



44th European Rotorcraft Forum

GENERAL INFORMATION AND PROGRAMME

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DELFT - THE NETHERLANDS

18-21 SEPTEMBER 2018



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DELFT - THE NETHERLANDS 18-21 SEPTEMBER 2018

Welcome at the European Rotorcraft Forum in Delft!

It is a great pleasure to welcome you to the 44th ERF on behalf of the International Committee and our national partners. Like the seven previous events in the Netherlands, again this year's forum is hosted by the Netherlands Association of Aeronautical Engineers (NVvL) as a member of the Council of European Aerospace Societies CEAS and with great support and contributions from the Netherlands Aerospace Centre (NLR) and the Delft University of Technology (TU Delft).



I'm glad that distinguished guests and more than 130 speakers are willing to share their views with you. We will offer you an attractive conference program with high quality papers on relevant topics, the latest developments, innovative concepts and smart technical solutions to the challenges of our sector. The importance of safety for rotary wing operations will be explicitly addressed during the Helicopter Safety Workshop, in association with the European Safety Promotion Network Rotorcraft ESPN-R, on the third conference day.

I'm sure the forum at the university campus will provide you with the opportunity to broaden your network of contacts, share best practices and exchange your experiences with others during this premier event of the European rotorcraft community. Information about the event and practical matters can be found on the conference website (www.erf2018.org).

Welcome at the 44th European Rotorcraft Forum and enjoy your stay in the beautiful city of Delft!

Christophe Hermans, Chairman of the local organizing committee and president of the Netherlands Association of Aeronautical Engineers NVvL

About ERF

The European Rotorcraft Forum is one of the premier events in the rotorcraft community's calendar bringing together manufacturers, research centres, academia, operators and regulatory agencies to discuss advances in research, development, design, manufacturing, testing and operation of rotorcraft. The Forum takes place annually across Europe, rotating around the United Kingdom, Germany, France, Italy, the Netherlands and Russia. The first ERF was held in Southampton, England, in 1975.

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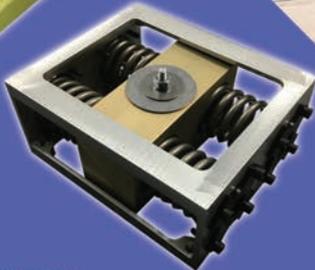
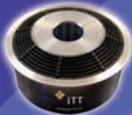
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Venue

City of Delft

Delft has a lot to offer! The city is well-known for its ties with the Dutch Royal family (tombs of William of Orange and members of the Royal family) and the famous painter Vermeer. Delft is also world renowned for its Delft Blue earthenware and its lovely canals. Delft has a pleasant, well-preserved, lively historical centre, with characteristic canals, ancient merchant houses, old churches and the splendid city hall. Delft is more than 750 years old. The city owes its name to the word 'delving', digging the oldest canal, the Oude Delft. In 1246, Delft received its city franchise from the Dutch Earl Willem II. Delft is nicknamed 'de Prinsenstad' (the Prince's City), because William of Orange, the first in the Dutch royal line, held court in Delft in the 16th century. In 1842 the Royal Academy for Civil Engineers was founded. The Academy used the building vacated by the artillery school. The Academy of then is the TUDelft of today, which is also the largest employer in Delft.

TU-Delft University

Daily, about 27.000 people travel across our campus: students, scientists, visitors, and employees of the university and the companies on campus. Stretching over 161 hectares, the campus is larger than downtown Delft, and one of the largest university campuses in the world. The campus has been equipped with an extensive bicycle and pedestrian road network. The TU Delft campus has a green, parky character. Large parts of the campus are therefore only accessible on foot, by bike, or public transport. For motorists there is the campus ring road, which circles the entire campus. Clear signage on the campus ring guides you easily to the central parking lots. From there, every destination is reachable on foot.



Keynote speakers

The committee is proud to introduce seven professionals from the world of aeronautics which will deliver the Keynote address at this symposium. The Keynote speakers at the 44th European Rotorcraft Forum are:

The Clean Sky 2 Fast Rotorcraft Initiatives: where are we today and where to next?

The Airbus Helicopter's RACER compound helicopter and the Leonardo Helicopter Division's NEXTGEN CIVIL TILTROTOR initiatives are breaking new ground in taking new technology and innovative solutions towards the stage of flight demonstration under their co-funded projects through the Clean Sky 2 Joint Undertaking [as part of the EU's Horizon 2020 Framework Programme for Research and Innovation].

These two innovative flying vehicle configurations will bridge the gap in performance [payload, range and speed] between traditional helicopter configurations and fixed wing alternatives: bringing superior mobility solutions to some key markets served by the current rotorcraft fleet, but also potentially opening up entirely new markets looking for the marriage of VTOL capability and the cruise performance of a fixed wing aircraft.

In this update the progress so far will be shown, highlighting some key technical challenges and the innovative approaches the teams working with the two lead manufacturers are implementing. Some thoughts on new steps beyond this new State of the Art, possibly under renewed collaboration in the next Framework Programme will be given and the forum is welcomed to engage in an exchange of ideas.



Ron van Manen (Clean Sky JU)

graduated at the TU Delft - Aerospace Engineering in 1987 and started his career at KLM Engineering & Maintenance before joining British Airways in a senior manager role. In 1998 he returned to KLM E&M as VP Business Development and in 2003 he joined QinetiQ in the UK as Programme Director Civil Aeronautics directing its contract research and development projects with industry, UK Government and EU, including several assignments in support of UK government transport, climate, science and technology policy. In 2008 he was appointed MD Aerospace Consulting, spanning QinetiQ's research, engineering and test services in aeronautics. In 2011 he joined the Clean Sky JU as Technology Evaluation Officer. In 2012 he was tasked with coordinating the preparation of the Clean Sky 2 Programme: the largest aeronautics research programme ever launched and now running under H2020; involving €4bn of total investment. In September 2013, he was appointed Programme Manager [acting] for Clean Sky 2, to coordinate the Programme's successful launch, a position that was confirmed in October 2014 after the formal launch of the Programme.

