13TH EUROPEAN TURBOMACHINERY CONFERENCE
8-12 APRIL 2019 LAUSANNE SWITZERLAND
TURBOMACHINERY FLUID DYNAMICS AND THERMODYNAMICS

MONDAY 8TH APRIL 2019

08:00-10:00	REGISTRATION		
10:00-10:15	OPENING CEREMONY		
10:15-11:15	INVITED LECTURE **ETC2019-IL1** Advances in Radial Fluid Machinery Prof. Zoltan Spakovszky – *Director* – MIT Gas Turbine Lab Chair: Prof. J. Schiffmann – *EPFL*		
	A-01 AXIAL TURBINES (I)	B-01 FANS (I)	C-01 VIBRATION, FLUTTER, AERO-ELASTICITY (I)
	Chair: R. Niehuis – *Univ.* Munich	Chair: W. Sanz – *TU Graz*	Chair: P. Patrie-Repar – *KTH*
11:30-12:00	**ETC2019-251** Numerical study of wake effects on the boundary layer of a high lift turbine cascade at several strouhal numbers and flow coefficients A.Führing, D.Kožulovic – *University of Applied Sciences Hamburg (HAW), DE* *M.Franke* – MTU Aero Engines AG, DE	**ETC2019-265** Quasi 3D nacelle design to simulate crosswind flows: merits and challenges A.Yeung – *Department of Engineering, University of Cambridge, UK* *N.Vadlamani* – Indian Institute of Technology, Madras, IN T.Hynes – Department of Engineering, University of Cambridge, UK	**ETC2019-138** Analysis of nodal diameter zero blade vibrations of a radial turbine M.Wunderlich, A.Esper, M.Wirsum – *RWTH Aachen UniversityInstitute of Power Plant Technology, Steam and Gas Turbines, DE* *K.Buchmann* – Kompressorenbau Bannewitz GmbH, DE
12:00-12:30	**ETC2019-216** The LEMCOTEC 1½ Stage Film-Cooled HP Turbine: Design, Integration and Testing in the Oxford Turbine Research Facility P.F.Beard, M.G.Adams – *Oxford Thermofluids Institute, University of Oxford* *J.R.Nagawakar* – GKN Aerospace, SE M.R.Stokes – Rolls-Royce plc, UK F.Wallin – GKN Aerospace, SE D.N.Cardwell, T.Povey, K.S.Chana – Oxford Thermofluids Institute, Univ. of Oxford, UK	**ETC2019-440** Body force modeling of the aerodynamics of a low-speed fan under distorted inflow E.Benichou, G.Dufour, Y.Bousquet, N.Binder, A.Ortolan, X.Carbonneau – *ISAE-SUPAERO, Université de Toulouse, FR*	**ETC2019-370** Prediction of aerodynamically induced fan blade vibration due to boundary layer ingestion F.Eichner, J.Belz, P.Winkelmann, R.Schnell, T.Lengyel-Kampmann – *German Aerospace Center (DLR), DE*
12:30-13:00	**ETC2019-165** Effects of hub endwall geometry and rotor leading edge shape on performance of supersonic axial impulse turbine. Part II: Method validation and final results. A.Sebelev, M.Smirnov, A.Borovkov, N.Kuklina, G.Rakov – *Peter the Great Saint-Petersburg Polytechnic University, RU*	**ETC2019-152** On the validity of the axial momentum theory as applied to the uniformly-loaded propeller R.Bontempo, M.Manna – *Università degli Studi di Napoli Federico II, IT*	**ETC2019-016** Sensitivity of the aerodynamics damping coefficient prediction to the turbulence modelling conjugated with the vibration mode shape. P.Duquesne – *Université de Lyon, FR* *B.Mahieux* – Safran Aircraft Engines, FR S.Aubert, P.Ferrand – Université de Lyon, FR
13:00-14:30	Lunch	Lunch	Lunch
	A-02 HEAT TRANSFER AND BLADE COOLING (I)	B-02 RADIAL COMPRESSORS (I)	C-02 EXPERIMENTAL TECHNIQUES
	Chair: T. Verstraete – *VKI*	Chair: D. Brillert – *Univ.-Esse*	Chair: S. Lavagnoli – *VKI*
14:30-15:00	**ETC2019-008** Combined experimental and CFD investigation of flat plate film cooling through fan shaped holes S.Rouina, S.Ravelli, G.Barigozzi – *Università di Bergamo, IT*	**ETC2019-156** Operating range extension of an open impeller centrifugal compressor stage utilising 3D diffuser end wall contouring D.Hermann, M.Wirsum – *Institute of Power Plant Technology, Steam and Gas Turbines, RWTH Aachen University, DE* *D.Robinson, P.Jenny* – MAN Energy Solutions Schweiz AG, CH	**ETC2019-326** Focusing schlieren visualization of transonic turbine tip-leakage flows M.Passmann, S.aus der Wiesche – *University of Applied Sciences Muenster, DE* *F.Joos* – Helmut-Schmidt-University, DE

