Mirgazov, V. A. Golovkin, B. S. Kritsky
Central Aerohydrodynamic Institute named after N. E. Zhukovsky (TsAGI)
Zhukovsky, Russia
Abstract

3. PREDICTION OF NOISE REDUCTION BY AN ACTIVE FLAP OF A MODEL ROTOR ..... 8
Yasutada Tanabe, Noboru Kobiki
e-mail: tan@chofu.jaxa.jp
JAXA (JAPAN)
Hideaki Sugawara
Ryoyu Systems, Co., Ltd. (JAPAN)
Abstract

4. ACOUSTIC DESIGN AND TESTING OF THE EUROCOPTER EC145T2 AND EC175B – A HARMONIZED FRANCO-GERMAN APPROACH ..... 10
Vincent Gareton
vincent.gareton@eurocopter.com
Marc Gervais
marc.gervais@eurocopter.com
Rainer Heger
rainer.heger@eurocopter.com
Aerodynamics Department
EUROCOPTER, Marignane, France
Aerodynamics Department
EUROCOPTER, Donauwörth, Germany
Abstract

5. IMPROVEMENTS TO THE HYBRID METHOD OF CFD AND PRESCRIBED WAKE MODEL ..... 14
Masahiko Sugiura, Yasutada Tanabe
e-mail: sugiura.masahiko@.jaxa.jp
JAXA (JAPAN)
Hideaki Sugawara
Ryoyu Systems, Co., Ltd. (JAPAN)
Abstract

6. TOWARDS ACCURATE REAL-TIME UNSTEADY HELICOPTER AEROACOUSTIC ANALYSIS USING GPU-CUDA ACCELERATED TOOLS ..... 17
Luis Cruz
e-mail: luis.cruz@agustawestland.com
Andrea D'Andrea
Abstract
Aerodynamics

1. PASSIVE BLADE OPTIMIZATION AND EVALUATION IN O_-DESIGN CONDITIONS ..... 21
   Manfred Imiela and Gunther Wilke
   German Aerospace Center
   Institute of Aerodynamics and Flow Technology
   Lilienthalplatz 7, 38108 Braunschweig, Germany
   manfred.imiela@dlr.de; gunther.wilke@dlr.de
   Abstract

2. CFD ANALYSIS AND CALCULATION OF AERODYNAMIC CHARACTERISTICS OF HELICOPTER ROTOR ..... 24
   N.A. Vladimirova, vlana@progtech.ru,
   TsAGI - Central Aerohydrodynamic Institute (Russia)
   Abstract

3. FLOW FIELD INVESTIGATION OF A GROUNDED HELICOPTER FUSELAGE IN CROSSWIND CONDITIONS ..... 26
   Alberto Fabbris, Research Engineer, a.fabbris@hit09.com, HIT09 Srl (ITALY),
   www.hit09.com
   Rita Ponza, Senior Research Engineer, r.ponza@hit09.com, HIT09 Srl (ITALY),
   www.hit09.com
   Ernesto Benini, Associate Professor, ernesto.benini@unipd.it, University of Padova (ITALY)
   Abstract

4. WIND TUNNEL CORRECTIONS FOR ISOLATED ROTOR TESTS ..... 28
   M. Biavai1, M. Valentini2, L. Vigevano2
   1 AWPARC, Milano, Italy 2 Dipartimento di Scienze e Tecnologie Aerospaziali -
   Politecnico di Milano, Via La Masa 34, 20156 Milano, Italy
   Abstract

5. EXPERIMENTAL EVALUATION OF AN L-SHAPED TAB TO BE USED AS AN ACTIVE GURNEY FLAP FOR DYNAMIC STALL CONTROL ..... 30
   A. Zanotti, D. Grassi and G. Gibertini
   Politecnico di Milano – Dipartimento di Scienze e Tecnologie Aerospaziali
   Via La Masa 34, 20156 Milano – Italy
   e-mail: alex.zanotti@polimi.it
   Keywords: Aerodynamics, Oscillating Airfoil, Gurney Flap, Dynamic Stall.
   Abstract

6. NUMERICAL STUDY OF ROTORS IN SHIP AIRWAKE ..... 34
   C. Crozon, R. Steijl and G.N. Barakos
   CFD Laboratory, School of Engineering
   University of Liverpool, L69 3GH, U.K.
   http://www.liv.ac.uk/flightscience/PROJECTS/CFD/ROTORCRAFT/RBD/index.htm
   Email: crozon@liverpool.ac.uk, rsteijl@liverpool.ac.uk, G.Barakos@liverpool.ac.uk
   Abstract

7. HIGH ORDER CFD-SIMULATION OF THE ROTOR-FUSELAGE
INTERACTION ..... 37
Ulrich Kowarsch, Manuel Keßler and Ewald Krämer
kowarsch@iag.uni-stuttgart.de, University of Stuttgart, IAG, Pfaffenwaldring 21,
Stuttgart, 70569, Germany
Abstract

8. OPTIMIZED SKID-LANDING-GEARS FOR TWIN-ENGINE-LIGHT UTILITY
HELICOPTER ..... 40
Moritz Grawunder, Roman Reß, Christian Breitsamter
moritz.grawunder@ae.r.mw.tum.de
Institute of Aerodynamics and Fluid Mechanics
Technische Universität München
Abstract

9. ASSESSMENT OF AEROMECHANICS AND ACOUSTICS METHODS FOR BVI
PREDICTION USING CFD ..... 44
R. Boisard, M. Costes, G. Reboul, F. Richez, B. Rodriguez
ONERA - The French Aerospace Lab
F-92190 Chatillon, France
Abstract

10. PERFORMANCE AND LOADS PREDICTIONS OF A SLOWED UH-60A
ROTOR AT HIGH ADVANCE RATION ..... 47
Mark Potsdam Hyeonsoon Yeo Robert Ormiston
mark.potsdam@us.army.mil hyeonsoon.yeo@us.army.mil robert.ormiston@us.army.mil
U.S. Army Aviation Development Directorate - Aeroflightdynamics Directorate
(AMRDEC)
Research, Development, and Engineering Command, Moffett Field, CA, USA
Abstract