Training enhancement for the Defence Helicopter Command – The power of visionary needs analysis

For a helicopter training organisation there is always a challenge to ensure its Flight- and Aircrew is trained efficiently and effectively, using optimal training media in an affordable manner. Military training organisations not only train for safe and efficient operations, but also for combat readiness. Military helicopter operations abroad lead to highly experienced Flight- and Aircrew for a small set of operations and conditions, but they may not be able to maintain full combat readiness. The Defence Helicopter Command (DHC) of the Royal Netherlands Air Force (RNLAf) is in the process of a major training system revision, including the acquisition of simulators. This presentation provides an overview of the key ingredients for the approach implemented, which was developed by NLR in cooperation with DHC and JIVC (Joint Command Information management).

Blueprints for idealised qualification training (initial qualification, mission qualification) and currency training are defined, applying modern instructional principles, as far as accepted by the Flight- and Aircrew community. The idealised syllabus initially does not even consider whether a training sortie should be live or simulated.

Maj. Roland Blankenspoor, Defence Helicopter Command, Royal Netherlands Air Force, started his military career in 1990 in Breda. He became a Platoon Commander in the 11th

Air Mobile Brigade. In 1997 he started his flying career with the Air Force. He was trained to become an Apache Pilot. After deployments to Djibouti (2), Afghanistan (6) and recently Mali (1) Major Blankenspoor is now Head of Crew Training and Simulation in the Dutch Defence Helicopter Command based at Gilze-Rijen Airbase. With a total of more than 4000 flying hours, being Flight Instructor and Weapons Instructor Roland is one of the most experienced helicopter pilots of the Royal Netherlands Air Force.



Anneke Nabben has fifteen years of experience in instructional design and research in aviation. Anneke has a Master of Educational Science and worked for KLM and Airbus before she joined NLR in 2010. As senior training expert she is responsible for a variety of projects for civil and military aviation organizations related to training needs analysis, training concept design, training development and enhanced use of training media, including selection and development these media.



Aviation challenges for the Global Energy Market

This presentation is about the challenges to support and enable Shell's current and future operations through safe, secure and efficient aviation solutions in a competitive environment. Our aim is to enable sustainable, routine and reliable aircraft operations, whilst capable of adopting new technology for business advantage. This requires amongst others engagements and collaboration within the wider aviation industry to enable future growth prospects, well-considered aircraft certification standards, and robust Safety Management Systems with effective learning from incidents.

Shell's commercial airline exposure is approximately 558,000 passenger flights in an industry that is regulated by the highest standards. However, Shell's contracted aircraft do not enjoy the same regulatory protection as airlines with significant national variation and regulatory gaps. A significant higher overall Global Energy Market accident rate for helicopters reflects this difference. Continuous improvements are required for the prevention of accidents through improved helicopter design, enhanced operations procedures, and aspects of training and maintenance.



Tony Cramp was appointed as Shell's VP Aircraft and Managing Director Shell Aircraft in May 2016. With Shell since in 2003, he has global experience in working with aircraft

operators supporting oil and gas operations, undertaking assurance, air accident investigations and providing specialist advice to Shell's extensive business stakeholder group. Championing initiatives to enable safe and efficient operations in some of the most diverse and challenging environments, he has worked closely with OEMs on aircraft design specifications and represents the Company on several industry and national regulatory bodies. Prior to joining Shell, he served 19yrs in the Royal Navy as a helicopter pilot and instructor, commanded a Naval Air Squadron and a Warship and served as the media spokesman for overseas military operations

Alrik Hoencamp

works as Advisor Air Transport Safety for Shell Aircraft. With Shell since in 2015, he has global experience in working with aircraft operators supporting oil



and gas operations, undertaking assurance, air accident investigations and Remotely Piloted Aircraft Systems (RPAS). He graduated from the Empire Test Pilots' School as Flight Test Engineer, holds a PhD in aerospace engineering from Delft University of Technology and has extensive experience in helicopter flight testing and certification of synthetic training devices, including Helicopter-Ship Qualification Testing. Alrik is a member of the Vertical Flight Society (since 2007).

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The Electric VTOL Revolution

More than 100 electric vertical take-off and landing (eVTOL) announced concepts are being studied around the world, with several advanced prototypes already conducting impressive passenger-carrying flights. Companies like Uber, Airbus, Bell, Joby and Kitty Hawk are competing to develop the hardware, software and regulatory framework to provide all-electric intra-city air shuttle services at very low cost and low noises, with zero tailpipe emissions within the next 5-10 years. In addition, hybrid-electric VTOL aircraft designs promise larger payloads, longer-range and higher cruise speeds. This presentation will discuss the promise and progress of electric VTOL aircraft.

Mike Hirschberg

assumed the duties of the Vertical Flight Society Executive Director on June 1, 2011, after 20 years in the aerospace industry, primarily in vertical flight. As the Executive Director, he is responsible for the execution of the strategic direction set by the Vertical Flight Society Board of Directors. Mr. Hirschberg was previously a principal aerospace engineer with CENTRA Technology, Inc., providing technical and program management support for over 10 years to the Defense Advanced Research Projects Agency (DARPA) and Office of Naval Research (ONR) on advanced aircraft and rotorcraft concepts. Prior to this, Mr. Hirschberg worked from 1994 to 2001 in the Joint Strike Fighter (JSF) Program Office, supporting the



development of the X-32 and X-35 vertical flight propulsion systems. Mr. Hirschberg holds a B.S. in Aerospace Engineering from the University of Virginia (1991) and a M.E. Mechanical Engineering from Catholic University of America (1996). He completed a Master of Business Administration at the Virginia Polytechnic Institute & State University (Virginia Tech) in 2013.

EASA Rotorcraft Safety Strategy

European Helicopter industry is facing one accident per week and one fatal accident per month. The trend is not significantly improving over the last 10 years. In a more visible and connected world, this level of accident is not sustainable anymore. EASA has launched an initiative to develop a rotorcraft safety strategy aiming at reducing the number of accident by 50% in the next 10 year. This strategy will not only focus on Airworthiness, but will try to tackle some key areas such as Safety Culture, Operations, Airmanship, Training and technology. Within this last pillar, research can play a leading role in improving helicopter safety. Key aspect of the rotorcraft safety strategy will be highlighted and presented during this key note speech.