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	↕ A-02	↕ B-02	↕ C-02
15:00-15:30	**ETC2019-310** Effect of rotation and holes arrangement in cold bridge type impingement cooling systems L.Cocchi, A.Picchi, B.Facchini – *Università degli Studi di Firenze, DIEF, IT*	**ETC2019-038** Numerical investigation on the design of circumferential groove casing treatments in a radial compressor S.Bareiss, D.M.Vogt – *University of Stuttgart, Inst.* for Thermal Turbomachinery (ITSM), DE	**ETC2019-426** Technology development of Fast-Response Aerodynamic Pressure Probes P.Gaetani, G.Persico – *Politec.* di Milano, IT
15:30-16:00	**ETC2019-375** Heat transfer enhancement of impingement cooling by adopting circular-ribs or vortex generators in the wall jet region of a round impingement jet K.Takeishi – *Tokushima Bunri University, JP* *R.Krewinkel* – MAN Energy Solutions SE, DE Y.Oda – Kansai University, JP Y.Ichikawa – Mitsubishi Heavy Industries, JP	**ETC2019-304** Impact of large tip clearance ratios on the performance of a centrifugal compressor M.Diehl, J.A.Schiffmann – *LAMD of EPFL Lausanne, CH*	**ETC2019-253** Experimental investigation of moment coefficients in open rotor-stator disc systems A.Kuntze, S.Odenbach, W.Uffrecht – *Technische Universität Dresden, DE*
16:00-16:30	Coffee Break	Coffee Break	Coffee Break
	A-03 COMPRESSORS: NUMERICAL ANALYSIS	B-03 STEAM TURBINES	C-03 WIND TURBINES
	Chair: J. Boudet – *EC Lyon*	Chair: P. Doerffer – *Polish Academy of Sciences*	Chair: R. Bontempo – *Università di Napoli*
16:30-17:00	**ETC2019-190** Filtered geometry modelling for fan-intake interaction based on the immersed boundary method Y.Ma, P.Tucker – *Univ.* of Cambridge, UK	**ETC2019-350** Turbine cascades of last stage blades for wide range of operating conditions O.N .Bobčík – *Doosan Skoda Power, Ltd.,* CZ M.Luxa – Institute of Thermomechanics, CAS, v.v.i., CZ J.Fořt – CTU Prague, Faculty of MEchanical Engineering, CZ B.Rudas – Doosan Skoda Power, Ltd., CZ J.Synáč – University of West Bohemia, Faculty of Mechanical Engineering, CZ D.Simurda – Institute of Thermomechanics, CAS, v.v.i, CZ J.Fürst, J.Halama, V.Hric – CTU Prague, Faculty of Mechanical Engineering, CZ J.Příhoda – Institute of Thermomechanics, CAS, v.v.i, CZ	**ETC2019-234** Three-dimensional CFD simulation and experimental assessment of the performance of a H-shape VAWT at design and off-design conditions N.Franchina, O.Kouaissah – *Università degli Studi di Bergamo, IT* *G.Persico* – Politecnico di Milano, IT M.Savini – Univ. degli Studi di Bergamo, IT
17:00-17:30	**ETC2019-331** Coupled pressure based CFD solver for turbomachinery flows: overview of applications L.Mangani, E.Casartelli – *Hochschule Luzern, CH* *M.Darwish* – American Univ. of Beirut, LB	**ETC2019-135** Experimental investigation on performance of a control stage turbine under partial admission A.Berger – *Helmut Schmidt University, DE* *T.Polklas, O.Brunn* – MAN Energy Solutions SE, DE F.Joos – Helmut Schmidt University, DE	**ETC2019-188** Preliminary Design and performance estimation of self-rectifying turbines for application in the Channel Tunnel A.Baretter, A.C.Bayeul-Laine, A.Dazin – *Arts et Métiers PARISTECH, Laboratoire de Mécanique de Lille-Kampé de Fériet, FR*
17:30-18:00	**ETC2019-418** Influence of the numerical strategy on wall-resolved LES of a compressor cascade D.Papadogiannis, S.Mouriaux – *Safran Tech, FR* *J.S.Cagnone, K.Hillewaert* – CENAERO, BE F.Duchaine – CERFACS, FR S.Hiernaux – Safran Aero Boosters, BE	**ETC2019-153** *presentation moved to* Wednesday 10th April 2019 A-09 17:30-18:00	**ETC2019-174** Neural network topology for wind turbine analysis A.Gaymann – *Imperial College of London, UK* *G.Schiaffini* – Imperial College of London/ Universita' di Roma la Sapienza, UK M.Massini – UQuant F.Montomoli – Imperial College of London, UK A.Corsini – Univ. di Roma La Sapienza, IT
18:00-19:00	WELCOME RECEPTION		

TUESDAY 9TH APRIL 2019

08:30-09:30	INVITED LECTURE **ETC2019-IL2** Some perspectives in low pressure compressors design brought by emerging CFD technologies Dr Stéphane Hiernaux – *Senior Engineer Aerodynamics* – Safran Group Chair: Prof. G. Bois – *ENSAM*		
09:30-10:00	Coffee Break	Coffee Break	Coffee Break
	A-04 AXIAL COMPRESSORS (I)	B-04 DESIGN AND OPTIMISATION (I)	C-04 MODELLING OF PHYSICAL PHENOMENA (I)
	Chair: S. Hiernaux – *Safran SBE*	Chair: M. Ferlauto – *Univ Torino*	Chair: D. Vogt – *University of Stuttgart*
10:00-10:30	**ETC2019-202** 3D inverse problem solution used to redesign six-stage highly loaded high pressure compressor with the view of designed parameters achievement V.Mileshin, I.Orekhov, P.Kozhemyako, S.Shchipin – *Central Institute of Aviation Motors, RU*	**ETC2019-263** Gradient-free and gradient-based optimization of a radial turbine N.Lachenmaier – *MTU Friedrichshafen GmbH, DE* D.Baumgärtner – *Technical University of Munich, DE* H.Schiffer – *Technical University of Darmstadt, DE* J.Kech – *MTU Friedrichshafen GmbH, DE*	**ETC2019-327** Experimental and numerical investigation of CO2 dry-ice based aircraft compressor cleaning A.Rudek, D.Muckenhaupt, R.Kombeitz, T.Zitzmann, G.Russ – *Hochschule Darmstadt, Dept.* for Mechanical Engineering, DE B.Duignan – *Dublin Institute of Technology, School of Mechanical and Design Engineering, IE*
10:30-11:00	**ETC2019-178** Effect of manufacturing tolerance in flow past a compressor blade V.Suriyanarayanan, Q.Rendu, M.Vahdati, L.Salles – *Imperial College London, UK*	**ETC2019-048** Adjoint-based multi-point and multi-objective optimization of a turbocharger radial turbine L.Mueller, T.Verstraete – *Von Karman Institute for Fluid Dynamics , BE*	**ETC2019-037** Comparison of different models for determination of erosion wear in centrifugal pumps F.Hankeln, S.Riedelbauch – *Institute of Fluid Mechanics and Hydraulic Machinery, University of Stuttgart, DE*
11:00-11:30	**ETC2019-382** The effects of free-stream turbulence intensity on the aerodynamic performance of compressor cascade M.Etemadi, J.Defoe – *Department of Mechanical, Automotive, and Material, Engineering University of Windsor, CA* R.Taghavi-Zonouz – *Department of Mechanical Engineering, Iran University of Science and Technology , IR*	**ETC2019-215** Numerical optimization of air breathing radial outflow turbines I.Kavas, B.H.Saracoglu, T.Arts – *von Karman Institute for Fluid DynamicsSint Genesius Rode, Belgium, BE*	**ETC2019-389** Erosion behavior on a large-sized centrifugal fan N.Aldi, N.Casari, M.Pinelli, A.Suman, A.Vulpio – *Department of Engineering (DE), University of Ferrara, IT* P.Saccenti, R.Beretta – *Boldrocchi S.r.l.,* IT A.Fortini, M.Merlin – *Department of Engineering (DE), University of Ferrara, IT*
11:30-12:00	**ETC2019-070** Impact of underlying RANS turbulence models in Zonal Detached Eddy Simulation: application to a compressor rotor J.Marty, C.Uribe – *ONERA, FR*	**ETC2019-242** The continuous adjoint approach applied to the stabilized finite-element formulation of the incompressible Navier-Stokes equations B.Janssens – *Royal Military Academy of Belgium, BE* P.Vandenschrick, K.Stevens – *Belgian Defence, BE* G.Alessi – *von Karman Institute for Fluid Dynamics, BE*	**ETC2019-111** Prediction of erosion in an axial turbine with initial position of blade A.Ghenaiet – *University of Sciences and Technology Houari Boumediene, DZ*
12:00-12:30		**ETC2019-264** RANS closure by Artificial Neural Networks A.Ferrero – *Politecnico di Torino, IT* A.Iollo – *INRIA Bordeaux Sud-Ouest, FR* F.Larocca – *Politecnico di Torino, IT*	**ETC2019-218** Robust integration of real gas models into a pressure-based coupled solver L.Hanimann, L.Mangani, E.Casartelli – *Lucerne University of Applied Sciences and Arts, CH* D.Vogt – *ITSM, Institute of Thermal Turbomachinery and Machinery Laboratory, DE*
12:30-14:00	Lunch	Lunch	Lunch