11. COMPUTATIONAL MODELING OF VORTEX RING STATE MODES OF
HELICOPTER MAIN ROTOR ..... 50
Ignatkin Y.M., Makeev P.V.,Shomov A.I., Moscow Aviation Institute(National
University of Science) Russia
Keywords: numerical computation, main rotor, tail rotor, vortex ring state mode, non-
linear vertical model, aerodynamic characteristics.
Abstract

12. IMPROVEMENT OF COMPUTATION EFFICIENCY FOR HELICOPTER
ROTOR AERODYNAMIC ANALYSIS VIA ADAPTIVE WAVELET METHOD ..... 52
Sanghyun Chae, myugnas@pnu.edu, Pusan National University (Korea)
Sejong Oh, tazo@pnu.edu, Pusan National University (Korea)
Kwanjung Yee, daedalus@pnu.edu, Pusan National University (Korea)
Abstract

13. URANS SIMULATIONS OF ON OR NEAR THE GROUND FLIGHT OF THE
GYROPLANE ..... 55
Wierczyslaw Stalewski, stal@lot.edu.pl, Institute of Aviation, Poland
Abstract

14. TRIMMED ACTUATOR DISK MODELING FOR HELICOPTER ROTOR ..... 58
M. Biava1, M. Valentini2, L. Vigevano2
1 AWPARC, Milano, Italy 2 Dipartimento di Scienze e Tecnologie Aerospaziali -
Politecnico di Milano, Via La Masa 34, 20156 Milano, Italy
Abstract

15. ROTOR-HEAD/FUSELAGE INTERACTIONAL EFFECTS ON HELICOPTER
DRAG: INFLUENCE OF THE COMPLEXIFICATION OF THE ROTOR-HEAD ..... 60
GEOMETRY
D. Desvigne & D. Alfano
Eurocopter S.A.S.
Marseille-Provence International Airport
F-13725 Marignane cedex
France
Abstract

16. MULTI-POINT AERODYNAMIC OPTIMIZATION BY MEANS OF MEMETIC
ALGORITHM FOR DESIGN OF ADVANCED TILTROTOR BLADES ..... 64
Andrea Massaro
andrea.massaro@agustawestland.com
17. MULTI-OBJECTIVE OPTIMIZATIONS IN ROTOR AERODYNAMICS USING VARIABLE FIDELITY SIMULATIONS .... 69
Gunther Wilke
German Aerospace Center (DLR) Braunschweig, Institute of Aerodynamics and Flow Technology
Lilienthalplatz 7, 38108 Braunschweig, Germany, gunther.wilke@dlr.de

18. COMPARISON BETWEEN SLIDING AND CHIMERA GRIDS .... 73
Mikolaj Jarkowski, Mark Woodgate and George N. Barakos
CFD Laboratory, Department of Engineering
University of Liverpool, L69 3GH, U.K.
http://www.liv.ac.uk/flightsceience/PROJECTS/CFD/ROTORCRAFT/index.htm

19. COMPUTATIONAL ANALYSIS OF THE W3 SOKOL ROTOR WITH GURNEY FLAPS .... 75
Vasileios Pastrikakis, René Steijl and George N. Barakos
CFD Laboratory, School of Engineering
University of Liverpool, L69 3GH, U.K.
http://www.liv.ac.uk/flightsceience/PROJECTS/CFD/ROTORCRAFT/RBD/index.htm
Email: G.Barakos@liverpool.ac.uk

20. CFD CODE VALIDATION OF ROTOR/FUSELAGE INTERACTION USING THE COMMERCIAL SOFTWARE STAR-CCM+8.04 ...... 77
Boris KUBRAK1* and Deryl SNYDER2
1CD-adapco, 200 Sheperds Bush Road, London W6 7NL, UK
2CD-adapco, 2101 Park Center Drive, Suite 290, Orlando, FL 32835, USA
*Corresponding author, E-mail address: boris.kubrak@cd-adapco.com

21. RESEARCH INTO AERODYNAMICS, FLIGHT DYNAMICS AND STRENGTH OF NEW GENERATION HELICOPTERS AT TsAGI .... 78
S.L.Chernyshev and M.A.Golovkin
Central Aerohydrodynamic Institute named after N.Ye.Zhukovsky (TsAGI).
Zhukovsky, Russia

22. AERODYNAMIC AND STRUCTURAL INVESTIGATION OF AN ACTIVE BACK-FLOW FLAP FOR DYNAMIC STALL CONTROL .... 79
S. Opitz , A.D. Gardner , K. Kaufmann

23. ENHANCEMENT OF PRESCRIBED WAKE CODES WITH A CFD-BASED MODEL OF THE FUSELAGE-INDUCED VELOCITIES .... 82
Berend G. van der Wall
German Aerospace Center
38108 Braunschweig, Germany
berend.vanderwall@dlr.de
André Bauknecht
German Aerospace Center
37073 Göttingen, Germany
andre.bauknecht@dlr.de
Sung N. Jung, Young H. You
Konkuk University
143-701 Seoul, Korea
snjung@konkuk.ac.kr
Abstract

24. EXPERIMENTAL INVESTIGATION OF PERPENDICULAR VORTEX INTERACTION
OVER AN OSCILLATING AIRFOIL IN DYNAMIC STALL CONDITIONS ..... 85
A. Zanotti, G. Gibertini and A. Mencarelli
Politecnico di Milano – Dipartimento di Scienze e Tecnologie Aerospaziali
Via La Masa 34, 20156 Milano – Italy
e-mail: _alex.zanotti@polimi.it
Keywords: Vortex Interaction, Oscillating airfoil, PIV, Hot-Wire Anemometry.