David Solar started his career in Dassault Aviation as a development engineer on the F7X program. He was appointed as Falcon Customer Technical Manager addressing round the clock customer support of the Dassault Civil fleet from the Falcon 10 to the Falcon 900EX



Easy. He joined EASA in 2006 as a Large Transport Aircraft Project Certification Manager. He lead projects such as 777F, 787, A380, MRJ and A400M among others. In 2012, he was appointed Large Transport Aircraft Section Manager and Deputy Head of Large Transport Department. In September 2017, he was nominated as Acting Head of Rotorcraft Department.

The danger of speed instability below minimum power; A forgotten problem ?

Flying at low speed on the approach, both rotary and fixed-wing aircraft are susceptible to speed instability. Below minimum drag (or power depending on the type of propulsion), while the natural dynamics (e.g. phugoid mode) might be stable, when a pilot or an automatic system controls the vertical flight path with elevator or cyclic, the dynamics change and a new, speed, mode emerges that can be driven unstable by increasing pilot gain. This 'problem' was discovered on fixed-wing aircraft in the first decade of aviation but theory to predict its behaviour, and explain the underlying physics, came much later. The theory was extended to rotorcraft by the author. Nevertheless, accidents continue to occur all too frequently because of this adverse aircraft-pilot- coupling (APC); to the point where it seems appropriate to question whether pilot training properly addresses the risk to safety associated with this dangerous problem. The presentation will describe the theory for this APC and examine three accidents that involved speed instability on the approach; one involving a fixed-wing aircraft, the other two involving helicopters. A question arises from this as to whether the pilot community has a proper grasp of the fundamental

aeronautical science behind this APC? It is hoped that the presentation will stimulate discussion around this question.



The wonder of flight led **Gareth Padfield** to study aeronautical engineering at the University of London, later learn to fly both aeroplanes and helicopters and gain a PhD in flight

dynamics at Cranfield College of Aeronautics. His career has been spent in the aviation industry, government research and in academia and has involved all aspects of flight dynamics - flight testing, modelling and simulation, flying qualities and flight control. He has held senior management and leadership roles in Government service (Chief Rotorcraft Scientist, DERA) and Academia (Head of School of Engineering, Liverpool). Gareth is research-active in his current role as Emeritus Professor of Aerospace Engineering at The University of Liverpool where he also supports staff and students in their endeavours. He operates a consultancy company, Flight Stability and Control, undertaking a variety of specialist projects for the aviation industry, and has delivered short courses in Europe, North America and Asia. Gareth is a Chartered Engineer, a Fellow of the Royal Academy of Engineering and the Royal Aeronautical Society. He is an honorary member of the American Helicopter Society's Modelling and Simulation and Handling Qualities Technical Committees and he has served on the UK's Defence Scientific Advisory Council.

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Conference proceedings

You can download the complete conference proceedings in a Zip file at www.ERF2018.org.
The username and password to access the file will be provided at the conference.

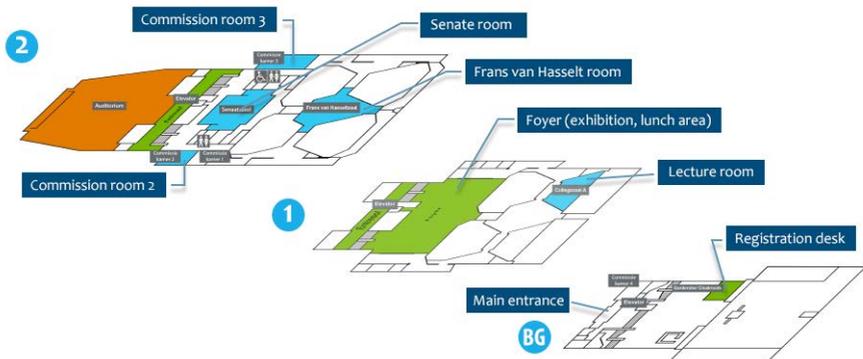
Publication Policy

Papers shall be unclassified for public release and be cleared by the appropriate company and/or government agency if necessary.

All papers accepted for presentation at the ERF will be published and distributed in electronic form. Proceedings will appear for free download and readership rights on the Rotorcraft (www.rotorcraft-forum.eu) and Aerospace Europe platforms (<https://aerospace-europe.eu/>), 2 years after the conference date.

Authors of ERF papers will be offered the opportunity to publish the results of their research in the CEAS Aeronautical Journal (<https://www.editorialmanager.com/can/j/default.aspx>). Authors are free to choose Springer's Open Choice Option to publish their papers with Open Access.

Location Conference Rooms



Forum Registration

To apply for registration please go to www.erf2018.org/registration

Registration at the TU Delft – Aula Conference Centre is opened at:

- Monday September 17th : 14:00-17:00 hr.
- Tuesday September 18th : from 7:30 hr.
- Wednesday & Thursday September 19th & 20th : from 8:00 hr.

Programme at a glance

Day 1 - Tuesday September 18th					
Auditorium					
9:00	Welcome and Opening Speeches Keynote presentation by Clean Sky JU on Fast Rotorcraft Program				
10:30	<i>Coffee break</i>				
11:00	Keynote presentations by GKN-Fokker, Defence Helicopter Command and SHELL Aircraft				
12:30	<i>Networking Lunch</i>				
13:30-15:30	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aero-dynamics I	Flight Mechanics I	Unmanned Rotorcraft I	Dynamics I	Test & Evaluation I
15:30	<i>Coffee break</i>				
16:00-17:30	Aero-dynamics II	Flight Mechanics II	Unmanned Rotorcraft II	Dynamics II	Test & Evaluation II
19:00	<i>Welcome reception at Prinsenhof Delft. A guided city walking tour towards the reception departs 17:45 from TU Delft Conference Centre</i>				

Day 2 - Wednesday September 19th					
9:00-10:30	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aero-dynamics III	Flight Mechanics III	Engine and Propulsion I	Dynamics III	Acoustics I
10:30	<i>Coffee break</i>				
Lecture Room					
11:00	“The Electric VTOL Revolution” by Mr. Mike Hirschberg (Executive Director AHS–The Vertical Flight Society)				
11:30	AHS Best Paper Award; “Avoiding Obstacles during Approach: DVE-Mitigation Flight Trials and Beyond” by Mr. Michael Zimmermann (DLR)				
12:00	ARF Best Paper Award; “A Study of Rotor/Wing Aerodynamic Interaction at High Speed Flight on a Compound Helicopter” by Mr. Hideaki Sugawara (JAXA)				
12:30	<i>Networking Lunch</i>				