Tuesday 9th April 2019

	↑ A-04	↑ B-04	↑ C-04
	A-05 **RADIAL COMPRESSORS (II)**	**B-05** **VIBRATION, FLUTTER, AERO-ELASTICITY (II)**	**C-05** **PUMPS (I)**
	Chair: I. Trebinjac – *EC lyon*	Chair: A. Marn – *TU Graz*	Chair: F. Benra – *Univ Duisburg*
14:00-14:30	**ETC2019-303** **Reliable seals for turbomachines: numerical analysis of the effects of compressible fluid flow through porous materials and narrow gaps** S.Schoar, H.Dohmen, F.Benra – *Universität Duisburg-Essen, DE*	**ETC2019-224** **Effect of geometry variability on transonic fan blade untwist** Y.Lu – *Imperial College London, UK* B.Lad, J.Green – *Rolls-Royce plc, UK* M.Vahdati, S.Stapelfeldt – *Imperial College London, UK*	**ETC2019-388** **Development of a one-dimensional model for the prediction of leakage flows in regenerative pumps** G.Cantini, S.Salvadori, M.Insinna – *Department of Industrial Engineering, University of Florence, IT* G.Peroni – *Pierburg Pump Technology Italy S.p.A.*, IT G.Simon – *Pierburg Pump Technology France S.p.A.*, FR D.Griffini, R.Squarcini – *Pierburg Pump Technology Italy S.p.A.*, IT
14:30-15:00	**ETC2019-171** **Impact of leakage inlet swirl angle in a rotor-stator cavity on flow pattern, radial pressure distribution and frictional torque in a wide circumferential Reynolds number range** T.R.Schröder, H.J.Dohmen, D.Brillert, F.K.Benra – *University of Duisburg-Essen, DE*	**ETC2019-032** **Flutter analysis of a steam turbine blade with frequency and time-domain solvers** C.Frey, G.Ashcroft, H.Kersken, D.Schlüß – *German Aerospace Center (DLR), DE*	**ETC2019-357** **Modelling of a radial pump fast startup with the CATHARE-3 code and analyse of the loop response** L.Matteo – *Fluid Mechanics Laboratory of Lille - Kampe de Feriet, Arts et Metiers ParisTech, FR* G.Mauger – *Thermalhydraulic and Fluid Mechanics Section, CEA Paris-Saclay university, FR* A.Dazin – *Fluid Mechanics Laboratory of Lille - Kampe de Feriet, Arts et Metiers ParisTech, FR* N.Tauveron – *Thermal Biomass & Hydrogen Department, CEA, FR*
15:00-15:30	**ETC2019-143** **Numerical investigation of the lean effects in centrifugal compressors** F.Merli, G.Paolo – *Politecnico di Milano, Dipartimento di energia, IT*	**ETC2019-088** **A higher fidelity approach for incorporating tip shroud geometry into aerodynamic flutter computations of rotating turbomachinery** A.V.Rozendaal, A.Torkaman, G.Vogel – *Power Systems Mfg.*, LLC, Ansaldo Energia Group, US A.Lo Balbo – *Ansaldo Energia, IT*	**ETC2019-386** **Modes identification and interactions in a rotor/stator academic cavity** M.O.Queguineur, L.Y.Gicquel, G.Staffelbach – *CFD Team Cerfacs Toulouse, FR*
15:30-16:00	**ETC2019-257** **Some guidelines for the experimental characterization of turbocharger compressors** T.Dielenschneider, J.Bühler, S.Leichtfuß, H.Schiffer – *Technische Universität DarmstadtInstitute of Gas Turbines and Aerospace Propulsion, DE*	**ETC2019-056** **Numerical and experimental study of the aerodynamic and aeroelastic performance of a low pressure turbine** L.Simonassi – *Institute of Thermal Turbomachinery and Machine Dynamics - Graz University of Technology, AT* R.Benauer – *Bionic Surface Technologies GmbH, Graz, Austria, AT* M.Zenz – *Institute of Thermal Turbomachinery and Machine Dynamics - Graz University of Technology, AT* P.Leitl – *Bionic Surface Technologies GmbH, Graz, Austria, AT* F.Heitemeir, A.Marn – *Institute of Thermal Turbomachinery and Machine Dynamics - Graz University of Technology, AT*	**ETC2019-228** **Axial force modelling and measurement in a single stage centrifugal pump** B.Mary, F.Cerru – *CETIM, FR*
16:00-16:30	Coffee Break	Coffee Break	Coffee Break