Abstract
Aircraft Design

1. DESIGN, EXPERIMENTS AND DEVELOPMENT OF A POLISH UNMANNED HELICOPTER ILX-27 ..... 89
   Session subject: Aircraft Design
   Pawel Gula, Tomasz Gorecki
   pawel.gula@ilot.edu.pl
tomasz.gorecki@ilot.edu.pl
   Institute of Aviation al. Krakowska 110/114 02-256 Warsaw Poland
   Abstract

2. A STUDY in HELICOPTER FUSELAGE DRAG ..... 92
   Andrey S. Batrakov†, Alexander N. Kusyumov†, Sergey A. Mikhailov†, Vladimir V. Pakhov†,
   Artur R. Sungatullin†, Vladimir V. Zherekho† and George N. Barakos‡
   †Tupolev Kazan National Research Technical University
   10 Karl Marx St., Kazan 420111, Russian Federation
   Email: lvi@au.kstu-kai.ru,
   ‡School of Engineers, University of Liverpool
   Liverpool, L69 3GH, U.K.
   Email: G.Barakos@liverpool.ac.uk
   Abstract

3. A CONCEPTUAL DESIGN METHODOLOGY FOR ROTORCRAFT MANEUVERABILITY ..... 95
   Frank Patterson, Romain Lamour, Dr. Daniel Schrage
   School of Aerospace Engineering
   Georgia Institute of Technology
   Atlanta, Georgia, United States
   Abstract

4. AEROFOIL SELECTION AND SPANWISE PLACEMENT IN AERODYNAMIC DESIGN AND OPTIMIZATION OF TILTROTOR BLADES ..... 98
   Antonio Pagano, a.pagano@cira.it, CIRA, Italian Aerospace Research Centre (Italy)
   Abstract

5. PARAMETRIC FUSELAGE GEOMETRY GENERATION AND AERODYNAMIC PERFORMANCE PREDICTION IN PRELIMINARY ROTORCRAFT DESIGN ..... 100
   Philipp Kunze, Philipp.Kunze@dlr.de, German Aerospace Center (DLR)
   Abstract

6. THEORETICAL EVALUATIONS AND NUMERICAL RESEARCHES OF POSSIBILITIES OF SERVICE LIFE EXTENSION FOR STACKED TORSION MEMBERS OF HELICOPTER MAIN AND TAIL ROTOR HUBS ..... 103
   Yu.S. Alexandrin, L.A. Maslov, V.P. Timokhin
   Mil Moscow Helicopter Plant
   Tomilino, Russian Federation
   Abstract

7. DEVELOPMENT AND TESTING OF AN ELECTRICAL SWASHPLATE ..... 104
   Uwe T. P. Arnold, uwe.arnold@zf.com
   André Hausberg, andre.hausberg@zf.com
ZF Luftfahrttechnik GmbH (Germany)

Abstract

8. AERODYNAMIC ANALYSIS OF TILTROTTORS IN HOVERING A AND PROPELLER MODES USING ADVANCED NAVIER-STOKES COMPUTATIONS ..... 106
S. Gates
AgustaWestland, Yeovil, UK

Abstract

9. SURROGATE MODELS FOR HELICOPTER LOADS ..... 110
Alain Struzik1, Evgeny Burnaev2,3,4 and Pavel Prikhodko2,3,4
With contributions of J-C. Auzet1, A. Mayan1, S. Morozov2,4, S. Alestra2, C. Brand2
(1) EUROCOPTER:
alain.struzik@eurocopter.com
jean-christian.auzet@eurocopter.com
aurelien.mayan@eurocopter.com
(2) DATADVANCE:
evgeny.burnaev@datadvance.net
pavel.prikhodko@datadvance.net
sergey.morozov@datadvance.net
stephan.alestra@datadvance.net
christophe.brand@datadvance.net
(3) PreMoLab: Moscow Institute of Physics and Technology
(4) Institute for Information Transmission Problems

Abstract

10. NEW ROLE OF CFD IN THE HELICOPTER DESIGN PROCESS - THE EC145 T2 EXPERIENCE ..... 111
Alessandro D’Alascio alessandro.dalascio@eurocopter.com Klaus Kicker
klaus.kicker@eurocopter.com Thomas Kneisch thomas.kneisch@eurocopter.com
Stefanie Link stefanie.link@eurocopter.com Tobias Ries
tobias.ries@eurocopter.com Dieter Schimke dieter.schimke@eurocopter.com
Aerodynamics Department
EUROCOPTER, Donauwörth, Germany

Abstract
1. **FLEXIBLE PLATFORM APPROACH FOR CS27/29 FLY-BY-WIRE SYSTEMS** ..... 114
   Stephan Korn, Rolf-Rekke Riebeling, Simon Görke, Reinhard Reichel,  
   stephan.korn@ils.uni-stuttgart.de, University of Stuttgart, Germany
   
   **Abstract**

2. **DESIGN VALIDATION OF A NEW GENERIC FLY-BY-X FLIGHT CONTROL SYSTEM FOR HELICOPTERS** ..... 116
   N. Bickel, J. P. Klaubert, M. Hammerlindl Eurocopter Deutschland GmbH  
   Donauwörth, D-86607 Germany e-mail: norbert.bickel@eurocopter.com  
   S. Korn, R. Reichel, R. Riebeling University of Stuttgart Stuttgart, D-70569 Germany
   
   **Abstract**

3. **ACTUATION SYSTEM MODELING FOR ERICA TILTROTOR** ..... 122
   Przemysław Bibik, Associate Professor, ppbibk@meil.pw.edu.pl  
   Antoni Kopyt, Ph.D. student, akopyt@meil.pw.edu.pl  
   Janusz Narkiewicz, Professor, jnark@meil.pw.edu.pl  
   Department of Automation and Aeronautical Systems,  
   Warsaw University of Technology,  
   ul. Nowowiejska 24; 00-665 Warsaw, Poland
   
