ISROMAC 18

18th International Symposium on Transport Phenomena and Dynamics of Rotating Machinery

ISROMAC 18

November 23rd-26th 2020 → Online

Symposium Booklet & Program

Organized by:

Waseda University

Pacific Center of Thermal-Fluid Engineering (PCTFE)

Supported by:

Nippon Travel Agency

Turbomachinery Society of Japan (TSJ)

www.isromac2020.com

Contents

Welcome message from the conference chair

It is with pleasure that I welcome you to the 18th edition of the International Symposium on Transport Phenomena and Dynamics of Rotating Machinery (ISROMAC), which will be held online from November 23rd to 26th 2020.

The Organizing committee initially planned to have this symposium in beautiful Hawaii, at the Hawaii Convention Center in its capital Honolulu on Oahu island on April 2020. All participants were supposed to have the opportunity to appreciate the wonderful scenery, beach and the Pacific Ocean. We were looking forward to welcoming you in Hawaii.

But due to the COVID-19 pandemic, the ISROMAC18 committee decided to move to an online symposium. This situation imposes on the committee many difficult constraints like travel restrictions, national event rules, and health considerations no longer allow the symposium to proceed in the face-to-face type meeting. We tried to postpone this symposium several times and still hold it in Hawaii, but it was impossible to predict the COVID-19 pandemic evolution. For these reasons, the symposium was changed to an online-only event. The opening time has been set in consideration of the large number participants from Europe and Asia. We apologize for any inconvenience due to the time differences.

In this symposium, a wide breath of topics related to the dynamics of rotating machinery will be presented, including compressors, turbines, pumps and other fluid machinery, multi-phase flows, cavitation, rotor-dynamics, heat transfer, combustion, aero-acoustics, CFD and experimental techniques applied to turbomachines. We welcome everyone to present their technical papers, to share knowledge and participate in meaningful discussions with experts from all over the world. Four attractive plenary lectures by distinguished Professor Avellan, Professor Holl, Professor Kato and Professor Zangeneh will be held in each day. All participants will be able to hear the notable lectures at home. We highly appreciate the contribution of professors from all over the world.

All technical papers and extended abstracts will be compiled in a symposium proceeding, and most will be published in the IOP conference series. Some of the technical papers will be published in special issues of the MDPI Acoustics, ASME Journal of Energy Resources Technology (JERT) and ASME Journal of Fluids Engineering (JFE).

Until now ISROMAC has always taken place in Hawaii, since its first edition in 1985. All organizing chairs have been as listed in the following page.

Finally, on behalf of the Committee, I would like to thank all session chairs, the plenary lectures, the authors, participants, reviewers and the ISROMAC18 staff. I hope you all have many fruitful discussions, get useful knowledge from the technical presentations and mutual communication with your peers.

Sincerely yours,

Kazuyoshi Miyagawa (Waseda University)
Symposium Chair

Past ISROMAC organizers:

1985 ——— Wen-Jei Yang (University of Michigan)

1988 ——— J. H. Kim (Electric Power Research Inst.)

1990 ——— J. H. Kim (Electric Power Research Inst.)

1992 ——— Wen-Jei Yang (University of Michigan)

1994 ——— Wen-Jei Yang (University of Michigan)

1996 ——— D. C. Han (Seoul National University)

1998 ——— A. Muszynska (Bently Rotor Dynamics Corp.)

2000 ——— J. C. Han (Texas A&M University)

2002 ——— Y. Tsujimoto (Osaka University)

2004 ——— D. Bohn (Aachen Univ. of Technology)

2006 ——— Knox T. Millsaps (Naval Postgraduate School)

2008 ——— G. Bois (LML, ENSAM Lille, France)

2010 ——— T. Watanabe (University of Tokyo, Japan)

2012 ——— P. F. Pelz (Technische Univ. Darmstadt)

2014 ——— Hyung Hee Cho (Yonsei University, Korea)

2016 ——— O. Coutier-Delgosha (Arts et Metiers ParisTech, France)

2017 ——— O. Coutier-Delgosha (Arts et Metiers ParisTech, France)

Introductory Speech by the Pacific Center of Thermal-Fluid Engineering (PCTFE)

Welcome to ISROMAC18, on line.

I am Masaru Ishizuka, the president of PCTFE, Pacific Center of Thermal-Fluid Engineering. I am very sorry that we cannot see all of you in Honolulu due to the COVID-19 situation. First on behalf of PCTFE, I would like to thank especially the Symposium Chair, Prof. Kazuyoshi Miyagawa and the executive committee members, who have worked so hard to make this symposium on line well organized in such a difficult situation. Professor W. J. Yang has founded PCTFE, a non-profit organization, in 1985. Professor Yang was the first Chair of PCTFE. In addition, Professor Sadanari Mochizuki was the second chair and I have been the third chair. PCTFE was established to organize symposia, workshops and continuing educational lectures and to gather together researchers and practitioners in the spirit of cooperation and friendship. The Center's main activities include four series of international symposia:

1. International Symposium on Rotating Machinery (ISROMAC)
2. International Symposium on Transport Phenomena (ISTP)
3. Pacific Symposium on Flow Visualization and Image Processing (PSFVIP)
4. International Symposium on Micro and Nanotechnology (ISMNT)

This serie of four conferences has been phenomenally successful with broad-based support from various international scientific, engineering, and industrial organizations. A number of internationally-recognized researchers were invited to deliver keynote lectures in each meeting. This serie of four conferences also has been held in many countries except South America and Africa. We are convinced that PCTFE has made a great contribution to the exchange of heat transfer and fluid flow related researchers and engineers around the world. Finally, I wish to express my sincere thanks to the distinguished keynote speakers, the contributing authors, and the participants. I would also like to thank all members of the Honorary Committee and the International Scientific Committee.

We hope you will have a wonderful time during the symposium.

Thank you.