Tuesday 9th April 2019

	↑ A-05	↑ B-05	↑ C-05
	A-06 **HYDRAULIC TURBINES**	**B-06** **DIFFUSERS**	**C-06** **FANS (II)**
	Chair: G. Pavesi – *Univ Padova*	Chair: J. Marty – *ONERA*	Chair: J. Vad – *Univ Budapest*
16:30-17:00	**ETC2019-123** **Numerical fatigue analysis of a prototype Francis turbine runner in low-load operation** J.Unterluggauer, E.Doujak, C.Bauer – *TU Wien, Institute for Energy Systems and Thermodynamics, AT*	**ETC2019-055** **Aerodynamical and aeroelastic investigations of a riblet design applied on the surface of turbine exit guide vanes of a low pressure turbine** M.Zenz, A.Hafizovic, L.Simonassi – *Institute of Thermal Turbomachinery and Machine Dynamics Graz University of Technology, AT* P.Leitl, R.Benauer – *Bionic Surface Technologies GmbH, AT* F.Heitmeir, A.Marn – *Institute of Thermal Turbomachinery and Machine Dynamics Graz University of Technology, AT*	**ETC2019-195** **Testing, modeling and simulation of fans working with organic vapors** F.Reinker, R.Wagner, K.Hasselmann, S.aus der Wiesche – *Muenster University of Applied Sciences, DE* M.Fritsche, P.Epple – *Hochschule Coburg, DE* H.J.Russwurm – *Rußwurm Ventilatoren GmbH, DE*
17:00-17:30	**ETC2019-378** **Multiscale simulation of the hydroabrasive erosion of a pelton bucket: bridging scales to improve accuracy** S.Leguizamón, E.Jahanbakhsh, S.Alimirzazadeh, A.Maertens, F.Avellan – *Ecole Polytechnique Fédérale de Lausanne (EPFL), CH*	**ETC2019-115** **Improvement of a gas turbine exhaust hood and diffuser performance within spatial limitations** N.I.Kuklina – *Engineering Center "Center of Computer-Aided Engineering" of Peter the Great St.* Petersburg Polytechnic University (SPbPU), RU M.V.Smirnov – *Peter the Great St.* Petersburg Polytechnic University (SPbPU), RU A.A.Sebelev – *Engineering Center "Center of Computer-Aided Engineering" of Peter the Great St.* Petersburg Polytechnic University (SPbPU), RU E.A.Volkov, N.A.Zabelin – *Peter the Great St.* Petersburg Polytechnic University (SPbPU), RU	**ETC2019-306** **Analysis of tip-gap size on tip-leakage flow in an axial fan at design and off-design operating conditions** S.Alavi Moghadam, M.Meinke, W.Schröder – *Institute of Aerodynamics, RWTH Aachen University, DE*
17:30-18:00	**ETC2019-244** **Hydro-structural stability investigation of a 100 MW Francis turbine based on experimental tests and numerical simulations** WITHDRAWN J.Decaix, V.Hasmatuchi – *HES-SO Valais/Wallis, School of Engineering, CH* M.Titzschkau – *Kraftwerke Oberhasli AG, CH* L.Rapillard – *HES-SO Valais/Wallis, School of Engineering, CH* P.Manso – *Ecole Polytechnique Fédérale de Lausanne, Hydraulic Constructions Platform, CH* F.Avellan – *Ecole Polytechnique Fédérale de Lausanne, Laboratory for Hydraulic Machines, CH* C.Münch-Alligné – *HES-SO Valais/Wallis, School of Engineering, CH*	**ETC2019-061** **Validation of RANS simulations of the flow in a short highly bent intake duct** J.P.Haug, R.P.Rademakers – *Bundeswehr University Munich – Institute of Jet Propulsion, DE* M.Krummenauer – *Wehrtechnische Dienststelle für Luftfahrzeuge und Luftfahrgerät der Bundeswehr (WTD 61), DE* R.Niehuis – *Bundeswehr University Munich - Institute of Jet Propulsion, DE*	**ETC2019-110** **Improvement of the performance of an axial fan with counter-rotation** A.Ghenaiet – *Laboratory of Energetics and Conversion Systems, Faculty of Mechanical Engineering, University of Sciences and Technology Houari Boumediene, DZ* I.Beldjilali – *Laboratory of Turbomachinery, Fluid Mechanics and Energetic, Ecole Militaire Polytechnique, DZ*