Day 2 - Wednesday September 19th					
	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
13:30-15:30	Aero-dynamics IV	Flight Mechanics IV	Engine and Propulsion II	Operational aspects	Crew Station Human Factors
15:30	Coffee break				
16:00-17:30	Aero-dynamics V	Aircraft Design I	Unmanned Rotorcraft III	Simulation and training I	HUMS & Maintenance
19:00	Conference dinner at paddle steamer 'De Majesteit' (Bus departs 18:00 from TU Delft conference centre)				

Day 3 - Thursday September 20th					
	Lecture Room				
9:00	Opening of the Safety workshop				
9:10	Keynote presentation on Rotorcraft Safety Strategy by EASA				
9:50	Emeritus Professor Gareth Padfield "The Danger of speed instability below minimum power; a forgotten problem?"				
10:30	Coffee break				
	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
11:00-12:30	Aero-dynamics VI	Safety Workshop	Systems, Avionics & sensors	Simulation & training II	Acoustics II
12:30	Networking Lunch				
13:30-15:30	Aero-dynamics VII	Safety Workshop	Aircraft Design II	Simulation & training III	Structures & Materials
15:30	Coffee break				
16:00-17:30	Aero-dynamics VIII	Safety Workshop	Aircraft Design III	Flight Mechanics V	Test & Evaluation III

Day 4 - Friday September 21st	
8:30-15:00	Technical tour to Fokker-GKN Aerostructures or LC Woensdrecht (National Defence helicopter maintenance and supply centre)

Detailed presentation and activity schedule

Day 1 - Tuesday September 18th

Auditorium					
9:00	Welcome and Opening Speeches Keynote presentation by “The Clean Sky 2 Fast Rotorcraft Initiatives: where are we today and where to next?” by Ron van Manen (Clean Sky JU)				
10:30	Coffee break				
11:00	Keynote presentations by “GKN Fokker: From Past to Future Vertical Lift” by Peter Kortbeek (GKN-Fokker), “Training enhancement for the Defence Helicopter Command – The power of visionary needs analysis” by Maj. Roland Blankenspoor (DHC, RNAF) & Anneke Nabben (NLR) and “Aviation challenges for the Global Energy Market” by Tony Cramp & Alrik Hoencamp (SHELL Aircraft)				
12:30	Networking Lunch				
	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aerodynamics I Philippe Beaumier	Flight Mechanics I Marilena Pavel	Unmanned Rotorcraft I Richard Markiewicz	Dynamics I Pierangelo Masarati	Test & Evaluation I Klausdieter Pahlke
13:30	23 A Hybrid Navier-Stokes/ Viscous Vortex Particle Methodology for Modeling Maneuver Loads Sankar Lakshmi (Georgia Institute of Technology, USA)	108 Progress in the development of a time- to-contact autorotation cueing system Michael Jump (University of Liverpool, UK)	5 Impact scenarios for collisions with unmanned aerial vehicles and their consequences to rotorcraft Florian Franke (Tech Hochschule Ingolstadt, Germany)	49 Evaluation of a Slung Load Control System for Piloted Cargo Operations Daniel Benjamin Nonnenmacher (DLR, Germany)	
14:00	40 Aerodynamics of Single and Multiple Rotors Hovering Inside a Square Tunnel Yasutada Tanabe (JAXA, Japan)	25 Complementary Use of Black-Box and Physics- Based Techniques in Rotorcraft System Identification Susanne Seher-Weiss (DLR - Flight Systems, Germany)	59 Design space analysis of an autonomous aerial crane VTOL concept with a detachable airship envelope Yu Ito (Yamato Holdings Co., Ltd., Japan)	14 An extensive helicopter Ground Vibration Test: from pretest analysis to the study of non-linearities Christopher Ciavarella (Airbus Helicopters GmbH, Germany)	86 Measurement of Transient Blade Passage Loads in a Coaxial Counter-Rotating Rotor in hover Daiju Uehara (The University of Texas at Austin, USA)
14:30	96 Assessing different blade designs in hover and forward flight Thomas Fitzgibbon (University of Glasgow, UK)	20 Height-Velocity Diagram Analysis of a Variable Speed Rotor Helicopter Renliang Chen (Nanjing University, China)	51 The Tilt-Quadrotor: Modelling and Attitude Stabilization Ricardo Marques (Inst Superior Técnico, Uni Lisboa, Portugal)	41 Vibration Reduction Analyses using Individual Blade Pitch Controls for Lift-offset Rotors Jae-Sang Park (Chungnam National University, South Korea)	165 Measurement of rotorblade structural dynamics Simone Weber (Airbus Helicopters/ Cranfield University, UK)
15:00	47 Rotor Airfoil Aerodynamic Design Method and Test Verification Long He (CARDC, China)	10 Real Time Flight Dynamics Model Identification of Tilt-Rotor Aircraft Wei Wu (Nanjing University, China)		100 Human biodynamic models for rotorcraft comfort assessment Aykut Tamer (Politecnico Di Milano, Italy)	57 Helicopter Engine Air Intake Icing Wind Tunnel Certification Test Karel Lammers (NLR, Netherlands)
15:30	Coffee break				