Prof. Masaru Ishizuka

Plenary Lectures

Lecture 1- XFLEX Hydro: a technology road map for Hydroelectric power plants to enable massive photovoltaic and wind penetration of the electric power system

Chair: Prof. Shuhong Liu, Tsinghua University (China)

Lecturer: Prof. François Avellan

Prof. François Avellan, director of the EPFL Laboratory for Hydraulic Machines, graduated in Hydraulic Engineering from Ecole nationale supérieure d'hydraulique, Institut national polytechnique de Grenoble, France, in 1977 and, in 1980, got his doctoral degree in engineering from University of Aix-Marseille II, France. Research associate at EPFL in 1980, he is director of the EPFL Laboratory for Hydraulic Machines since 1994 and, in 2003, was appointed Ordinary Professor in Hydraulic Machinery. Supervising 37 EPFL doctoral theses, he was distinguished by SHF, Société Hydrotechnique de France, awarding him the "Grand Prix 2010 de l'Hydrotechnique". His main research domains of interests are hydrodynamics of turbine, pump and pump-turbines including cavitation, hydro-acoustics, design, performance and operation assessments of hydraulic machines. Prof. Avellan was Chairman of the IAHR Section on Hydraulic Machinery and Systems from 2002 to 2012. He has conducted successfully several Swiss and international collaborative research projects, involving key hydropower operators and suppliers, such as:

- Scientific Advisor to the Coordinator of the Hydropower Extending Power System Flexibility (XFLEX HYDRO) project which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857832.
- Coordination for the FP7 European project n° 608532 "HYPERBOLE: HYdropower plants PERformance and flexiBle Operation towards Lean integration of new renewable Energies" (2013-2017);
- Deputy Head of the Swiss Competence Center for Energy Research – Supply of Electricity (SCCER-SoE) to carry out innovative and sustainable research in the areas of geo-energy and hydropower for phase I (2013-2016) and Phase II (2017 2020).
- EUREKA European research projects: N° 4150 and N° 3246, "HYDRODYNA, Harnessing the dynamic behavior of pump-turbines", (2003-2011), N° 1605, "FLINDT, Flow Investigation in Draft Tubes", (1997-2002), N° 2418, "SCAPIN, Stability of Operation of Francis turbines, prediction and modeling";
- Swiss KTI/CTI research projects with GE Renewable Energy (anc. ALSTOM Hydro, Birr), ANDRITZ Hydro (Kriens), FMV (Sion), Groupe E (Granges-Paccot), Power Vision engineering (Ecublens) and SULZER Pumps (Winterthur).
- ETH Domain, HYDRONET Project for the Competence Center Energy and Mobility, PSI Villingen.

Furthermore, he is involved in scientific expertise and independent contractual experimental validations of turbines and pump turbines performances for the main hydropower plants in the world. In

recognition for his work as Convener of the TC4 working group of experts in editing the IEC 60193 standard he received the "IEC 1906 Award" from the International Electrotechnical Commission.

Summary

With increasing levels of variable renewables in the energy system, new opportunities emerge for hydropower as a provider of flexibility services in modern power markets. To address this question, a consortium of 19 European partners is committed to the Hydropower Extending Power System Flexibility (XFLEX HYDRO) project.

The ultimate objective of the XFLEX HYDRO project is to increase hydropower potential in terms of plant efficiency, availability and provision of flexibility services to the Electric Power System (EPS).

The high Renewable Energy Sources (RES) scenario of the decarbonisation process relies on a drastic change of the European Union EPS with a massive integration of non-dispatchable RES and disconnection of the so-called conventional units, as greenhouse gases emitters. These changes influence drastically the provision of the power grid balancing, and challenge the EPS operations and safety. It is of upmost importance to provide reliable solutions to support the EPS with more flexibility services. Hydroelectric Power Plant (HPP) already significantly supports EPS flexibility in terms of regulation capability, fast frequency control, fast start/stop, fast generating to pumping modes transition, high ramping rate, inertia emulation, fault ride through capacity, etc.

The XFLEX HYDRO project aims to demonstrate an innovative methodology for system integration of hydroelectric technology solutions, variable speed being a key component and a reference, to provide further enhanced flexibility services assessed by a crosscutting analysis of their impact on both the technology and the market aspects.

Innovative solutions also target an optimize maintenance plan to decrease the outage time and increase the availability of the plant. Seven demonstrations are scheduled in the cases of run-of-river, storage and pumped storage HPPs and they cover cases of refurbished, uprated and especially existing HPP to be applied and scaled to any unit size. XFLEX HYDRO draws the roadmap for the exploitation of its solutions to all the European HPP fleet. A strategic dissemination plan is set to promote the deployment of the demonstrated solutions to stakeholders, to the scientific community and the public and to further support the communication in workshops, conferences, scientific journals, newspapers and various social media.

Acnowledgement

The XFLEX HYDRO project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857832.

Lecture 2- Simulation of non-linear dynamic variable mass systems with variable parameters

Chair: Prof. Yu Ito, The University of Tokyo (Japan)

Lecturer: Prof. Helmut J. Holl

Helmut J. Holl is working as an Assistant Professor at the Institute of Technical Mechanics at the Johannes Kepler University of Linz, Austria. He developed a time-integration procedure for the application in nonlinear rotor-dynamic systems including substructuring and variable mass systems. His current research is in the field of the interaction of axially moving structures, fluid-structure interaction and variable mass systems. Furthermore, he holds lectures in rotor-dynamics and numerical and experimental methods in mechanics.