   **Abstract**

4. **UNIFIED ADVANCED HUMS AND MAINTENANCE SYSTEM FOR “RH” HELICOPTERS** ..... 123
   D. Podoryashy 1, A. Soloviov 1, D. Soloviov 1, A. Mironov, 2 P. Doronkin, 2  
   1- Russian Helicopters CI&C, Russian Federation 2- D un D centrs, Riga, Latvia  
   a.soloviov@rus-helicopters.com aleksei@ddcentrs.lv
   
   **Abstract**

5. **INTEGRATED INFORMATION SYSTEM WITH SYNTHESIZED IMAGE OF THE FLIGHT ENVIRONMENT, PREVENTING COLLISIONS WITH OBSTACLES AND PROVIDING A BLIND LANDING** ..... 125
   Alexey SOLOVIOV, Ilya TARATONOV  
   a.soloviov@rus-helicopters.com, i.taratonov@rus-helicopters.com  
   Russian Helicopters, JSC  
   12 Krasnopresnenskaya naberezhnaya, Moscow, 123610, Russia
   
   **Abstract**

6. **APPLICATION OF THE PREDICTOR-BASED SUBSPACE IDENTIFICATION METHOD TO ROTORCRAFT SYSTEM IDENTIFICATION** ..... 126
   Johannes Wartmann, Susanne Seher-Weiss  
   Johannes.Wartmann@dlr.de, Susanne.Seher-Weiss@dlr.de  
   German Aerospace Center (DLR), Institute of Flight Systems  
   Lilienthalplatz 7, 38108 Braunschweig, Germany
   
   **Abstract**
Dynamics

1. **ROBUST DESIGN OF TRAILING EDGE FLAP WITH ORTHOGONAL ARRAY INSPIRED RESPONSE SURFACE FOR HELICOPTER VIBRATION REDUCTION** ..... 129
   Rajnish Mallick1, Ranjan Ganguli2, M. Seetharama Bhat3
   1, 2, 3 Department of Aerospace Engineering, Indian Institute of Science, Bangalore 560012, India
   
   **Abstract**

2. **HELICOPTER VIBRATORY LOADS AND VIBRATIONS REDUCTION USING HIGHER-HARMONIC CONTROL** ..... 133
   Aykut Tamer, Vincenzo Muscarello
   Pierangelo Masarati, Giuseppe Quaranta
   Department of Aerospace Science and Technology, Politecnico di Milano, Milano - Italy
   aykut.tamer@polimi.it
   vincenzo.muscarello@polimi.it
   pierangelo.masarati@polimi.it
   giuseppe.quaranta@polimi.it
   Yavuz Yaman ¶
   Department of Aerospace Engineering, Middle East Technical University
   yyaman@metu.edu.tr
   
   **Abstract**

3. **GROUND RESONANCE ANALYSIS METHOD FOR SKID LANDING GEAR HELICOPTER** ..... 135
   Nikolaev E.I.
   Kazan Helicopter Industry
   Pantyukhin K.N.
   Kazan National Research Technical University, named after A.N.Tupolev
   10 Karl Marx St., Kazan 420111, Russian Federation, Russia
   
   **Abstract**

4. **HIGHER HARMONICS CONTROL OF HELICOPTER ROTOR WITH ELASTIC BLADES** ..... 143
   V.A. Ivchin
   MIL Moscow Helicopter plant, JSC
   Russia
   I.O. Averyanov
   “MATI” - Russian State Technological University
   Russia
   
   **Abstract**

5. **AEROELASTIC ANALYSIS OF A HELICOPTER IN STEADYMANEUVER USING DYNAMIC WAKE/DYNAMIC STALL MODELS** ..... 145
   Session subject – Dynamics
   M Rohin Kumar, Graduate student, rohin@iitk.ac.in
   and
   C. Venkatesan, Professor and Head, even@iitk.ac.in
   Department of Aerospace Engineering,
6. **AN ENERGETIC APPROACH TO AEREOELASTIC ROTORCRAFT-PILOT COUPLINGS ANALYSIS** ..... 156
   Georges Tod, François Malburet, Julien Gomand, Pierre-Jean Barre and Benjamin Boudon
greges.tod@ensam.eu, francois.malburet@ensam.eu, julien.gomand@ensam.eu
   Arts et Metiers ParisTech, Aix-en-Provence, France
   **Abstract**

7. **EXPERIENCE OF VIRTUAL SIMULATION OF AIRCRAFT ACCIDENTS RELATED TO STRENGTH PROBLEMS** ..... 157
   Yuri Aleksandrin, Vladimir Grgoryev, vgrigoryev@mi-helicopter.ru, Mil Moscow Helicopter Plant (Russia)
   **Abstract**

8. **CLOSED-FORM SOLUTIONS FOR AXIALLY FUNCTIONALLY GRADED Rotating Timoshenko Beams** ..... 159
   Korak Sarkar
   koraksarkar@aero.iisc.ernet.in
   Research Student
   Department of Aerospace Engineering
   Indian Institute of Science
   Bangalore, India.
   Ranjan Ganguli
   ganguli@aero.iisc.ernet.in
   Professor
   Department of Aerospace Engineering
   Indian Institute of Science
   Bangalore, India.
   **Abstract**

9. **AN ASSESSMENT OF ONE-DIMENSIONAL APPROACH FOR STRUCTURAL MODELING OF COMPOSITE HELICOPTER ROTOR BLADES FOR AEREOELASTIC ANALYSIS** ..... 164
   Murat Sahin, mursahin@taig.com.tr, TAI-Turkish Aerospace Industries Inc., Ankara, Turkey
   Evren Taskinoglu, etaskinoglu@taig.com.tr, TAI-Turkish Aerospace Industries Inc., Ankara, Turkey
   Gokhan Tursun, gtursun@taig.com.tr, TAI-Turkish Aerospace Industries Inc., Ankara, Turkey
   Serdar Dilaver, sdilaver@taig.com.tr, TAI-Turkish Aerospace Industries Inc., Ankara, Turkey
   **Abstract**