Day 1 - Tuesday September 18th

	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aerodynamics II Philippe Beaumier	Flight Mechanics II Marilena Pavel	Unmanned Rotorcraft II Richard Markiewicz	Dynamics II Pierangelo Masarati	Test & Evaluation II Klausdieter Pahlke
16:00	56 Investigation on Loss of Tail-rotor Effectiveness of Helicopter with Ducted Fan Tail Rotor Nahyeon Roh (Pusan National University, South Korea)	39 Low Order Aeromechanics of Tilt-Rotor Helicopters Wesley Appleton (University of Manchester, UK)	18 A Physics-Based Approach to Urban Air Mobility Patricia Ventura Diaz (NASA Ames Research Center, USA)	69 Simulation of Active Flow Control Actuator Using CFD with Application to Rotor Blade Vibration Reduction Ryan Patterson (University of Michigan, USA)	107 Optimisation of differential infrared thermography for unsteady boundary layer transition measurement Christian Wolf (DLR, Germany)
16:30	66 Aerodynamic and Flight Mechanics Analysis of Airbus Helicopter's Compound Helicopter RACER in Hover under Crosswind Jakob Thiemeier (Universität Stuttgart, Germany)	30 Identification and Selection of Rotorcraft Candidate Models to Predict Handling Qualities and Dynamic Stability Johannes Wartmann (DLR, Germany)	143 Development of an Automatic System for Helicopter Approach to a Moving Vessel Sebastian Topczewski Warsaw University of Technology	16 Drivetrain Influence on the Lead-Lag Modes of Hingeless Helicopter Rotors Felix Armin Weiss (DLR, Germany)	168 Tracking dynamically scaled separating objects during a helicopter wind tunnel test Anton de Bruin (NLR, Netherlands)
17:00	98 An Experimental Investigation of Hub Drag Characteristic on Coaxial Rigid Rotor Aircraft Min Tang (CARDC, China)	53 Extensive analysis of hardover and trim-runaway failures on t1uh mathematical model based on cs-29 requirements Dogan Yildiz (TAI, Turkey)	178 The conceptual design of an auto-rotary mono-wing decelerators based on Maple seeds as an entry-decent-landing system for Mars explorations Sepehr Sangina (TU-Clausthal, Germany)	21 Helicopter vibrations: a major comfort improvement through seat sarib implementation Julien Guitton (Airbus Helicoptes, France)	174 Actively controlled trailing edge flaps with electromechanical actuation M.I. Myasnikov (Mil Moscow Helicopter Plant, Russia)
19:00	<p>Welcome reception at Prinsenhof (Sint Agathaplein 1, Delft) A guided city walking tour towards the reception departs 17:45 from TU Delft Conference Centre</p>				

Day 2 - Wednesday September 19th

	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aerodynamics III Klausdieter Pahlke	Flight Mechanics III Przemyslaw Bibik	Engine and Propulsion I Philippe Beaumier	Dynamic III Ruslan Mirgazov	Acoustics I Rainer Heger
9:00	13 Aerodynamic Investigation of Rotor / Propeller Interactions on a Fast Rotorcraft Ronan Boisard (ONERA, France)	161 Rotorcraft-pilot couplings: analysis and detection in a safety enhancement framework Simone Fasiello and Ying Yu (Politecnico di Milano, Italy)	33 Flight Testing and Analysis of Gas Turbine Engine Performance- A Multivariable Approach Ilan Arush (National Test Pilot School, USA)	144 Mixed-Sensitivity H_∞ On-Blade Control Jahaz Alotaibi (University of Leicester, UK)	77 Aero-acoustic analysis with a permeable surface for tip-jet rotor noise characterisation in hovering flight Kiro Kim (KonKuk University, South-Korea)
9:30	89 Experimental and numerical aerodynamic investigation of advanced tail boom designs based on optimised thick airfoil profiles Guillaume Legras (Airbus Helicopters, France)	118 Wind turbine wakes and helicopter operations. Overview of the Garteur HC-AG23 activities Richard Bakker (NLR, Netherlands)	38 Low Order Multidisciplinary Optimisation of Counter-Rotating Open Rotors Dale Smith (University of Manchester, UK)	84 Experimental Research on Whirl Flutter of Tiltrotor Aircraft Linghua Dong (Nanjing University, China)	50 The development of a European helicopter noise model Marthijn Tuinstra (NLR, Netherlands)
10:00	91 Numerical-Experimental Correlation of Rotor Flowfield in Ground Effect Claudio Pasquali (Roma Tre University, Italy)	36 Numerical investigations of the aerodynamics and handling qualities of a helicopter flying across a wind turbine wake Antonio Visingardi (CIRA, Italy)	113 An examination of hydrogen fuel cells and lithium-ion batteries for electric vertical take-off and landing (EVTOL) aircraft Wanyi Ng (University of Maryland, USA)		71 Design of a generic rotor noise source for helicopter fuselage scattering tests Jianping Yin (DLR, Germany)
10:30	Coffee break				
	Lecture Room				
11:00	"The Electric VTOL Revolution" by Mr. Mike Hirschberg (Executive Director AHS—The Vertical Flight Society)				
11:30	AHS Best Paper Award; "Avoiding Obstacles during Approach: DVE-Mitigation Flight Trials and Beyond" by Mr. Michael Zimmermann (DLR)				
12:00	ARF Best Paper Award; "A Study of Rotor/Wing Aerodynamic Interaction at High Speed Flight on a Compound Helicopter" by Mr. Hideaki Sugawara (JAXA)				
12:30	Networking Lunch				
	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aerodynamics IV Alan Irwin	Flight Mechanics IV Przemyslaw Bibik	Engine and Propulsion II Richard Markiewicz	Operational aspects Alrik Hoencamp	Crew Station & Human Factors Antoine de Reus
13:30	35 Experimental studies of non-stationary aerodynamic characteristics of a helicopter profile oscillating over the angle of the pitch Ruslan Mirgazov (TsAGI, Russia)	68 Load limiting control design for rotating blade root pitch link load using higher harmonic LTI models J.V.R. Prasad (Georgia Institute of Technology, USA)	55 Dynamic Simulation of a Rotorcraft Hybrid Engine in Simcenter Amesim Ioannis Roumeliotis (Cranfield University, UK)	17 Master Minimum Equipment List (MMELE) / Engine Time Limited Dispatch (TLD) on Helicopter Matthias Hatzak (Airbus Helicopters Deutschland, Germany)	94 Isomorphic Spatial Visual-Auditory Displays for Operations in DVE for Obstacle avoidance Martine Godfroy-Cooper (San Jose State Uni/NASA ARC, USA)