Summary

For the modelling of transport processes and the interaction of rotating machinery it is important to be aware of the importance of the boundaries of the system and to apply a suitable description. The computation of vibrations in such dynamic systems with open boundaries has lots of applications. The derivation of the mechanical model has to concentrate on the flow of mass through the boundary of the applied control volume. For the derivation of the equations of motion it is important to distinguish between the material control volume and the spatial control volume. The spatial control volume is an arbitrary moving non-material volume with a surface that has a speed $\mathbf{w}$, which is different from the velocity of the material at the surface $\mathbf{v}$. The transport of kinetic energy and mass can be determined and is related to the spatial derivative of the total kinetic energy at the boundary of the control volume. With the extended equation of Lagrange these effects can be described. Usually nonlinearities are present in the system and the parameters vary with time as the stiffness and some other system parameters change. One example of such a dynamic system is the mechanical model of a winding process, which has to consider the coupling of the vibrations of the axially moving strip and the coiling drum due to non-steady state operation conditions. As the outer radius of the coiling drum and the stiffness is increasing also varying parameters are present. Like in other processes the transported mass can cause vibrations, which influence the whole production process and can reduce its efficiency. The semi-analytic algorithm results in an efficient computation of the solution and the numerical behaviour is demonstrated also for variable mass systems. This semi-analytic time-integration procedure has been extended to consider substructuring. Additionally systems described by differential equations of first and second order are computed effectively.

Lecture 3- High Performance Computing and Its Industrial Applications in Fugaku Era

Chair: Prof. Yuka Iga, Tohoku University (Japan)

Lecturer: Prof. Chisachi Kato

Dr. Chisachi Kato is a professor of mechanical engineering at the University of Tokyo. In 1984, he graduated the Graduate School of Engineering at the University of Tokyo and obtained a master's degree in mechanical engineering. He obtained another master's degree from Stanford University in August 1989. He was conferred his doctoral degree in engineering from the University of Tokyo in 1995.

Upon graduation from the mechanical engineering department at the University of Tokyo in 1984, Dr. Kato joined the Mechanical Engineering Research Laboratory of Hitachi, Ltd. and had been working as a research engineer for about 15 years.

In January 1999, Dr. Kato moved to the Institute of Industrial Science (IIS), the University of Tokyo and was appointed as a professor in January 2003. Since then, he has also been a director of Center for Research on Innovative Simulation Software (CISS).

Summary

Most industries are currently using the time averaged turbulent flow simulation, called RANS, for the development as well as for the evaluation of their flow-related products. RANS is a model-based simulation of turbulent flows and the optimum model depends strongly on the individual flows. For this reason, RANS can never become a complete alternative to the tests made for the final evaluation of a product. On the other-hand, the Large Eddy Simulation, hereafter abbreviated as LES, directly resolves turbulent eddies in the production scale and provides accuracy compatible with the Direct Numerical Simulation (DNS) all the times.

However, the LES requires billions of computational grids for its application to a high Reynolds number engineering flows, which was not feasible in the past. On the other hand, recent progress of the high-end computer performance is going to make such simulations, which use billions of grids, practical. With all of these in mind, we have fully optimized our flow solver, named FrontFlow/blue, to substantially shortened the time needed for such a high Reynolds number LES of an engineering flow.

As a result, we have achieved 35 times speedup of our code and a parallel computing efficiency of over 85In this presentation, we will review the features of our flow solver, describe the code optimization that has been made and resulted in such a remarkable performance improvement and finally provide several engineering applications of LES, which we believe will help the audience develop future vision of the computer aided engineering (CAE).

Lecture 4- Multi-objective, Multi-disciplinary Inverse design based automatic optimization of turbomachinery

Chair: Prof. Satoshi Watanabe, Kyushu University (Japan)

Lecturer: Prof. Mehrdad Zangeneh

Mehrdad Zangeneh is Professor of Thermofluids at University College London. His research interests cover development of computational design methods based on 3D inverse design and automatic optimization to variety of turbomachinery applications (such as pumps, turbines, compressors and pumps) as well microfluidics and micropump applications. More recently he has focused on development of multi-disciplinary optimization methods that aim to improve both aerodynamic and structural performance of turbomachinery. Professor Zangeneh has been involved in many collaborative research programs with major Turbomachinery manufacturers in Europe, US and Japan, including Ebara Corporation and Hitach of Japan, ABB Turbo and Man Turbo of Germany and US Office of Naval Research. He has published more than 120 papers in journals and refereed conferences and has been granted 7 international patents. He has founded UCL spin out company Advanced Design Technology Ltd which licenses turbomachinery design software globally.

Summary

Turbomachinery manufacturers face many challenges such as legislative pressures to improve efficiency (e.g ECOdesign directive in EU) as well as competitive pressure to reduce cost and developments times. Many of these challenges require innovative design solutions that can solve multi-point/multi-objective and multi-disciplinary problems.

The 3D inverse design method computes the turbomachinery blade geometry for a specified distribution of blade loading and pressure field. The method enables designers to optimize turbomachinery vanes and blades by exploring a large design space without the trial and error of traditional design methodologies.

There are also computational advantages in using inverse design as an optimization strategy. In inverse design, the optimization is parametrized through the blade loading and not the blade geometry, which can significantly reduce the number of design parameters to cover the same design space. This feature improves the speed and accuracy of automatic optimization. In particular, by using the inverse design approach it is possible to achieve accurate surrogate model based optimization. This approach can then be used to solve difficult multi-point, multi-objective and multi-disciplinary problems under industrial time scales.

Two examples of this approach will be presented. In the first instance the approach is used for multi-point optimization of a mixed flow pump stage. Design of experiment is done for a mixed flow pump stage by using the 3D inverse design method. Both meridional geometry and blade loading parameters (which control the 3D blade geometry) are parametrized. The geometries in the design matrix are then run in CFD at multiple operating points from high flow to shut off conditions at 15 different operating points and the results are then used to create a surrogate model. The surrogate model is then used with Multi-objective genetic algorithm to design stages which meet required power ratio and head ratios and avoid dropping head curve and yet maximize efficiency. The surrogate model can predict the optimized design's HQ curve and this then compared with actual CFD predictions where very good correlation is obtained between CFD and the surrogate model prediction of the stage head versus flow characteristic.