10. **COMPLETE DYNAMIC MODEL OF THE TWIN ROTOR MIMO SYSTEM (TRMS) WITH EXPERIMENTAL VALIDATION** ..... 166
    Azamat Tastemirov;1, Andrea Lecchini-Visintini ;2 and Rafael M. Morales ;3
    *Dept. of Engineering, University of Leicester, University Rd., Leicester, UK, LE1 7RH, UK
    lazamat.tastemirov@gmail.com, 2alv1@le.ac.uk, 3rmm23@le.ac.uk
    **Abstract**

11. **THE SUPPORT PROCESS, SIMULATION RESEARCH DESIGN AND STRUCTURE OF THE NEW HELICOPTER’S CONSTRUCTION SCHEMATICS WITH SPECIAL EMPHASIS ON GROUND RESONANCE PHENOMENON** ..... 169
    Tomasz Gorecki, tomasz.gorecki@ilot.edu.pl, Institute of Aviation (POLAND)
    **Abstract**

12. **DEVELOPMENT OF A MULTI-STATE FLUIDLASTIC® LEAD-LAG DAMPER** ..... 172
    Conor Marr
    Senior Engineer
    LORD Corporation conor.marr@lord.com
    Haris Halilovic
    Engineering Manager
    LORD Corporation
    haris.halilovic@lord.com
    LORD Corporation Mechanical Technology Erie, PA
13. TOPOLOGY OPTIMIZATION OF A GEARBOX CASING ..... 173
Veysel Yalin Ozturk,
yalozturk@tai.com.tr, TAI-Turkish Aerospace Industries Inc., Ankara, Turkey
Evren Taskinoglu,
etaskinoglu@tai.com.tr, TAI-Turkish Aerospace Industries Inc., Ankara, Turkey

14. NON-LINEAR ENGINEERING MODEL FOR THE DYNAMIC ANALYSIS OF SEMI-RIGID HELICOPTER ROTORS ..... 174
Ivanova E.
Kazan National Research Technical University, named after A.N. Tupolev
10 Karl Marx St., Kazan 420111, Russia
Nikolaev E.
JSC Kazan Helicopters, Tetsevskaya, 14, Kazan 420085, Russia

15. MODIFICATION OF A FOUR BLADED MAIN ROTOR – IMPACT ON DYNAMICS AND VIBRATIONS ..... 175
Raphael Rammer, Martijn Priems, Peter Konstanzer,
Eurocopter Deutschland GmbH, Germany

16. LAG DAMPING STUDY OF A VIBRATION CONTROL SYSTEM WITH SEMI-ACTIVE VALVE LAG DAMPERS AND INNER FORCE CONTROLERS ..... 176
R. M. Morales and M. C. Turner†
Control Systems Research Group
Dept. of Engineering, University of Leicester, University Rd., Leicester, UK, LE1 7RH, UK
Email: rmm23@le.ac.uk, † mct6@le.ac.uk

17. THE STRUCTURAL DYNAMICS OF A FREE FLYING HELICOPTER IN MBS- AND FEM-ANALYSIS ..... 178
Stefan Waitz
Institute of Aeroelasticity, DLR, Göttingen, Germany
Engine & Propulsion

1. TURBOSHAFT ENGINE PERFORMANCE COMPARISON BETWEEN CVT AND FIXED RATIO TRANSMISSION FOR A VARIABLE SPEED ROTOR ..... 180
   Gianluigi Alberto Misté
gianluigialberto.miste@studenti.unipd.it
   Ernesto Benini
   ernesto.benini@unipd.it
   University of Padova (Padova, ITALY)
   Abstract

2. AERODYNAMIC PARAMETRIC STUDY OF HELICOPTER ENGINE NOZZLE ..... 183
   Thaenan dos Reis Marioni, Laurent Sudre
   Eurocopter (France)
e-mail: thaenan.dos-reis-marioni@eurocopter.com
e-mail: laurent.sudre@eurocopter.com
   Abstract

3. HELICOPTER ENGINE-IN-THE-LOOP TEST SETUP ..... 186
   M. Kerler, J. Hönle, W. Erhard, H.-P. Kau †
   Institute for Flight Propulsion, Technische Universität München
   Boltzmannstr. 15, 85748 Garching, Germany
   martin.kerler@tum.de
   Abstract
Flight mechanics

1. PERIODIC SYSTEM ANALYSIS USING A LINEAR TIME INVARIANT FORMULATION ..... 189
Mark Lopez J.V.R. Prasad
(mlopez33@gatech.edu) (jvr.prasad@ae.gatech.edu)
School of Aerospace Engineering
Georgia Institute of Technology
Atlanta, GA 30332, USA

Abstract

2. OPTIMISATION AND EVALUATION OF AN ACTIVE GURNEY FLAP SYSTEM FOR ROTORCRAFT PERFORMANCE IMPROVEMENT AND ITS IMPACT ON HANDLING QUALITIES ..... 194
Stefan van ’t Hoff, hoff@nrl.nl, NLR (The Netherlands)
Luigi Federico, l.federico@cira.it, CIRA (Italy)
Marilena D. Pavel, m.d.pavel@tudelft.nl, TU Delft (The Netherlands)
Antonio Visingardi, a.visingardi@cira.it, CIRA (Italy)
Michel van Rooij, rooijm@nrl.nl, NLR (The Netherlands)

Abstract

3. A POTENTIAL FLOW MODEL FOR COAXIAL ROTORS IN FORWARD FLIGHT ..... 196
Morgan Nowak J. V. R. Prasad
Graduate Research Assistant Professor
mnowak@gatech.edu jvr.prasad@ae.gatech.edu
School of Aerospace Engineering
Georgia Institute of Technology
Atlanta, Georgia
USA
Hong Xin David Peters
Handling Qualities Principal Engineer Professor
hong.xin@sikorsky.com dap@me.wustl.edu
Sikorsky Aircraft Corp. Dept. of Mechanical Engineering & Materials Science
Fort Worth System Integration Center Washington University
Fort Worth, Texas Saint Louis, Missouri
USA USA