WEDNESDAY 10TH APRIL 2019

08:30-09:30	INVITED LECTURE **ETC2019-IL3** Role and Challenges of CFD in the Design of Gas Turbines Dr. Raul Vazquez – *Senior Aerothermal Specialist – Rolls Royce* Chair: Prof. F. Martelli – *University of Firenze, Euroturbo Chairman*		
09:30-10:00	Coffee Break	Coffee Break	Coffee Break
	A-07 HEAT TRANSFER AND BLADE COOLING (II)	B-07 DESIGN AND OPTIMISATION (II)	C-07 NOVEL TEST RIGS
	Chair: G. Barigozzi – *Univ.* Bergamo	Chair: S. Salvadori – *Università di Firenze*	Chair: R. Obertacke – *SIEMENS*
10:00-10:30	**ETC2019-119** Steady and unsteady RANS simulations of heat transfer on a turbine vane endwall with inlet boundary layer skew X.Yang, Z.Feng – *Xi'an Jiaotong University, CN* T.W.Simon – *University of Minnesota, US*	**ETC2019-307** A method for matching compressor stage characterstics to a given load profile by operating point weighting N.E.Kienzle – *Fraunhofer Institute UMSICHT, Ruhr-University Bochum, DE* M.Wäsker – *Fraunhofer Institute UMSICHT, DE* F.di Mare – *Ruhr Universität Bochum, DE* B.Bulten – Fraunhofer UMSICHT, TURBONIK, DE C.Doetsch – *Fraunhofer UMSICHT, Ruhr Universität Bochum, DE*	**ETC2019-105** A new rotating test facility for the experimental characterisation of shaft seals E.Pedraza-Valle, J.Scobie, C.Sangan, P.Keogh – *University of Bath, UK* A.Bowsher, P.Crudgington – *Cross Manufacturing, UK*
10:30-11:00	**ETC2019-158** Coupled FE-CFD analysis of transient conjugate heat transfer A.P.Schindler, S.Brack, J.von Wolfersdorf – *University of Stuttgart, DE*	**ETC2019-104** Metamodel-assisted multidisciplinary design optimization of a radial compressor M.h.Aissa, T.Verstraete – *Von Karman Institute for Fluid Dynamics, BE*	**ETC2019-006** Introduction of a novel test rig for the investigation of fluid-structure interaction effects in steam turbine control valves using an elastic model C.Windemuth, M.Lange, R.Mailach – *Technische Universität Dresden, DE*
11:00-11:30	**ETC2019-042** Heat transfer in a square ribbed channel: evaluation of turbulent heat transfer models B.Woerz, M.Wieler, V.Dehe, P.Jeschke – *Institute of Jet Propulsion and Turbomachinery RWTH Aachen University, DE* M.Rabs – *MAN Energy Solutions SE, Oberhausen, DE*	**ETC2019-212** Surge margin optimization of centrifugal compressors using a new objective function based on local flow parameters J.Ratz, S.Leichtfuß, M.Beck, H.P.Schiffer – *TU Darmstadt, Institute of Gas Turbines and Aerospace Propulsion, DE* F.Fröhlig – *MTU Friedrichshafen GmbH, DE*	**ETC2019-035** Design, integration and operation of a rotating combustor-turbine-interaction test rig within the scope of EC FP7 project FACTOR A.Krumme, M.Tegeler, S.Gattermann – *German Aerospace Center DLR, DE*
11:30-12:00	**ETC2019-252** Narrow impingement channels: recent advancements and future directions M.Gaffuri – *École Polytechnique Fédérale de Lausanne (EPFL) Group of Thermal Turbomachinery (GTT), CH* A.Terzis – *University of StuttgartInstitute of Aerospace Thermodynamics (ITLR), DE* P.Ott – *Group of Thermal Turbomachinery (GTT) École Polytechnique Fédérale de Lausanne (EPFL), CH*	**ETC2019-322** Sampling strategies for metamodel enrichment and automotive fan optimization M.Henner, T.Gonon, B.Demory – *Valeo Thermal Systems, FR* C.Helbert – *École Centrale de Lyon, FR*	**ETC2019-439** A novel modular test rig for experimental investigation of mixing and separation processes in turbomachines A.Schramm, D.Engelmann, F.di Mare – *Ruhr University Bochum, Faculty of Mechanical Engineering , DE*

Wednesday 10th April 2019

	↕ A-07	↕ B-07	↕ C-07
12:00-12:30	**ETC2019-226** Conjugate heat transfer a[illegible]ls of C3X turbine through a cart[illegible]grid approach - A validation study U.Ozturk – *EEBE[illegible]celonaTech Barcelona, ES* S.Soganci – *[illegible]dia, BE* A.Aksen[illegible]*SIS, RU* WITHDRAWN	**ETC2019-432** Optimization of a carbon-fiber composite blade of a counter-rotating fan for aircraft engines T.Schmid – *Institute of Propulsion Technology, DLR, DE* T.Lengyel-Kampmann – *Institute for Propulsion Technology, German Aerospace Center, DE* T.Schmidt – *Institute of Structures and Design, German Aerospace Center, DE* E.Nicke – *Institute of Propulsion Technology, German Aerospace Center, DE*	**ETC2019-347** A novel grazing flow rig for acoustic liner investigations F.Taddei, M.De Lucia, A.Pourreza, H.Rashidi, G.Pierucci, M.Messeri, F.Fagioli, M.Salvestroni – *University of Florence, IT* D.Torzo – *Avio Aero , IT*
12:30-14:00	Lunch	Lunch	Lunch
	A-08 VIBRATION, FLUTTER, AERO-ELASTICITY (III)	B-08 DESIGN, ANALYSIS AND PERFORMANCE-TURBINE	C-08 SPECIAL PANEL SESSION (ETC2019-IL6)
	Chair: X. Ottavy – *EC Lyon*	Chair: M. Carnevale – *University of Bath*	Chair: T. H. Fransson – *EIT InnoEnergy*
14:00-14:30	**ETC2019-044** Prediction of the acoustic influence of an intake on fan flutter: a comparison of numerical methods T.Bontemps – *Safran Aircraft Engines / Université de Lyon, ECL, LMFA, FR* S.Aubert – *Université de Lyon, ECL, LMFA, FR* N.De Cacqueray – *Safran Aircraft Engines, FR*	**ETC2019-185** Thermodynamic modeling of a closed gas turbine process working with Helium and stoichiometric combustion of Hydrogen and Oxygen M.Schatz, M.Wachter – *Institute of Thermal Turbomachinery and Machinery Laboratory (ITSM), University of Stuttgart, DE*	*Panel with the contribution* Andreas Mar — *Graz University* Damian Vogt — *University of Stuttgart* Dieter Brillert — *University Duisburg-Essen* Jérôme Boudet — *EC Lyon* Jürg Schiffman — *EPF-Lausanne* Nenad Glodic — *KTH* Nicolas Binder — *ISAE Toulouse* Torsten Fransson — *EIT InnoEnergy* *Overview* The session will give a few historical notes on higher education in general, give examples of present "best practices" within turbomachinery education, a few "around the corner" possibilities and considerations about the potential for future university-wide collaborations within the educational energy sector as well as exploration of enhanced efforts between academic and professional education sectors. A substantial amount of the session will be devoted to audience interactions, identifying ideas for post-conference collaborations and setting the stage for a turbomachinery educational session at the next ETC conference.
14:30-15:00	**ETC2019-352** Compressor mild surge simulation with variable nozzle models: influence of throttle area on surge behavior and aeroelastic stability at reverse flow conditions C.Reiber, V.A.Chenaux – *German Aerospace Center (DLR), DE*	**ETC2019-004** Performance improvement of the CFM56-3 aircraft engine by electric power transfer H.Balaghi Enalou, S.Bozhko – *University of Nottingham, UK*	
15:00-15:30	**ETC2019-199** An integrated numerical procedure for flutter and forced response assessment of turbomachinery blade-rows F.Vanti, A.Agnolucci, L.Pinelli, A.Arnone – *University of Florence, IT*	**ETC2019-438** Investigation of the ventilation flow in a gas turbine package enclosure J.Kowalski – *Chair of Thermal Turbomachines and Aeroengines, Ruhr-Universität Bochum, Germany, DE* F.di Mare – *Ruhr-Universität Bochum, DE* S.Theis, A.Wiedermann – *MAN Energy Solutions SE, DE* M.Lange, R.Mailach – *Technische Universität Dresden, DE*	
15:30-16:00	**ETC2019-051** Fsi modelling of an industrial centrifugal compressor stage operation at stable and unstable operating points K.Kabalyk – *Lodz University of Technology, PL*	**ETC2019-030** Thermodynamic analysis of the net power oxy-combustion cycle A.Rogalev, V.Kindra, S.Osipov, N.Rogalev – *National Research University "Moscow Power Engineering Institute", RU*	
16:00-16:30	Coffee Break	Coffee Break	Coffee Break