The second example will show the application of the process to multi-disciplinary, multi-point optimization of a radial turbine stage. For this problem, as well as efficiency and mass flow parameter at several operating points the maximum stress in the turbine impeller, and 1st and 2nd modal natural frequencies are also included in the optimization. Again accuracy of the using surrogate model based optimization are confirmed by direct high fidelity CFD and FEA results.

Organizing Committee

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Prof. Satoru Watano, Osaka Prefecture University, Japan
Dr. Nakjoong Lee, Waseda University, Japan
Mr. Gabriel Taillon, Waseda University, Japan

Session Organizers

S1 Advanced and multiphysics CFD
Dr. Akira Fujii, ANSYS, Japan
Prof. Koichi Nishibe, Tokyo City University, Japan
S2 Aero-acoustics of turbomachines
Prof. Michel Roger, École Centrale de Lyon, France
Prof. Stéphane Moreau, Université de Sherbrooke, Canada
S3 Cavitation and multi-phase flow
Prof. Yuka Iga, Tohoku University, Japan
Dr. Mohamed Farhat, Ecole Polytechnique Fédérale de Lausanne, Switzerland
Prof. Shin-Ichi Tsuda, Kyushu University, Japan
S4 Cavitation in turbomachines
Prof. Xianwu Luo, Tsinghua University, China
Dr. Motohiko Nohmi, Ebara Corporation, Japan
S5 Combustion in turbomachines
Hideyo Negishi, JAXA, Japan
S6 Compressors and fans
Dr Florent Ravelet, ENSAM, France
Prof. Kazutoyo Yamada, Iwate University, Japan
S7 Design and optimization of turbomachines
Dr. Hiroyoshi Watanabe, Ebara Corporation, Japan
Mr. Satoshi Kawasaki, Japan Aerospace Exploration Agency (JAXA), Japan
S8 Experimental techniques applied to turbomachines
Dr Shigeyuki Tomimatsu, DMW Corporation, Japan
Prof. Teiichi Tanaka, National Institute of Technology, Kumamoto College, Japan
Dr Arthur Favrel, Waseda University, Japan
S9 Fluid-structure interaction in turbomachines
Prof. Kazuyoshi Miyagawa, Waseda University, Japan
Dr. Koichi Yonezawa, Central Research Institute of Electric Power Industry, Japan
Dr. Takeshi Sano, Mitsubishi Heavy Industries, Japan
S10 General topics
Dr. Nakjoong Lee, Waseda University, Japan
Mr. Gabriel Taillon, Waseda University, Japan
S11 Hydraulic machines and systems
Prof. Eduard Doujak, TU Wien, Austria
Prof. Shuhong Liu, Tsinghua University, China
Prof. Shouichiro Iio, Shinshu University, Japan
S12 Liquid rocket engines
Prof. Masaharu Uchiumi, Muroran Institute of Technology, Japan
Prof. Angelo Pasini, University of Pisa, Italy
S13 Marine energy and propulsion systems
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Dr. Abdus Samad, Indian Institute of Technology Madras, India
S14 Heat and mass transfer & Transport phen omena
Prof. Helmut J. Holl, Johannes Kepler University of Linz, Austria
Prof. Yu Ito, University of Tokyo, Japan
S15 Positive displacement machines
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Prof. Davide Ziviani Purdue University, USA
S16 Pumping machinery
Prof. Satoshi Watanabe, Kyushu University, Japan
Prof. Young-Seok Choi Korea Institute of Industrial Technology, Korea
S17 Rotor and structural dynamics in turbomachines
Prof. Tsuyoshi Inoue, Nagoya University, Japan
Prof. Jaroslav Zapomel, Technical University of Ostrava, Czech Republic
Dr Yusuke Watanabe, Ebara Corporation, Japan
S18 Steam and gas turbines
Prof. Tetsuya Sato, Waseda University, Japan
Prof. Jae Su Kwak Korea Aerospace University
S19 Turbocharging systems
Prof. Chen Hua, Dalian Maritime University, China
Dr. Hideaki Tamaki IHI Corporation, Ltd., Japan
S20 Wind energy
Prof. Akihiro Honda, Hirosaki University, Japan
Prof. Takao Maeda, Mie University, Japan

Online Instructions

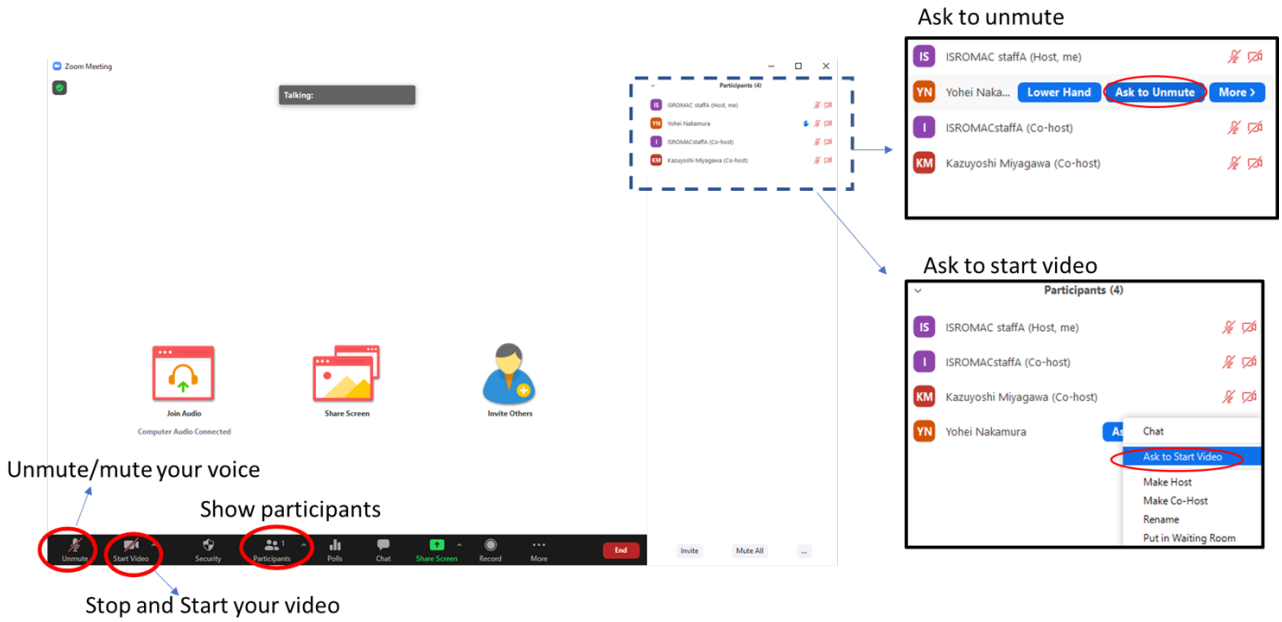
The Conference is to be held online using the Zoom software. There is a total of 6 Zoom rooms: Room 1-4 for parallel sessions, the Lounge, and the Plenary Session Room for the opening / closing ceremonies and the plenary lectures. Upon first login, all participants need to register their name (in Latin alphabet) and email addresses.