Abstract

JETTISONING SIMULATION IMPROVEMENTS–PROCESS, MODELING AND VALIDATION WITH FLIGHT TEST RESULTS ..... 201
T. Ries, U. Kiesewetter
Flight-Mechanics
Eurocopter Deutschland GmbH
86607 Donauwoerth, Germany
e-mail: tobias.ries@eurocopter.com, uwe.kiesewetter@eurocopter.com

Abstract

5. A COMPREHENSIVE APPROACH FOR THE PREDICTION AND THE ANALYSIS OF THE BEHAVIOUR OF JETTISONED EXTERNAL LOADS ..... 203
Manufacturing

1. IMPROVING THE TEETH AND BEARING RACEWAY SURFACE ROUGHNESS QUALITY BY GRINDING AND SUPERFINISHING PROCESS

MASTERING ..... 205
De Looze, J.B.
Dynamic Systems Product Center
EUROCOPTER Company
France
Abstract
Operational Aspects & Safety

1. ROBOTIZED INSPECTION OF OVERHEAD POWER LINES BY UNMANNED HELICOPTER ..... 219
Rafael García, Luis Felipe Alvarado, Vicente Gonzalez, Miguel Lorenzo (Red Eléctrica de España-REE, Spain)
Teo Vitoria (tvitoria@ain.es), Antonio Vallés, Jorge Alonso, David Armendáriz, Román Estébanez (Control & Communications Area, AlN_tech, Spain)

Abstract

2. SIMULATION OF HELICOPTER DITCHING USING SMOOTHED PARTICLE HYDRODYNAMICS ..... 226
Mark A. Woodgate1, George N. Barakos1, Nigel Scrase2 and Tim Neville2
1 CFD Laboratory, Department of Engineering
University of Liverpool, L69 3GH, U.K.
http://www.liv.ac.uk/flightscience/PROJECTS/CFD/ROTORCRAFT/index.htm
2 Fuselage Aerodynamics, Helicopter Systems Design
AgustaWestland Ltd, Yeovil, BA20 2YB, UK
University of Liverpool, L69 3GH, U.K.

Abstract

3. THE UK MOD HELICOPTER SAFETY ENHANCEMENT PROGRAMME ..... 228
Pat Collins, Science Gateway, Stuart Long, Safety Team Leader, & Gareth Rudge, Safety Compliance,
Helicopters Operating Centre, Defence Equipment & Support, Bristol, UK
Bryan Finlay, Capability Advisor, Defence Science & Technology Laboratory, Fareham, UK

Abstract

4. THE KEY FACTS OF SHIP HELICOPTER OPERATIONAL LIMITATION DEVELOPMENT ..... 229
Lieutenant Alrik Hoencamp
Experimental Flight Test Engineer
Netherlands Defense Academy
Marilena D. Pavel
Assistant Professor
Delft University of Technology
Douwe Stapersma
Professor
Netherlands Defense Academy

Abstract

5. ENCOUNTERING HELICOPTER WAKE BY LIGHT AIRCRAFT ..... 231
Yaxing Wang, Mark White and George N. Barakos
School of Engineering, University of Liverpool, L69 3GH, U.K.
Email: yxwang@liverpool.ac.uk
Peter Tormey and Panagiota Pantazopoulou
Civil Aviation Authority, U.K.

Abstract

6. SENSOR FAULT DETECTION FOR THE ANSAT HELICOPTER USING OBSERVERS ..... 235
Simulation & Training

1. NUMERICAL SIMULATION OF THE FULL-SCALE PLANTING HELICOPTER SKID TYPE CHASSIS MODE AVTOROTATION ..... 284
   Michailov S.A., Doctor of of Science, Professor,
   Kazan State Technical University named A.N. Tupolev
   Karl Marx str., 10, Kazan, Russian Federation, 420111
   Email: michailov@kai.ru
   Nedel’ko D.V., Candidate of Science, Alimov S.A., Usol’tsev A.A.,
   Shakirov M.Z.
   J.S.C. «Kazan Helicopters Plant»,
   Tetsevskaya str., 14, Kazan, Russian Federation, 420085
   Email: samlabkaz@yandex.ru

   Abstract

2. MODELING OF QUADROTOR DYNAMICS FOR RESEARCH AND TRAINING SIMULATOR ..... 291
   Przemysław Bibik, pbibik@meil.pw.edu.pl,
   Janusz Narkiewicz, jnark@meil.pw.edu.pl
   Maciej Zasuwamzasuwa@meil.pw.edu.pl,
   Marcin Żugaj zugaj@meil.pw.edu.pl
   Department of Automation and Aeronautical Systems,
   Warsaw University of Technology,
   ul. Nowowiejska 24; 00-665 Warsaw, Poland

   Abstract

3. PILOT SENSITIVITY TO HANDLING QUALITIES-RELATED DESIGN PARAMETERS FOR A FUTURE PERSONAL AERIAL VEHICLE CONCEPT ..... 297
   Dr Philip Perfect, p.perfect@liv.ac.uk, The University of Liverpool (UK)
   Dr Mark D White, mdw@liv.ac.uk, The University of Liverpool (UK)
   Dr Michael Jump, mjump1@liv.ac.uk, The University of Liverpool (UK)

   Abstract

4. HELICOPTER FLIGHT IN A DEGRADED VISUAL ENVIRONMENT ..... 309
   Joost VREEKEN, Joost.Vreeken@nlr.nl, NLR (The Netherlands)
   Henk HAVERDINGS, NLR (The Netherlands)

   Abstract

5. NUMERICAL SIMULATION OF THE HELICOPTER DITCHING ON A CALM WATER SURFACE ..... 321
   L. Gontsova, Candidate of Science, A. Belyaevskiy
   TsAGI Moscow complex,
   17, Radio Street, Moscow, 105005, Russian Federation
   Email: alexpostcard@gmail.com
   D. Nedel’ko, Candidate of Science, T. Mukhametshin
   J.S.C. «Kazan Helicopters Plant»,
   14 Tetsevskaja Street, Kazan, 420085, Russian Federation

