## Contents

SARISTU: Six Years of Project Management .......................... 1
Piet Christof Wölcken, Andreas Kötter, Ben Newman, Rebecca Wadleich and Katrin Genzel

### Part I  Technology Stream: Morphing. Enhanced Adaptive Droop Nose for a Morphing Wing

Morphing Wing Integrated Safety Approach and Results ............ 43
Maurizio Verrastro and Sylvain Metge

Development and Validation of a Bird Strike Protection System for an Enhanced Adaptive Droop Nose .................... 71
Charles Chary

Testing Overview of the EADN Samples ............................... 85
Vladimir Snop and Vaclav Horak

Enhanced Adaptive Droop Nose—from Computer Model to Multi-functional Integrated Part ............................... 97
Olaf Heintze, Stefan Steeger, Alexander Falken and Jürgen Heckmann

Assessment of the SARISTU Enhanced Adaptive Droop Nose .... 113
Markus Kintscher, Johannes Kim, Stefan Storm and Fabian Peter
Part II Technology Stream: Morphing. The Adaptive Trailing Edge Device (ATED)

Adaptive Trailing Edge: Specifications, Aerodynamics, and Exploitation ....................................... 143
Giovanni Marco Carossa, Sergio Ricci, Alessandro De Gaspari, Cedric Liauzun, Antoine Dumont and Moshe Steinbuch

Structural Design of an Adaptive Wing Trailing Edge for Large Aeroplanes ................................. 159
Rosario Pecora, Marco Magnifico, Francesco Amoroso, Leonardo Lecce, Marco Bellucci, Ignazio Dimino, Antonio Concilio and Monica Ciminello

Distributed Actuation and Control of a Morphing Wing Trailing Edge ........................................... 171
Ignazio Dimino, Monica Ciminello, Antonio Concilio, Rosario Pecora, Francesco Amoroso, Marco Magnifico, Martin Schueller, Andre Gratias, Avner Volovick and Lior Zivan

Elastomer-Based Skin for Seamless Morphing of Adaptive Wings . . . 187
Oliver Schorsch, Andreas Lühring and Christof Nagel

Manufacturing and Testing of Smart Morphing SARISTU Trailing Edge ........................................ 199
Yasser Essa, Federico Martin de la Escalera Cutillas, Ignazio Dimino, Monica Ciminello and Antonio Concilio

Part III Technology Stream: Morphing. Wingtip Morphing Trailing Edge

Design, Optimization, Testing, Verification, and Validation of the Wingtip Active Trailing Edge ........ 219
Andreas Wildschek, Stefan Storm, Martin Herring, Danijel Drezga, Viken Korian and Olaf Roock

Winglet Design, Manufacturing, and Testing ......................... 257
Danijel Drezga, Viken Korian, Olaf Roock, Bernardo Lopez, Arne Fiedler, Stefan Storm and Vladimir Snop
Seamless Morphing Concepts for Smart Aircraft Wing Tip ................. 275
Christof Nagel, Arne Fiedler, Oliver Schorsch and Andreas Lühring

Dynamic Aircraft Model with Active Winglet, Effects of Flight Mechanics and Loads Analysis ..................................................... 293
Toni Kanakis, Bimo Prananta, Hans van Tongeren and Rob Huls

Influence of $H_2$ and $L_\infty$ Criteria on Feed-Forward Gust Loads Control Optimized for the Minimization of Wing Box Structural Mass on an Aircraft with Active Winglets ................. 319
Andreas Wildschek

Evaluation of the Performance Benefits of the Winglet Active Trailing Edge in AS03 ................................................................. 333
Martin Herring

Part IV Technology Stream: Integrated Sensing, Fiber Optic-Based Monitoring System

Ribbon Tapes, Shape Sensors, and Hardware .................................. 349
Matthijs Bosboom, Martijn van Wijngaarden, Rolf Evenblij, Paolo Bettini, Theodoros Loutas, Vassilis Kostopoulos, Dimitrios Habas, Moshe Tur, Nahum Gorbatov, Arik Bergman, Uri Ben Simon, Iddo Kressel, Christos Koimtzoglou, Monica Ciminello, Alexander Weisser and Christophe Paget

Methodologies for the Damage Detection Based on Fiber-Optic Sensors. Applications to the Fuselage Panel and Lower Wing Panel ......................................................... 407
Alfredo Güèmes, Julian Sierra, Frank Grooteman, Toni Kanakis, Pavlos Michaelides, Dimitrios Habas, Moshe Tur, Nahum Gorbatov, Christos Koimtzoglou and Nikolaos Kontis

Load Monitoring by Means of Optical Fibres and Strain Gages .... 433
Alessandro Airoldi, Giuseppe Sala, Rolf Evenblij, Christos Koimtzoglou, Theodoros Loutas, Giovanni Marco Carossa, Pasquale Mastromauro and Toni Kanakis

Shape Sensing for Morphing Structures Using Fiber Bragg Grating Technology .......................................................... 471
Rolf Evenblij, Frank Kong, Christos Koimtzoglou, Monica Ciminello, Ignazio Dimino and Antonio Concilio
Part V Technology Stream: Integrated Sensing. Wing Damage Detection Employing Guided Waves Techniques

Methodologies for Guided Wave-Based SHM System Implementation on Composite Wing Panels: Results and Perspectives from SARISTU Scenario 5 ........................................... 495
Ernesto Monaco, Natalino Daniele Boffa, Vittorio Memmolo, Fabrizio Ricci, Nicola Testoni, Luca De Marchi, Alessandro Marzani, Jan Hettler, Morteza Tabatabaeipour, Steven Delrue and Van Den Abeele Koen