Links to Zoom Rooms

Plenary	https://zoom.us/webinar/register/WN_fpTFErV1R3W9ls04A8_RUQ
Room 1	https://us02web.zoom.us/meeting/register/tZEudeuurjIuGNRh5kXXRhWyJ9dzv2URoXTc
Room 2	https://us02web.zoom.us/meeting/register/tZMpcuyprTorGdfu39yOJwzaZvKnklSNE8Hq
Room 3	https://us02web.zoom.us/meeting/register/tZMtdOmhrT0rHtPEYXsQcThh62-cHk-H80mE
Room 4	https://us02web.zoom.us/meeting/register/tZYqdO6tqDsuH9Ly1sF6Y9QYZq9YbQtRN0a6
Lounge	https://us02web.zoom.us/j/88939156336

Link to ISROMAC2020 Official Virtual Background

Instructions for the Chair



Make sure to log in to your Room 10 minutes before the session starts. The rooms will always be hosted by at least one Waseda host. The room Waseda host will assign you to be co-host of the meeting. Check your microphone and video feeds. Your microphone should be unmuted only when you need to speak. Before the session starts, please do:

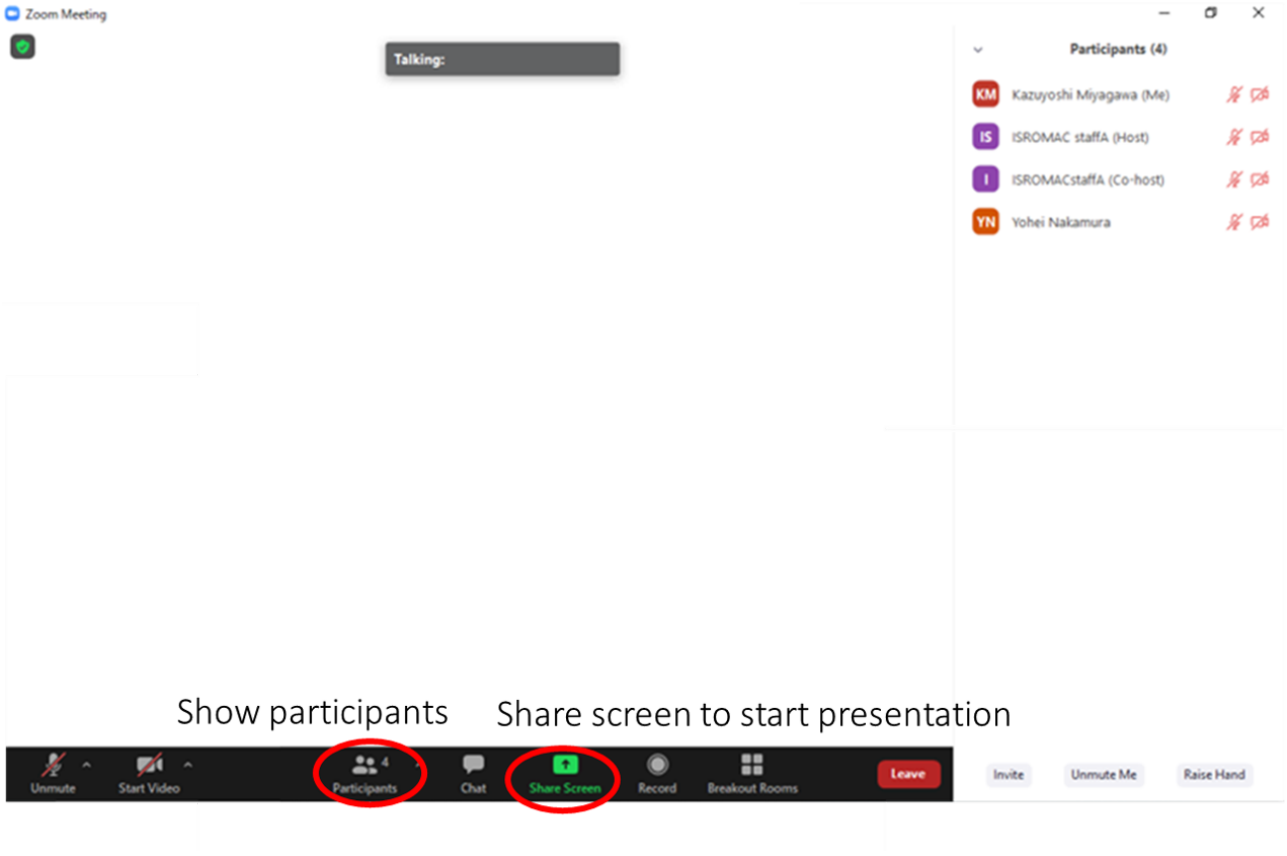
- Introduce yourself and the session.
- Mention the presentation time: 25 minutes total.
  - 18 minutes for the presentation,
  - 5 minutes for questions,
  - 2 min to prepare for the next presentation.
- Introduce the hand raising function for Q&A.
- Remind the audience that recording the conference is prohibited.