Day 2 - Wednesday September 19th

	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aerodynamics IV Alan Irwin	Flight Mechanics IV Przemyslaw Bibik	Engine and Propulsion II Richard Markiewicz	Operational aspects Alikr Hoencamp	Crew Station & Human Factors Antoine de Reus
14:00	8 Orthogonal vortex-rotor interaction: impact on rotor controls, blade flapping, thrust and power Berend Van der Wall (DLR, Germany)	135 Reinforcement Learning Control for Helicopter Landing In Autorotation Kadircan Kopsa (Middle East Technical University, Turkey)	83 Simulation of a Compound-Split transmission for the UH-60 Pierre Paschinger (Zoerkler Gears, Austria)	67 Development and Validation of Physics Based Models for Ice Shedding Lakshmi Sankar (Georgia Institute of Technology, USA)	132 Skyflight Mobile: a service to enhance the Leonardo flying experience Susanna Maria De Bernardi (Leonardo Helicopters, Italy)
14:30	110 Investigation of a Helicopter Model Rotor Wake Interacting with a Cylindrical Sling Load Antonio Visingardi (CIRA, Italy)	99 Modeling and Control of Lift Offset Coaxial and Tiltrotor Rotorcraft Tom Berger (US Army Aviation Development, USA)	87 Performance Degradation Modelling of Rotorcraft Engines Operating in Brownout Conditions Matthew Ellis (University of Manchester, UK)	114 Determining a safe-distance guideline for helicopters near a wind turbine and wind park Richard Bakker (NLR, Netherlands)	133 Active Vibration Control for the Kazan ANSAT Bastian Kindereit (LORD Corporation, France)
15:00	117 Experimental Investigation of the Effects of Helicopter Rotor Tip Geometries on Aerodynamic Performance and Tip Vortex Sinem Uluocak (TAI, Turkey)	60 Estimation of Handling Quality Parameters of a Rotorcraft using Open-loop Linearized and Nonlinear Flight Dynamic Models Sakthivel Thangavel (Indian Institute of Technology, India)	155 Loss of Lubrication Test of Isotropic Superfinished AH-64 D (Apache) Engine Nose Gearbox Without Black Oxide Coating Lane Winkelmann (REM Surface Engineering, Inc, USA)	11 Shipboard Landing Period Based on Dynamic Rollover Risk Prediction Binh Dang Vu (ONERA, France)	
15:30	<i>Coffee break</i>				
	Aerodynamics V Alan Irwin	Aircraft Design I Rainer Heger	Unmanned Rotorcraft III Przemyslaw Bibik	Simulation and training I Pierangelo Masarati	HUMS & Maintenance Lex ten Have
16:00	28 Improved Mars Helicopter aerodynamic rotor model for comprehensive analyses Witold Koning (NASA Ames Research Center, USA)	26 Development of Improved Rotor Blade Tip Shape Using Multidisciplinary Design Analysis and Optimization Joonbae Lee (KAI, South Korea)	141 Simulation tools for UAV/OPV autorotation performance metrics evaluation Laurent Binet (ONERA, France)	145 Safety, quality and efficiency in flight data gathering Regine Pattermann (Reiser Simulation and Training, Germany)	3 A rugged fiber optics monitoring system for helicopter rotor blades Luigi Bottasso (Leonardo Helicopters, Italy)
16:30	15 Unsteady Aerodynamic Interaction between Rotor and Ground Obstacle Jianfeng Tan (Nanjing Tech University, China)	32 HOPLITE - A Conceptual Design Environment for Helicopters Incorporating Morphing Rotor Technology Kushagra Vidyarthi (Delft Uni of Technology, Netherlands)	104 Unified Framework for Analysis and Design Optimization of a Multirotor Unmanned Aerial Vehicle Daejin Lim (Seoul National University, South Korea)	45 Eigenmode distortion as a novel criterion for motion cueing fidelity in rotorcraft flight simulation Ivan Miletovic (Delft Uni of Technology, Netherlands)	22 Detecting Planetary Gear Bore Crack Wenyi Wang (Defence Science and Technology, Australia)
17:00		75 A Design-Centric Evaluation of Multi-Fidelity Aircraft Cost Modeling Approaches Rober Scott (US Army Aviation Development, USA)	175 Development of UAV rotor blades using RTM process Auke Jongbloed (KVE Composites, Netherlands)	125 Model Predictive Motion Cueing for a Helicopter Hover Task on an 8-DOF Serial Robot Simulator Frank Drop (Max Planck Institute, Germany)	119 Predictive Maintenance for Helicopter from Usage Data: Application to Main Gear Box Nassia Daouayry (Airbus Helicopters, France)
19:00	Conference dinner at paddle steamer 'De Majesteit' (Maasboulevard 100, Rotterdam) Bus departs 18:00 from TU Delft conference centre				

Day 3 - Thursday September 20th

Lecture Room					
9:00	Opening of the Safety workshop				
9:10	EASA Rotorcraft Safety Strategy by David Solar (EASA)				
9:50	The Danger of speed instability below minimum power; a forgotten problem? by emeritus Professor Gareth Padfield				
10:30	Coffee break				
	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aerodynamics VI Alan Irwin	Safety Workshop Joost Vreeken	Systems, Avionics & sensors Ivan Miletovic	Simulation and training II Jasper van de Vorst	Acoustics II Yves Delrieux
11:00	101 Higher-Order Simulations of Interactions Aerodynamics on Full Helicopter Configurations using a Hamiltonian Strand Approach Jannik Petermann (TU München, Germany)	200 Airbus Helicopters (AH) flight test safety management system	170 BladeSense – A novel approach for measuring dynamic helicopter rotor blade deformation Simone Weber (Airbus Helicopters/Cranfield University, UK)	70 Correlation of finite state multi-rotor dynamic inflow models with a high fidelity viscous vortex particle method J.V.R. Prasad (Georgia Institute of Technology, USA)	46 Towards a European helicopter noise calculation method Marthijn Tuinstra (NLR, Netherlands)
11:30	128 The Elevated Helipads – Study of Wind And Rotor Wash Influence for Most Common Configuration Types Adam Sieradzki (Instytut Lotnictwa, Poland)	Antoine van Gent (Airbus Helicopters, Germany) and Dominique Fournier (Airbus Helicopters, France)	42 Development of Integrated Avionics Functions for Enhanced Crew Situation Awareness in Civil Helicopter Missions Omkar Halbe (Airbus Helicopters Deutschland, Germany)	79 Effectiveness of a Computer-Based Helicopter Trainer for Initial Hover Training Paolo Francesco Scaramuzzino (Technical University of Delft)	92 Boundary integral formulations for noise scattered by helicopter fuselage Caterina Poggi (Roma Tre University, Italy)
12:00	150 Prediction of Unsteady Aerodynamic Loads and Wake Structure of Wind Turbine in Yawed Inflow Hakjin Lee (Korea Advanced Inst. of S&T, South Korea)	24 The potential of technologies to mitigate helicopter accident factors - status update and way forward Jos Stevens (NLR, Netherlands)	121 Research on Vision System for Degraded Visual Environment Kohei Funabiki (JAXA, Japan)	111 Investigation of Optic Flow, Time-to-Intercept, and Pilot Workload During Aggressive Approach-to-Hover Maneuvers Edward Bachelder (San Jose State University, USA)	116 Experimental and Numerical Investigation of Near-Field Rotor Aeroacoustics Robert Stepanov (Kazan Nat. Research Technical Uni, Russia)
12:30	Networking Lunch				
	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aerodynamics VII Harmen van der Ven	Safety Workshop Jos Stevens	Aircraft Design II Luca Medici	Simulation and training III Jasper van der Vorst	Structures & Materials Rainer Heger
13:30		19 New technologies to enhance rotorcraft crash safety Dr. Akif O. Bolukbasi (The Boeing Company, USA)	58 Probabilistic approach and inertial Tolerancing for H/C ramp-up in production Mathieu Krebs (Airbus Helicopters, France)	131 An Objective Assessment Tool (gOAT) for Helicopter Pilot's performance Antoni Kopyt (Warsaw University of Technology, Poland)	90 Automation of structural cross sectional rotor blade modeling for aero-mechanical rotor blade optimization Bram Van de Kamp (DLR, Germany)