	↕ A-08	↕ B-08	↕ C-08
	A-09 TURBINES: SECONDARY, TIP CLEARANCE AND LEAKAGE FLOWS	B-09 FANS (III)	
	Chair: F. Montomoli – *Imperial College*	Chair: N.P. Kruyt – *Univ.Twente*	
16:30-17:00	**ETC2019-019** The effect of shroud design on flow structure at the tip area and stage efficiency A.Granovskiy, I.Afanasiev, E.Marchukov – *Lyulka Design Bureau, RU*	**ETC2019-140** Sound source localisation at an axial contra-rotating fan by means of PIV and rotational beamforming C.Friebe, R.Krause – *Institut für Luft- und Kältetechnik gGmbH, DE* M.Kerscher – *gfai tech GmbH, DE* O.Velde – *CFturbo GmbH, DE*	
17:00-17:30	**ETC2019-078** Sensitivity analysis, design, instrumentation, and experimental validation of a novel labyrinth seal rig T.Kluge, L.Wein – *Leibniz University Hannover, Inst.* of Turbomachinery and Fluid Dynamics, DE R.Schmierer – *MTU Aero Engines AG, DE* J.R.Seume – *Leibniz University Hannover, Inst. of Turbomachinery and Fluid Dynamics, DE*	**ETC2019-311** A semi-empirical model for predicting the frequency of profile vortex shedding relevant to low-speed axial fan blade sections E.Balla, J.Vad – *Department of Fluid Mechanics, Faculty of Mechanical Engineering, Budapest University of Technology and Economics, HU*	
17:30-18:00	**ETC2019-153** Aerodynamics and strength of a two-tier stage based on a fork-shape blade A.Zaryankin, S.Osipov – *National Research University "Moscow Power Engineering Institute", RU* *T.Shibaev, M.Stepanov, D.Kshesinsky* – The Ural Turbine Works, RU	**ETC2019-399** Experimental research of noise reduction possibilities of an axial fan with an additional contra-rotor J.R.Blaszczak, W.Kryllowicz – *Lodz Univeristy of Technology, PL*	

THURSDAY 11TH APRIL 2019

08:30-09:30	INVITED LECTURE **ETC2019-IL4** Flutter in Turbomachine, Theoretical and Numerical Aerodynamic Analysis of Instabilities Dr. Pascal Ferrand – *Senior Researcher Emeritus LMFA – Ecole Centrale de Lyone* Chair: Prof. S. Aubert – *ECL*		
09:30-10:00	Coffee Break	Coffee Break	Coffee Break
	A-10 COMPRESSORS : UNSTEADY FLOWS AND STALL	B-10 MODELLING OF PHYSICAL PHENOMENA (II)	C-10 TURBINES : UNSTEADY FLOWS AND BLADE-ROW INTERACTIONS
	Chair: M. Dumas – *Safran SAE*	Chair: M. Manna – *Università di Napoli*	Chair: H.P. Dickmann – *ABB Turbo Systems*
10:00-10:30	**ETC2019-219** Efficient simulation of inlet distortion in engine fan stage using nonlinear harmonic method O.Z.Mehdizadeh, S.Vilmin, B.Tartinville, C.Hirsch – *NUMECA International, BE*	**ETC2019-141** Comparison of the cubic equations of state and different transport properties models for ORC turbines modeling A.Sebelev – *Engineering center "Center of computer-aided engineering", Peter the Great Saint-Petersburg Polytechnic University, RU* M.Smirnov – *Peter the Great Saint-Petersburg Polytechnic University, RU* N.Kuklina – *Engineering center "Center of computer-aided engineering", Peter the Great Saint-Petersburg Polytechnic University, RU* K.Lapshin, A.Laskin – *Peter the Great Saint-Petersburg Polytechnic University, RU*	**ETC2019-184** Characterization of the unsteady aerodynamics of optimized turbine blade tips through modal decomposition analysis B.C.Cernat, S.Lavagnoli – *von Karman Institute for Fluid Dynamics, BE*