Starting each presentation, please follow the steps below.

- The Waseda host will let the presenter screen-share. If the presentation is pre-recorded, the Waseda host will share his screen and play the video.
- Introduce the paper title and authors.
- Start the presentation (Mute yourself and turn off video when the presenter talks).
- Ask participants to turn on/off participants' microphones and video for questions if they forget.
- Check the chat window in case of questions. Ask the question with your voice in the chatter's stead.
- At end of presentation, ask the presenter to turn off the screen sharing, microphone and video.
- Make sure to respect the schedule.

At end of session, mention the next time block start and end time, whether it is a break, lunchtime or another session or any pertinent information.

Instructions for the Presenter



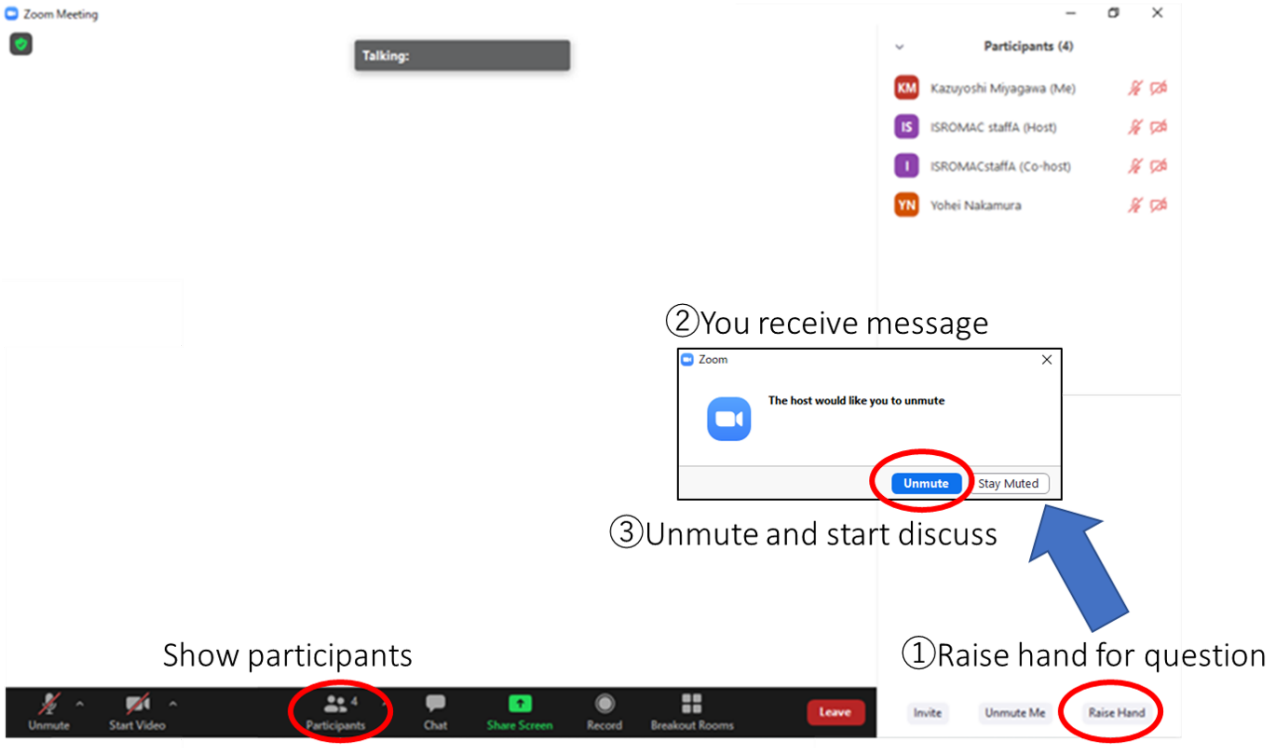
Make sure to log in to your Room 10 minutes before the session starts. The chair will enable your microphone and screen sharing. Check your microphone and video feeds. Your microphone should be unmuted only when you need to speak. Before the session starts, please do:

- Prepare your presentation.
- Test your video/audio.
- Share your screen.

Make sure to respect the presentation time: 25 minutes total.

– 18 minutes for the presentation,
– 5 minutes for questions,
– 2 min to prepare for the next presentation.

Instructions for the Audience



Only registered participants can login to the rooms.
Make sure to use your real name in Latin alphabet when logging in to the rooms: nicknames and anonymous accounts will be blocked.
Mute your microphone and turn off your video.
Please use the hand raising function if you have any question.
If nominated by the chair, you may turn on your video and audio feed to ask a question.

General Schedule

Timezone used is UK time: GMT/UTC. Japan and Korea are UTC+9. China is UTC+8. Europe is UTC+1. US/Canada span UTC-8 west coast to UTC-5 east coast/UTC-4 maritimes.

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Prof. François Avellan (EPFL, Switzerland)</td><td>09:00-10:00</td><td colspan="4">Plenary Session 2
Prof. Helmut J. Holl (Johannes Kepler University of Linz, Austria)</td></tr>
<tr><td>10:00-10:10</td><td colspan="4">Break</td><td>10:00-10:10</td><td colspan="4">Break</td></tr>
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<tr><td>15:00-15:25</td><td rowspan="4">S(1:40)
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S2</td><td rowspan="4">S(1:40)
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S3</td><td rowspan="4">S(1:40)
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Discussion</td></tr>
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S1	Advanced and multiphysics CFD	S11	Hydraulic machines and systems
S2	Aero-acoustics of turbomachines	S12	Liquid rocket engines
S3	Cavitation and multi-phase flows	S13	Marine energy and propulsion systems
S4	Cavitation in turbomachines	S14	Mass and Heat transfer & transport phenomena
S5	Combustion in turbomachines (included in S10)	S15	Positive displacement fluid machinery
S6	Compressors and fans	S16	Pumping machinery
S7	Design and optimization of turbomachines	S17	Rotor and structural dynamics in turbomachines
S8	Experimental techniques applied to turbomachines	S18	Steam and gas turbines
S9	Fluid-structure interaction in turbomachines	S19	Turbocharging systems
S10	General topics	S20	Wind energy