   Abstract
Structures & Materials

1. DESIGN AND FABRICATION OF A POST-BUCKLED AMPLIFICATION MECHANISM TO ACTUATE TRAILING EDGE FLAPS FOR HELICOPTER VIBRATION REDUCTION ..... 337
Rajnish Mallick1, Ranjan Ganguli2, M. Seetharama Bhat3
1, 2, 3 Department of Aerospace Engineering, Indian Institute of Science, Bangalore 560012, India
Abstract

2. ANALYSIS AND OPTIMIZATION OF AUTOMATED FIBER PLACED ROTORCRAFT COMPOSITE TAIL BOOM ..... 346
Sedat GULDU, Anil KOCKAR, Gokhan TURSUN
sguldu@tao.com.tr, akockar@tao.com.tr, gtursun@tao.com.tr
Turkish Aerospace Industries, Inc. (TAI), Helicopter Group
Ankara, Turkey
Abstract

3. EFFECTS OF DEFECTS ON INTERLAMINAR PERFORMANCE OF COMPOSITES ..... 354
Andrew Makeev*, Yuri Nikishkov, Guillaume Seon, and Erian Armanios Department of Mechanical and Aerospace Engineering University of Texas at Arlington, Arlington, Texas, U.S.A.
Abstract

4. ADVANCED COMPOSITE MATERIALS TECHNOLOGY FOR ROTORCRAFT ..... 365
Andrew Makeev*, University of Texas at Arlington, Arlington, Texas, USA
Charles Bakis and Eric Strauch, Penn State University, University Park, PA, USA
Mark Chris, Bell Helicopter Textron, Fort Worth, TX, USA
Peter Holemans and Gina Miller, Boeing Rotorcraft Systems, Ridley Park, PA, USA
Don Spencer, Kaman Helicopters, Bloomfield, CT, USA
Nicolas Patz, Patz Materials & Technologies, Benicia, CA, USA
Abstract
1. EQUIVALENT MODELLING AND SUPPRESSION OF AIR RESONANCE FOR THE ACT/FHS IN FLIGHT ..... 376
Steffen Greiser and Robin Lantzsch
Steffen.Greiser@dlr.de, Robin.Lantzsch@dlr.de
German Aerospace Center (DLR), Institute of Flight Systems
Lilienthalplatz 7, 38108 Braunschweig, Germany
Abstract

2. EXPERIMENTAL RESEARCH OF AERODYNAMIC PERFORMANCE OF MIL-171A2 HELICOPTER AIRFRAME VARIABLE MODEL IN T-1 WIND-TUNNEL OF MAI ..... 388
B.L. Artamonov
Moscow Aviation Institute, Moscow, Russia, k102@mai.ru
V.A. Ivchin
JSC “Moscow Helicopter Plant n.a. M.L. Mil”, Tomilino, Moscow Region, Russia, Vivtchin@mi-helicopter.ru
Abstract

3. DETERMINATION OF STRUCTURAL INTEGRITY OF TEETERING ROTOR SYSTEM BY WHIRL TOWER TESTS ..... 402
Betul Pelin ERGUL, Onur Arif YASA, Gokhan TURSUN
bpmaradit@tai.com.tr, oayasa@tai.com.tr, gtursun@tai.com.tr
Turkish Aerospace Industries, Inc. (TAI),
Helicopter Group
Ankara, Turkey
Abstract

4. HOVER PERFORMANCE ASSESSMENT OF 3 METER RADIUS ROTOR ON WHIRL TOWER ..... 411
Alper EZERTAS, Arda YUCEKAYALI, Yüksel ORTAKAYA
Turkish Aerospace Industries, Inc.
Ankara Turkey
aezertas@tai.com.tr, ayucekayali@tai.com.tr, yortakaya@tai.com.tr
Abstract

5. WING–ROTOR INTERACTIONS ON A 1/4–SCALE TILTROTOR HALF–MODEL ..... 426
G. Droandi, G. Gibertini, M. Lanz, G. Campanardi, D. Grassi, S. Garbaccio
Dipartimento di Scienze e Tecnologie Aerospaziali – Politecnico di Milano
Campus Bovisa, Via La Masa 34, 20156 Milano – Italy
e–mail: giovanni.droandi@polimi.it
Keywords: Tiltrotor, Aerodynamic, Rotor, Experimental model, PIV measurements.
Abstract

6. DATA COLLECTION FOR DEVELOPING A DYNAMIC MODEL OF A LIGHT HELICOPTER ..... 419
Stefano Geluardi 1,2, Frank Nieuwenhuizen 1,
Lorenzo Pollini 2, and Heinrich H. B¨ ulthoff 1
1Max Planck Institute for Biological Cybernetics, T’ubingen, Germany
2University of Pisa, Pisa, Italy
7. EXPERIMENTAL CHARACTERIZATION OF A MAGNETOHYDRODYNAMIC PLASMA ACTUATOR FOR STALL ALLEVIATION

Young-Joon Choi
Undergraduate Research Assistant, Jayant Sirohi
Assistant Professor
jayant.sirohi@mail.utexas.edu, Laxminarayan Raja
Professor, Department of Aerospace Engineering and Engineering Mechanics
The University of Texas at Austin,
Austin, TX 78712, United States

8. TOOLCHAIN FOR FREE FLIGHT MEASUREMENT AND CODE VALIDATION PURPOSES

Test and Evaluation session
Benjamin M. Kutz, Manuel Keßler and Ewald Krämer
kutz@iag.uni-stuttgart.de, University of Stuttgart, IAG, Pfaffenwaldring 21, Stuttgart,
70569, Germany

9. BLADE DEFORMATION MEASUREMENT OF A MODEL-SCALE ROTOR SYSTEM USING A SPR SYSTEM WITH IR CAMERAS

Do-Hyung Kim
dhkim@kari.re.kr
Research Engineer,
Seung-Ho Kim
kseungho@kari.re.kr
Head of Rotor Team
Jae-Won Park
skeleton46@kaist.ac.kr
Ph. D Candidate
Jae-Hung Han
jaehunghan@kaist.ac.kr
Professor
Rotor Team
Korea Aerospace Research Institute
Daejeon, Republic of Korea
Department of Aerospace Engineering
Korea Advanced Institute of Science and Technology
Daejeon, Republic of Korea