Thursday 11th April 2019

	↕ A-10	↕ B-10	↕ C-10
10:30-11:00	**ETC2019-330** Instantaneous flow field measurements in the interstage section between a fan and the outlet guiding vanes at different axial positions R.K.Meyer, S.Hakansson, W.Hage, L.Enghardt – *German Aerospace Center (DLR), DE*	**ETC2019-121** Stabilizing effects of supercritical CO2 fluid properties on compressor operation A.J.Hacks, S.Schuster, D.Brillert – *University of Duisburg-Essen, DE*	**ETC2019-351** Characterization of periodic incoming wakes in a low-pressure turbine cascade test section by means of a fast-response single sensor virtual three-hole probe J.Clinckemaillie, T.Arts – *von Karman Institute for Fluid Dynamics, BE*
11:00-11:30	**ETC2019-371** Stall and recovery process of a transonic fan with inlet distortion W.Zhang, M.Vahdati, S.Stapelfeldt – *Imperial College London, UK*	**ETC2019-136** Evaporation modelling of water droplets in a transonic compressor cascade under fogging conditions A.Seck – *University of Stuttgart, DE* S.Geist, J.Harbeck – *Helmut Schmidt University, Hamburg, DE* B.Weigand – *University of Stuttgart, DE* F.Joos – *Helmut Schmidt University, Hamburg, DE*	**ETC2019-412** Transient flow in infinitely thin airfoil cascade F.Hermet, N.Binder, J.Gressier – *ISAE-SUPAERO, Université de Toulouse, FR*
11:30-12:00	**ETC2019-285** Application of wavelet analysis on early stall warning in the axial compressor Y.Liu, J.Li, J.Du, H.Zhang – *Institute of Engineering Thermophysics,Chinese Academy of Sciences, CN*	**ETC2019-366** Dynamics of a spray formed by laminar liquid jet in modulated crossflow V.Bodoc, A.Desclaux, P.Gajan, F.Simon, G.Illac – *ONERA- The French Aerospace Lab, FR*	**ETC2019-413** Implementation of non-reflecting boundary conditions in a finite volume unstructured solver for the study of turbine cascades G.De Cosmo – *von Karman Institute for Fluid Dynamics, BE* S.Salvadori – *University of Florence, IT*
12:00-12:30			
12:30-14:00	Lunch	Lunch	Lunch
	A-11 RADIAL TURBINES	B-11 AERO-ACOUSTICS, NOISE GENERATION AND REDUCTION	C-11 HYDRAULIC TURBINES (II)
	Chair: D. Rusch – *ABB Turbo Systems*	Chair: R. Vazquez – *Rolls Royce*	Chair: G. Cavazzini – *Università di Padova*
14:00-14:30	**ETC2019-114** Unconventional centrifugal bladeless turbine for low power range turboexpander applications M.Smirnov – *Peter the Great St.* Petersburg Polytechnic University (SPbPU), RU A.A.Sebelev, N.N.Kuklina – *Engineering Center "Center of Computer-Aided Engineering" of SPbPU, RU* G.A.Fokin – *Gazprom transgaz Saint-Petersburg LLC, RU* N.A.Zabelin – *Peter the Great St.* Petersburg Polytechnic University (SPbPU), RU	**ETC2019-368** Leakage flow noise and related flow pattern in a low-speed axial fan with rotating shroud E.Canepa, A.Cattanei, F.Mazzocut Zecchin – *DIME-Università di Genova, IT*	**ETC2019-434** CFD analysis of the performance of a novel impeller for a double suction centrifugal pump working as a turbine T.Capurso – *Polytechnic University of Bari, IT* L.Bergamini – *Nuovo Pignone, IT* S.M.Camporeale, B.Fortunato, M.Torresi – *Polytechnic University of Bari, IT*
14:30-15:00	**ETC2019-017** Uncoupled CFD-FEA methods for the thermomechanical analysis of turbochargers P.Luczynski, M.P.Giesen, T.S.Gier, M.Wirsum – *RWTH Aachen, DE*	**ETC2019-150** Simulations and experimental investigations on the acoustic characterisation of centrifugal pumps of different specific speed C.Lehr, A.Linkamp, A.Brümmer – *TU Dortmund University, DE*	**ETC2019-436** Preliminary assessment of a pump used as turbine in a water distribution network for the recovery of throttling energy M.Stefanizzi, T.Capurso, G.Balacco, M.Torresi, M.Binetti, A.F.Piccinni, B.Fortunato, S.M.Camporeale – *Polytechnic University of Bari, IT*
15:00-15:30	**ETC2019-021** Multi-channel casing design for radial turbine operation control A.S.Hassan, C.Fuhrer, M.Schatz, D.Vogt – *Institute for Thermal Turbomachinery and Machinery Laboratory, University of Stuttgart, DE*	**ETC2019-071** Investigation of the wall pressure fluctuations, the operational deflection shapes and the airborne noise radiation of a single stage radial pump M.Witte, O.Kranz, B.Torner, F.H.Wurm – *Institute of Turbomachinery, DE*	**ETC2019-381** Part load resonance risk assessment of francis hydropower units J.Gomes Perreira Junior, A.Favrel – *Laboratory for Hydraulic Machines, EPFL, CH* C.Nicolet – *Power Vision Engineering Sàrl, CH* F.Avellan – *Laboratory for Hydraulic Machines, EPFL, CH*