ISROMAC18 (4 Rooms, 15/18 min presentation - 5 min Q&A)				
Nov. 25, 2020 (Wed)				
Time (GMT+0)	Room 1	Room 2	Room 3	Room 4
08:50-09:00	Opening			
09:00-10:00	Plenary Session 3 Prof. Chisachi Kato (University of Tokyo, Japan)			
10:00-10:10	Break			
10:10-10:35	S(2:05) 5 papers S16	S(00:50) 2 papers S18	S(2:05) 5 papers S3	S(1:15) 3 papers S8
10:35-11:00				
11:00-11:25				
11:25-11:50				
11:50-12:15				
12:15-13:10	Lunch (00:55)			
13:10-13:35	S(1:40) 4 papers S12	S(1:40) 4 papers S2		S(1:40) 4 papers S1
13:35-14:00			S(1:15) 3 papers S15	
14:00-14:25				
14:25-14:50				
14:50-15:00	Break			
15:00-15:25	S(2:05) 5 papers S12	S(1:40) 4 papers S2	S(1:40) 2 papers + Discussion S15	S(00:50) 2 papers S1
15:25-15:50				
15:50-16:15				
16:15-16:40				
16:40-17:05				

ISROMAC18 (4 Rooms, 15/18 min presentation - 5 min Q&A)				
Nov. 26, 2020 (Thu)				
Time (GMT+0)	Room 1	Room 2	Room 3	Room 4
08:50-09:00	Opening			
09:00-10:00	Plenary Session 4 Prof. Mehrdad Zangeneh (University College London, United Kingdom)			
10:00-10:10	Break			
10:10-10:35	S(1:40) 4 papers S13	S(1:15) 3 papers S6	S(1:40) 4 papers S4	S(1:40) 4 papers S7
10:35-11:00				
11:00-11:25				
11:25-11:50				
11:50-12:45	Lunch (00:55)			
12:45-13:10				S(1:15) 3 papers S7
13:10-13:35	S(1:15) 3 papers S13	S(1:40) 4 papers S6	S(1:15) 3 papers S4	
13:35-14:00				
14:00-14:25				S7 Panel Discussion
14:25-14:50				
14:50-15:15	Closing Ceremony			

S1	Advanced and multiphysics CFD	S11	Hydraulic machines and systems
S2	Aero-acoustics of turbomachines	S12	Liquid rocket engines
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S9	Fluid-structure interaction in turbomachines	S19	Turbocharging systems
S10	General topics	S20	Wind energy

Opening Ceremony

November 23rd, 2020 (Monday) - Plenary Session Room

08:40−9:00 (GMT+0)	**Opening Ceremony** Chair: Dr. Arthur Favrel (Waseda University, Japan)
	Opening Speech: Prof. Kazuyoshi Miyagawa (Waseda University, Japan) Chair of ISROMAC18
	Introductory Speech: Prof. Masaru Ishizuka, President of Pacific Center of Thermal-Fluid Engineering (PCTFE)
	Conference Information: Gabriel Taillon (Waseda University, Japan)
	Introduction of Plenary Lecture 1: Prof. Shuhong Liu (Tsinghua University, China)

Closing Ceremony

November 26th, 2020 (Thursday) - Plenary Session Room

14:50−15:15 (GMT+0)	**Closing Ceremony** Chair: Dr. Nakjoong Lee (Waseda University, Japan)
	Presentation of ASME Journal of Energy Resources Technology Special Issue: Prof. Ryo S. Amano (University of Wisconsin-Milwaukee, USA)
	Introduction of next ISROMAC chair
	Conference statistics & closing: Dr Arthur Favrel & Prof. Kazuyoshi Miyagawa (Waseda University, Japan)

JOURNAL OF ENERGY RESOURCES TECHNOLOGY

SPECIAL ISSUE DEDICATED TO 2020 ISROMAC--- TRANSPORT PHENOMENA AND DYNAMICS OF ROTATING MACHINERY RESEARCH

Call for Papers

The Special Issue on selected papers from 2020 ISROMAC will include papers that deal with, but are not limited to, the following topics:

- Wind Energy
- Hydraulic Machines and Systems
- Tidal Wave Turbines
- Rotating Equipment for Renewable Energy Power Generation Systems
- Reliability, Operations, and Maintenance
- Fluid Dynamics Issues on Renewable Energy Systems
- Heat Transfer Issues on Renewable Energy Systems
- Advanced Designs of Turbines for Renewable Energy Production Systems
- Other Related Topics

Submission Instructions

Please submit your paper to ASME at http://journaltool.asme.org/Content/index.cfm. If you are a new author go to the site:

https://journaltool.asme.org/Authors/Author/Login-New and log in. Then click "Submit paper." And select Journal of Energy Resources Technology in the Select Journal menu. Click "Continue" bottom, and select "SPECIAL ISSUE DEDICATED TO 2020 ISROMAC--ON TRANSPORT PHENOMENA AND DYNAMICS OF ROTATING MACHINERY RESEARCH"

Early submission before the deadline is strongly encouraged.

Publication Target Dates

Authors submit papers by:	**June 1, 2021 (papers can be submitted after this deadline)**
Initial review completed by:	**September 1, 2021**
Publication of Special Issue:	**January 1, 2022**

Papers submitted by March 1, 2021, will be reviewed in time for inclusion in the Special Issue. Manuscripts received after that date may still be considered for the Special Issue if time and space permit. Manuscripts that are not ready for production in time for inclusion in the Special Issue may be considered for a regular issue of the journal.