Day 3 - Thursday September 20th

	Lecture Room	Senate Room	Frans van Hasselt Room	Commission Room 3	Commission Room 2
	Aerodynamics VII Harmen van der Ven	Safety Workshop Jos Stevens	Aircraft Design II Luca Medici	Simulation and training III Jasper van der Vorst	Structures & Materials Rainer Heger
14:00	140 Investigation on Hovering Rotors over Inclined Ground Planes – a Computational and Experimental Study Stefan Platzer (Technical University of Munich, Germany)	127 Cabin safety sensitivity to the mechanical parameters of the main crashworthy stages Paolo Astori (Politecnico di Milano, Italy)	81 Qualification and certification of Special Patrol Insertion & Extraction (SPIE) equipment for military helicopters Natalie Münningshoff (NLR, Netherlands)	138 Development of a civil light helicopter flight simulator for pilot training Urs Kazenmaier (Max Planck Institute, Germany)	43 Twist morphing of a hingeless rotor blade using a moving mass Mohammadreza Amoozgar (Swansea University, UK)
14:30	148 Implementation of aeroelastic capabilities in a LBM flow solver: application to a low-Reynolds rotor for micro-air vehicles Antonio Alguacil (ISAE-Supaero, France)	78 Rotorcraft loss of control in-flight - The need for research to support increased fidelity in flight training devices, including analogies Mark White (University of Liverpool, UK)	102 Conceptual Design Tradeoffs for Future Single Main Rotor Compound Helicopters Daniel Schrage (Georgia Tech, USA)	126 Initial Progress in Developing a Predictive Simulation Tool to Inform Helicopter Ship Operations Wajih Ahmed Memon (University of Liverpool, UK)	158 A Preprocessor for Parametric Composite Rotor Blade Cross-Sections Tobias Pflumm (Technische Universität München, Germany)
15:00	166 Application of Parametric Airfoil Design for Rotor Performance Improvement Joon Lim (US Army ADD, USA)	130 Embedding intelligent image processing algorithms: the new safety enhancer for helicopter missions Pierre Zoppitelli (Airbus Helicopters, France)	7 Dynamic extendable chord for improved helicopter rotor performance Dong Han (Nanjing University, China)		167 Vibration Fatigue Analysis of Horizontal Tail using Finite Element Method Vijaya Kumar Rayavarapu (RWRDC, HAL, India)
15:30	Coffee break				
	Aerodynamics VIII Harmen van der Ven	Safety Workshop Jos Stevens / Joost Vreeken	Aircraft Design III Luca Medici	Flight Mechanics V Marilena Pavel	Test & Evaluation III Ruslan Mirgazov
16:00	147 Studies on the influence of rotor distance on the efficiency of a coaxial rotor system Matthias Kränzler (Robert-Bosch, Germany)	120 Evaluation of rotor blade models for rotor outwash Umberto Morelli (CFD Laboratory School of Engineering, UK)	63 Universal geometric transformation method PGT for aircraft design Alexander Nikolsky (TsAGI, Russia)	156 Rotorcraft shipboard landing guidance using MPPI trajectory optimization J.V.R. Prasad (Georgia Institute of Technology, USA)	173 Some results of GARTEUR Action Group HC-AG 19 on Methods for Improvement of Structural Dynamic Finite Element Models Hans van Tongeren (NLR, Netherlands)
16:30	85 Experimental study of rotor and ship interference in the absence of ambient wind Jie Wu (CARD, China)	109 CFD analysis for the helicopter wake in ground effect Gianmarco Ducci (CFD Laboratory School of Engineering, UK)	105 Development of a Conceptual Design Tool for Various Compound Helicopters Donguk Lee (Seoul National University, South Korea)	106 A generic ground dynamics model for ground handling evaluations Kaan Sansal (TAI, Turkey)	172 Using Multibody Dynamics for the Stability Assessment of a new Double-Swept Rotor Blade Setup Jürgen Arnold (DLR, Germany)
17:00	159 Aerodynamic analysis of helicopter in interaction with wind turbine's wake Theologos Andronikos (National Technical Uni of Athens, Greece)	171 Assessment of the feasibility of an extended range helicopter operational standard for offshore flights Myles Morelli (Politecnico di Milano, Italy)	154 Dynamic Stall Model Optimization with CFD and Assessment with Comprehensive Approach for Improved Blade Design Arda Yucekayali (TAI, Turkey)		80 An experimental study on the hover performance characteristics of the coaxial propellers configuration for the Drone Deog-Kwan Kim (KARI, South Korea)

Technical tours

TU Delft - Aula Conference Centre, Mekelweg 5, 2628 CC Delft

Day 4 - Friday September 21st (optional)	
Technical tour to Logistic Centre Woensdecht (LCW)	
8:15	Assemble at the Conference Centre registration desk
8:30	Departure of the bus
11:00	Start of the tour
12:30	Lunch
13:00	Departure from LCW
14:00	Return at Delft
15:00	Arrival at Schiphol Airport

Day 4 - Friday September 21st (optional)	
Technical tour to Fokker / GKN	
8:15	Assemble at the Conference Centre registration desk
8:30	Departure of the bus
11:00	Start of the tour
12:30	Lunch
13:00	Departure from Fokker / GKN
14:00	Return at Delft
15:00	Arrival at Schiphol Airport



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March 4-8th 2019

NLR Amsterdam

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Info: nlr.org/capabilities/helicopter-ship-qualification-training

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The Vertical Flight Society's

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Discover the best of Holland

Discover the true story of Willem of Orange, get up close and personal with Johannes Vermeer, and see how the world-famous Delft Blue ceramics are made.