An Electromechanical Impedance-Based Mobile System for Structural Health Monitoring and Reliability Check of Bonded Piezoelectric Sensors ........................................... 529
Mihail Lilov and Thomas Siebel

PAMELA SHM System Implementation on Composite Wing Panels ........................................... 545
Angel Alcaide, Federico Martin, Eduardo Barrera and Mariano Ruiz

Toward the Upscaling of Guided Waves-Based NDE and SHM in Aeronautics ........................................... 557
Nicola Testoni, Luca De Marchi and Alessandro Marzani


Damage Identification in Composite Panels—Methodologies and Visualisation ........................................... 579
Richard Loendersloot, Inka Buethe, Pavlos Michaelides, Maria Moix-Bonet and George Lampeas

Manufacturing of CFRP Panels with Integrated Sensor Network and Contacting of the Network ........................................... 605
Dimitrios Habas, Daniel Schmidt and Nicolas Dobmann

Damage Assessment in Composite Structures Based on Acousto-Ultrasonics—Evaluation of Performance ........................................... 617
Maria Moix-Bonet, Peter Wierach, Richard Loendersloot and Martin Bach
Enhancement of Primary Structure Robustness
by Improved Damage Tolerance

Use of Carbon Nanotubes in Structural Composites
Daniel Bonduel, Nadir Kchit and Michael Claes

Enhancement of Primary Structure Robustness
by Improved Damage Tolerance
Sonia Flórez and Jorge Gayoso

Enhancement of Infused CFRP Primary Structure Mechanical
Properties Using Interleaving Thermoplastic Veils
Daniel Breen

Multi-scale-Reinforced Prepregs for the Improvement of Damage
Tolerance and Electrical Properties of Aeronautical Structures
A. Vavouliotis, G. Sotiriadis and V. Kostopoulos

Part X Technology Stream: Multifunction Materials. Improvement
of the Electrical Isotropy of Composite Structures

Improvement of the Electrical Isotropy of Composite
Structures—Overview
Sonia Flórez, Idoia Gaztelumendi and Jorge Gayoso

Fabrication of Carbon Nanotubes-Doped Veils
Paulina Latko and Anna Boczkowska

Finite Element Modelling of CNT-Doped CFRP Plates
for Lightning Strike Damage
Omer Soykasap, Sukru Karakaya, Yelda Akcin and Mehmet Colakoglu

Metallic Strip Details for Validation of ESN Technologies
Richard Perraud, Olivier Urrea, Thierry Pelegrin,
Michel Bermudez, Michel Fouquembergh, Stephane Guinard
and Christoph Breu
Part XI  Technology Stream: Integration and Validation.
Implementation of Morphing, Structural Health Monitoring and Nanomaterials on an Outer Wing Box

Morphing Value Assessment on Overall Aircraft Level .......................... 859
Fabian Peter, Eike Stumpf, Giovanni Marco Carossa, Markus Kintscher, Ignazio Dimino, Antonio Concilio, Rosario Pecora and Andreas Wildschek

Implementation of Morphing, Structural Health Monitoring and Nanomaterials on an Outer Wing Box .......................... 873
Giovanni Marco Carossa, Michelangelo Giuliani, Alan Johnston, Christina Altkvist, Alessandro Airoldi, Zahra Sharif Khodaei and M.H. Aliabadi

Implementation of a Structural Health Monitoring System for a Composite Wing Box Skin .................................................. 883
Alessandro Marzani, Nicola Testoni, Luca De Marchi, Ernesto Monaco, Zahra Sharif Khodaei, M.H. Aliabadi and Julio Viana

Value at Risk for a Guided Waves-Based System Devoted to Damage Detection in Composite Aerostructures .......................... 909
Luca De Marchi, Alessandro Marzani, Nicola Testoni, Ulrike Heckenberger and Alfonso Apicella

Part XII  Technology Stream: Integration and Validation.
Fuselage Assembly, Integration and Testing

Fuselage Demonstrators: An Overview of the Development Approach ................................................................. 921
Ben Newman

Development of a Door Surround Structure with Integrated Structural Health Monitoring System ............................................ 935
Daniel Schmidt, Andreas Kolbe, Robert Kaps, Peter Wierach, Stefan Linke, Stefan Steeger, Friedrich von Dungern, Juergen Tauchner, Christoph Breu and Ben Newman

Damage Introduction, Detection, and Assessment at CFRP Door Surrounding Panel ..................................................... 947
Martin Bach, Nicolas Dobmann and Maria Moix-Bonet
Installation of Metallic Strip on CRFP Frames: Assessment of IS13 Mechanical and Electrical Performance
Richard Perraud, Olivier Urrea, Thierry Pelegrin, Michel Bermudez, Stephane Guinard and Christoph Breu

Benefit Analysis Value and Risk Assessment of New SARISTU-Technologies
Sevgi Batal and Stephane du Rand

Manufacturing of Nano-treated Lower Panel Demonstrators for Aircraft Fuselage
Feride Nur Sasal, Aysun Dogangun Akın, Ayhan Kılıç, Guray Erteği, Caglayan Duygu, Emre İşler, Ben Newman, Christos Koimtzoglou, Panagiotis Maroulas, Patrick Bara, Antonios Vavouliotis, George Sotiriadis and Vassilis Kostopoulos

Design and Manufacturing of WP135 Side Panel for Validation of Electrical Structure Network (ESN) Technologies
Christina Altkvist, Jonas Wahlbäck, Juergen Tauchner and Christoph Breu
Smart Intelligent Aircraft Structures (SARISTU)  
Proceedings of the Final Project Conference  
Wölken, P.C.; Papadopoulos, M. (Eds.)  
2016, XXVIII, 1039 p. 865 illus., 774 illus. in color.  
Hardcover  
ISBN: 978-3-319-22412-1