Thursday 11th April 2019

	↕ A-11	↕ B-11	↕ C-11
15:30-16:00	**ETC2019-324** Radial Turbine Global Design for Liquid Rocket Engine Application A.Leto – *CIRA: Italian Aerospace Research Center, IT*		**ETC2019-313** Influence of the inlet boundary conditions on numerical flow simulations of a model kaplan turbine S.Joßberger, S.Riedelbauch – *Institute of Fluid Mechanics and Hydraulic Machinery, University of Stuttgart, DE*
16:00-16:30	Coffee Break	Coffee Break	Coffee Break
	A-12 AXIAL TURBINES(II)	B-12 RADIAL COMPRESSORS (III)	C-12 COMBUSTOR - TURBINE INTERACTION
	Chair: A. Wiedermann – *MAN Energy Solutions SE*	Chair: N. Binder – *ISAE Supaero*	Chair: T. Fransson – *EIT InnoEnergy*
16:30-17:00	**ETC2019-338** Reducing secondary flow losses in low-pressure turbines: the "SNAKED" blade M.Giovannini, F.Rubechini, M.Marconcini, A.Arnone – *University of Florence, IT* F.Bertini – *GE Avio Aero, IT*	**ETC2019-437** A new 1D method for assessing volute induced circumferential pressure distortion at the exit of a centrifugal impeller T.Ceyrowsky, A.Hildebrandt – *MAN Energy Solutions SE, DE* R.Schwarze – *TU Bergakademie Freiberg, DE*	**ETC2019-050** Aerothermal predictions of combustor/ turbine interactions using advanced turbulence modeling F.Cottier, P.Pinchaud, G.Dumas – *MTU Aero Engines AG, DE*
17:00-17:30	**ETC2019-164** Effect of Stall Fence on the Performance of an Axial Turbine for Wave Energy Conversion T.K.Das, A.Samad – *Wave Energy and Fluids Energy Lab, Ocean Engineering Department, IIT Madras, IN*	**ETC2019-431** Investigation of aerodynamic effects in stator components of multistage centrifugal compressors B.Dolle – *University of Duisburg-Essen, Chair of Turbomachinery, DE* V.Hermes – *Siemens AG, Dresser-Rand, DE* N.Petry – *Siemens AG, Dresser-Rand, Duisburg, Germany, DE* D.Brillert, H.Dohmen, F.Benra – *University of Duisburg-Essen, DE*	**ETC2019-100** Turbulence intensity measurements across a NGV cooled cascade with representative Lean Burn combustor outflow T.Bacci, A.Picchi, T.Lenzi, B.Facchini – *University of Florence, IT*
17:30-18:00	**ETC2019-408** Design of non-axisymmetric endwall of a stator to improve the efficiency of a high pressure turbine: a pseudo objective function A.Rehman, B.Liu, Z.Song – *Northwestern Polytechnical University, CN*	**ETC2019-329** Vaneless diffuser for low flow rate centrifugal compressor stage O.Solovyeva, Y.Galerkin, A.Drozdov – *Peter the Great St.Petersburg Polytechnic University R&D Laboratory "Gas dynamics of turbo machines", RU*	**ETC2019-293** External heat transfer on nozzle guide vanes under highly swirled combustor outlet flow S.Cubeda, L.Mazzei, A.Andreini – *University of Florence, IT*
18:30-22:30	**GALA DINNER AT THE OLYMPIC MUSEUM**		
18:30-30:00	FREE VISIT OF THE OLYMPIC MUSEUM		
19:30-20:15	APERITIVE		
20:15-22:30	GALA DINNER		

FRIDAY 12TH APRIL 2019

08:30-09:30	INVITED LECTURE **ETC2019-IL5** The Pathway forward for Gas and Steam Turbines in a world of increasing renewable source Dr. Michael Ladwig – *President – EUTurbines* Chair: Dr. A. Wiedermann – *MAN Energy Solutions SE*		
09:30-10:00	Coffee Break	Coffee Break	Coffee Break
	A-13 HEAT TRANSFER AND BLADE COOLING (III) Chair: A. Terzis – *University of Stuttgart*		C-13 PUMPS (II) Chair: A. Dazin – *ENSAM*
10:00-10:30	**ETC2019-314** Flat plate and turbine vane film-cooling performance with laid-back fan-shaped holes T.Bacci, A.Picchi, B.Facchini – *University of Florence, IT*		**ETC2019-076** Experimental investigation of transient characteristics of single-blade and two-blade pumps S.Melzer – *Ruhr-Universität Bochum, DE* S.Schepeler – *WILO SE, DE* J.Förster, J.Friderich – *KROHNE Messtechnik GmbH, DE* T.Kalkkuhl – *WILO SE, DE* R.Skoda – *Ruhr-Universität Bochum, DE*
10:30-11:00	**ETC2019-204** Experimental investigation of the aerodynamic and thermal behaviour of the film at the leading edge of a cooled nozzle vane cascade L.Casarsa, F.Pagnacco – *Polytechnical Department of Engineering and Architecture, University of Udine, IT* H.Abdeh, G.Barigozzi – *Dipartimento di Ingegneria e Scienze Applicate – Università di Bergamo , IT*		**ETC2019-316** Numerical investigation of trailing edge flow in centrifugal pump impellers O.Litfin, A.Delgado – *Institute of Fluid Mechanics, Friedrich-Alexander-University Erlangen-Nuremberg, DE*
11:00-11:30	**ETC2019-236** Experimental investigation of rotor tip film cooling at an axial turbine with swirling inflow conditions using pressure sensitive paint M.Wilhelm, H.Schiffer – *Institute of Gasturbines and Aerospace Propulsion, TU Darmstadt, DE*		**ETC2019-343** Analysis of flow losses and their contribution to the total flow loss in an axial flow pump using the large eddy simulation method B.Torner, L.Konnigk, M.Witte, F.H.Wurm – *Institute of Turbomachinery, University of Rostock, DE*
11:30-12:00	**ETC2019-243** Infrared thermography investigation of heat transfer on outlet guide vanes in an engine exit module I.J.Jonsson, V.Chernoray, R.Dhanasegaran – *Chalmers University of Technology, SE*		**ETC2019-047** Assessment of statistical eddy-viscosity turbulence models for unsteady flow at part and overload operation of centrifugal pumps N.Casimir – *Ruhr-Universität Bochum, DE* Z.Xiangyuan – *School of Energy and Power Engineering, Xi'an Jiaotong University, CN* G.Ludwig – *TU-Darmstadt, DE* R.Skoda – *Ruhr-Universität Bochum, DE*
12:00-12:30	**ETC2019-155** An experimental and numerical study of flow and heat transfer in cooling channels with pin fin-dimple and pin fin-groove arrays V.Kindra, S.Osipov, D.Kharlamova, I.Shevchenko – *National Research University "Moscow Power Engineering Institute", RU*		**ETC2019-011** Numerical investigation of Two-Phase air-water flow in a centrifugal pump with closed or semi-open impeller M.Hundshagen – *Ruhr University Bochum, DE* M.Mansour, D.Thévenin – *University of Magdeburg "Otto Von Guericke", DE* R.Skoda – *Ruhr University Bochum, DE*
12:30-12:45	CLOSING CEREMONY		