Delft, City of Delft Blue Pottery

Between 1600 and 1800, Delft was one of the foremost pottery producers in Europe as Delft Blue pottery was immensely popular. Only “De Koninklijke Porceleyne Fles”, known as “Royal Dutch”, has remained in operation since 1653 and still produces the Delft Blue pottery according to the traditional methods. Other locations in Delft where one can see the pottery are “De Delftse Pauw” and in the many souvenir shops around town.

Delft & the Royal House of Orange

The New Church contains the crypt where the members of the Dutch royal family, the house of Orange, have their final resting place.

Delft, City of Johannes Vermeer

Johannes Vermeer was born in Delft in 1632, he lived and painted all of his life in Delft until he died in 1675.

Information on Delft

Information on Delft (e.g. accommodations, shopping, eating & drinking, history of Delft) can be found on www.delft.com

Climate

The Netherlands share the temperate maritime climate common to much of Northern and Western Europe. The average day temperature in September is around 15 - 20° Celsius. An umbrella or rain coat for occasional showers may be useful.



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Electricity

The voltage in the Netherlands is 220-240V. USA, English and some other foreign appliances require an adapter for the voltage as well as an adapter for the plug.

Please bring your own adapter as there are no adapters available at the congress venue.

Currency and banking

The currency in the Netherlands is the Euro. In general, all major credit cards are accepted for payment in hotels, restaurants and shops. Most banks in Delft are open from 9.00 to 17.00 hours (Monday to Friday).

Opening hours shops

In the city center most shops are open 7 days a week. Opening hours: 09.30 until 18.00 hrs (Monday to Saturday); 12.00-17.00 hrs. (Sunday in the city center only). On Friday evening shops are open until 21.00 hrs.

Insurance

Delegates are advised to arrange adequate travel, health and other insurance before they leave their home country. The Forum does not cover participants against cancellations of bookings or loss/theft of belongings.

Passports and visa

All visitors travelling to the Netherlands must be in possession of a valid passport. Participants should check with their local travel agents whether they require an entry visa for the Netherlands.

Time zone

The Netherlands and Amsterdam are in the Central European Time Zone, one hour ahead of GMT.

Travel to ERF 2018

From Amsterdam Airport (by train)

Arriving at Amsterdam Airport, the Schiphol train station is located directly below the airport. Direct trains to Delft (final destination Vlissingen) leave every 30 minutes from platform 5-6. The journey by train will take approximately 39 minutes. A one-way journey will cost € 9,60 (full fare, 2nd class) and € 16,30 (full fare, 1st class)

Where to buy train tickets?

You can travel on NS (the Dutch Railways) with a single-use chip card that is available from the yellow ticket machines with the blue overhead sign reading 'train tickets'.

GENERAL INFORMATION AND PROGRAMME



You can find the ticket machines near the platforms at Schiphol Plaza. Tickets (for domestic and international travel) are also available at the Ticket- and Service desks at Schiphol Plaza.

When travelling with a single-use chip card, you need to check in at a check-in point before your journey, and to check out at a check-out point after your journey. For more information, please check the NS website.

From Rotterdam The Hague Airport (by bus and train)

Arriving at Rotterdam The Hague Airport there is no direct public transport to Delft. First take bus # 33 (direction Rotterdam Centraal, 20-25 minutes) to go to Rotterdam's central station. A one-way journey will cost € 1,70 for the bus (full fare). The buses stop right next to the departures hall.

Rotterdam central station has fast and regular railway connections to the city of Delft; almost every ten minutes trains to Delft leave from the platforms 8 or 9. A one-way journey will cost € 3,20 (full fare, 2nd class) or € 5,40 (full fare, 1st class) for the train.

The total journey from the airport to Delft station will take approximately 40-50 min.

Where to buy bus and train tickets?

On board of the bus you can purchase the bus ticket to the central station. At Rotterdam's central station you can purchase a single-use chip card from the yellow ticket machines with the blue overhead sign reading 'train tickets'.

Tickets (for domestic and international travel) are also available at the Ticket- and Service desks, which you can find in front of the luggage lockers and the toilets in the public area of the central station.

From Rotterdam The Hague Airport (by taxi)

You can also take a taxi to get to Delft. The taxi stand is located directly in front of the entrance/exit of the airport terminal. The fare to Delft (about 12 kilometers) will take 15-20 minutes (though not at rush hour traffic) and will cost approximately € 33.



Language

Conference language is English. Presentations and discussions are therefore in English. There will be no simultaneous translation during the session.

Welcome cocktail

Prinsenhof Delft

Sint Agathaplein 1
2611 HR Delft

i) <http://prinsenhof-delft.nl/en/>

Conference dinner

Paddle steamer 'De Majesteit'

Maasboulevard (next to nr. 100)
3063 NS Rotterdam



Hotel Accommodation

All hotel bookings must be arranged by participants themselves. We advise all delegates to book their hotels directly well in advance and referring to the specific hotel booking code: **ERF2018**. For more details see also: www.erf2018.org

Please note, the hotel rates are only applicable when reservations are made directly with the hotel.

	Hotel	Room price
1	Casa Julia	from € 80.00
2	Johannes Vermeer	from € 106.00
3	Hampshire Delft Centre	from € 106.00
4	Westcord Hotel	from € 129.00
5	Hotel de Plataan	from € 110.00

You can also use the following link to find hotel rooms:

www.preferredreservations.nl/erf-2018

More about these hotels and other hotels in Delft can be found on the website:

www.delft.com/planning-your-trip/stay

Venue

Delft University of Technology,
Aula Conference Centre,
Mekelweg 5, 2628 CC Delft

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Christophe Hermans (ERF 2018 Chairman)

Joost Hakkaart (ERF 2018 Deputy Chairman)