10. EXPERIMENTAL BENCH TESTING OF AN ACTIVE-TWIST ROTOR

Johannes Riemenschneider, Ralf Keimer, Steffen Kalow,
Institute of Composite Structures and Adaptive Systems, Lilienthalplatz 7, 38108 Braunschweig, Germany
Johannes.Riemenschneider@dlr.de

11. IMPROVING THE TEETH AND BEARING RACEWAY SURFACE ROUGHNESS QUALITY BY GRINDING AND SUPERFINISHING PROCESS MASTERING

De Looze, J.B.
Dynamic Systems Product Center
EUROCOPTER Company
France
Advanced materials

ADVANCED COMPOSITE MATERIALS TECHNOLOGY FOR ROTORCRAFT ..... N/A

Andrew Makeev*, University of Texas at Arlington, Arlington, Texas, USA
Charles Bakis and Eric Strauch, Penn State University, University Park, PA, USA
Mark Chris, Bell Helicopter Textron, Fort Worth, TX, USA
Peter Holemans and Gina Miller, Boeing Rotorcraft Systems, Ridley Park, PA, USA
Don Spencer, Kaman Helicopters, Bloomfield, CT, USA
Nicolas Patz, Patz Materials & Technologies, Benicia, CA, USA

Abstract
Adverse rotorcraft-pilot coupling: Synthesis of ARISTOTEL

1. ADVERSE ROTORCRAFT-PILOT COUPLINGS – MODELLING AND PREDICTION OF RIGID ..... 489
Marilena D. Pavel
Deniz Yilmaz
Delft University of Technology
Kluyverweg 1
NL-2629 HS Delft
The Netherlands
m.d.pavel@tudelft.nl
d.yilmaz@tudelft.nl
Binh Dang Vu
ONERA
Base Aerienne 701
FR-13661 Salon de Provence
France
binh.dangvu@onera.fr
Michael Jump
Linghai Lu
Michael Jones
University of Liverpool
Room 2.05 Chadwick Tower Peach Street
Liverpool L69 7ZF
UK
mjump1@liverpool.ac.uk
linghai.lu@liverpool.ac.uk
michael.jones@liverpool.ac.uk

Abstract

2. ANATOMY, MODELLING AND PREDICTION OF AEROSEROELASTIC ROTORCRAFT-PILOT-COUPLING ..... 494
Massimo Gennaretti, Marco Molica Colella, Jacopo Serafini
University Roma Tre, Dept. of Engineering, Rome, Italy - m.gennaretti@uniroma3.it
Binh Dang Vu
ONERA, Salon de Provence, France
Pierangelo Masarati, Giuseppe Quaranta, Vincenzo Muscarello
Politecnico di Milano, Dept. of Aerospace Engineering, Milano, Italy
Michael Jump, Michael Jones, Linghai Lu
University of Liverpool, School of Engineering, Liverpool, United Kingdom
Achim Ionita, Ion Fuiorea, Mihai Mihaila-Andres, Radu Stefan
STRAERO, Bucharest, Romania

Abstract

3. BIODYNAMIC PILOT MODELLING FOR AEROELASTIC A/RPC ..... 497
Pierangelo Masarati, Giuseppe Quaranta
pierangelo.masarati@polimi.it, giuseppe.quaranta@polimi.it
Politecnico di Milano, Italy
Larisa Zaichik, Yuri Yashin, Pavel Desyatnik
Abstract

4. AN APPROACH TO ASSESS AIRCRAFT – PILOT COUPLING CAUSED BY STRUCTURAL ELASTICITY ..... 502
Larisa Zaichik, Yury Yashin, Pavel Desyatnik, Vadim Perebatov
zaichik@tsagi.ru, yuyash@yandex.ru, desiatnik_pavel@mail.ru, flight15@tsagi.ru
TsAGI (Russia)
Hafid Smaili
hafid.smaili@nlr.nl
NLR (The Netherlands)

Abstract

5. EXPOSING ROTORCRAFT PILOT COUPLINGS USING FLIGHT SIMULATION ..... 506
Michael Jones, Michael Jump, and Linghai Lu,
fmichael.jones,mjump1,linghaig@liverpool.ac.uk, University of Liverpool. (UK)
Deniz Yilmaz, and Marilena Pavel,
fd.yilmaz,m.d.pavel@tudelft.nl, Delft University of Technology. (NL)
Pierangelo Masarati, Giuseppe Quaranta, and Vincenzo Muscarello,
fmasarati,quaranta,muscarellog@aero.polimi.it, Politecnico di Milano. (IT)

Abstract

6. ROTORCRAFT PILOT COUPLING SUSCEPTIBILITY ACCOMPANYING HANDLING QUALITIES PROSPECTS IN PRELIMINARY ROTORCRAFT DESIGN ..... 511
Deniz Yilmaz
D.yilmaz@tudelft.nl
Delft University of Technology, The Netherlands
Binh Dang-Vu
Binh.Dangvu@onera.fr
ONERA, France
Michael Jones
Michael.jones@liverpool.ac.uk
University of Liverpool, United Kingdom

Abstract
7. FLEXIBLE ROTOR BLADE DYNAMICS FOR HELICOPTER FLIGHT MECHANICS INCLUDING COMPARISONS WITH EXPERIMENTAL DATA ..... 515
Ioannis Goulos, Vassilios Pachidis, Pericles Pilidis
Cranfield University, United Kingdom

Abstract

8. CONCEPTS OF ROTORCRAFT ENHANCED ASSESSMENT THROUGH INTEGRATED OPTIMIZATION NETWORK: THE FIRST RESULTS ..... 517
Pierre-Marie Basset, Arnault Tremolet et al.
basset@onera.fr

Abstract