Guest Editors

Dr. Ryo S. Amano **University of Wisconsin-Milwaukee, USA** **amano@uwm.edu**	**Dr. Kazuyoshi Miyagawa** **Waseda University, Tokyo, Japan** **k-miyagawa@waseda.jp**	**Dr. Christopher Niezrecki** **University of Massachusetts Lowell, USA** **Christopher_Niezrecki@uml.edu**

Technical Sessions

S1 Advanced and multiphysics CFD

Session Description

In the last decades, the development of turbomachinery has progressed noticeably to elucidate internal flows by conducting Computational Fluid Dynamics (CFD) computations in addition to experiments. To further improve the efficiency of turbomachinery and develop the next generation of hydraulic machines, it is essential to clarify details of complex phenomena such as unsteady flow, vibration phenomena, fluid noises, thermal stresses, chemical kinetics, fluid interaction, and electromagnetic field. Recently, Advanced and Multiphysics CFD have been touted as a solution method to clear up these phenomena, and its contribution to technology improvement is significant. Thus, presenters and audiences are invited to participate in this session to share innovative ideas and expand international cooperation and understanding in the field of Advanced and Multiphysics CFD.

Session Organizers

Akira Fujii

Akira Fujii is working as a Lead Application Engineer at ANSYS Japan. His specialty is CFD (Computational Fluid Dynamics) for the turbomachinery including cavitating flow and FSI (Fluid Structure Interaction). He is also working on the IoT/Digital Twin regions for the predictive maintenance.

Koichi Nishibe is working as an Associate Professor at Department of Mechanical Engineering of Tokyo City University (Tokyo, Japan). His research interests include topics related to multi-phase and particulate flows, performance improvement and active control of unsteady internal flow of positive displacement machines and turbomachinery such as pump, fan, compressor, based on understanding obtained by comparison between Computational Fluid Dynamics (CFD) and Experimental Fluid Dynamics (EFD).

Koichi Nishibe

November 25th, 2020 (Wednesday) - Room 4

13:10–14:50 (GMT+0)	**S1 Advanced and Multiphysics CFD (Part 1)** Chair: Dr. Akira Fujii (ANSYS, Japan)
13:10–13:35	ISROMAC2020-00033 **Kaleb Brookshire** and O. Coutier-Delgosha *An Analysis of Computation Fluid Dynamics and Surface Piercing Propellers Hydrodynamic Loads*
13:35–14:00	ISROMAC2019-00085 **Sasuga Ito**, Masato Furukawa, Kazutoyo Yamada, and Kaito Manabe *Applying Ensemble Kalman Filter to Transonic Flows through a Two-Dimensional Turbine Cascade*
14:00–14:25	ISROMAC2019-00115 **Weixiang Ye**, Prof. K. Miyagawa, and Prof. X. W. Luo *A modified partially averaged Navier-stokes model for the turbulent flows over a backward facing step*
14:25–14:50	ISROMAC2019-00055 **Alexander Fuhring**, D. Kožulović, C. Bode, and M. Franke *Modeling of Wake Effects in Steady State Mixing Plane Simulations of a High Lift Turbine Cascade with Different Combinations of Wake Passing Frequency and Wake Orientation*
14:50–15:00	**Break**
15:00–15:50 (GMT+0)	**S1 Advanced and Multiphysics CFD (Part 2)** Chair: Prof. Koichi Nishibe (Tokyo City University, Japan)
15:00–15:25	ISROMAC2020-00032 **Alexander Fuchs***, Johann Göttler, and Oskar J. Haidn *Leakage and Movement Behavior of Brush Seals*
15:25–15:50	ISROMAC2020-00027 **Dr. Akira Fujii** *Unsteady Prediction of Thermal Flow by Machine and Deep Learning*

* Pre-recorded presentation

S2 Aero-acoustics of turbomachines

Session Description

Aeroacoustics refers to aerodynamic sound generation and propagation. It is a real concern in many areas of turbomachinery applications such as aeronautical propulsion systems, cooling and air-conditioning systems, drones, urban air vehicles and wind-turbine technology. It differs from structural-vibration noise in that it is an essential signature and by-product of unsteady flows in blade or vane rows. In aeronautics the growing interest for aeroacoustics is justified by the emergence of more and more stringent ICAO standards and the targeted reduction of community noise around airports. In low-speed air-engineering applications new regulations are also defined to meet the everyday-life comfort required by populations. Noise is one of the features to be reduced in multidisciplinary optimization approaches, together with pollutant emissions and energy losses/consumption. The growing development of wind turbines, both inside and outside cities, and moreover of drones and urban air mobility, generates new challenges to reduce noise exposure of populations. Aeroacoustics also requires the most demanding extensions of the computational resources presently used to produce realistic predictions of unsteady flows in turbomachinery stages. The session Aeroacoustics of turbomachines of ISROMAC 18 is aimed at making a point on recent advances in rotating-blade aeroacoustics, which includes: (1) - aerodynamic noise prediction strategies based on analytical and/or numerical methods; (2) - experimental studies dedicated to the characterization of aerodynamic noise sources; (3) - physical understanding and the connection with unsteady flows in turbomachines.

Session Organizers

Michel Roger is working as a Professor at Ecole Centrale de Lyon (ECL, France). Teaching General Aeroacoustics, he coordinates the research activities of the Laboratoire de Mécanique des Fluides et Acoustique (LMFA) of ECL in the field of rotating-blade and airfoil noise, essentially by means of experimental and analytical methods.

Michel Roger

Stéphane Moreau has been working as a Research Manager at Safran Aircraft Engines and Valeo (France), before he obtained a Professor position in the Mechanical Engineering department of Sherbrooke University (Québec, Canada). He develops advanced numerical and analytical methods in unsteady Fluid Dynamics, dedicated to the aeroacoustics design of rotating-blade technologies.

Stéphane Moreau

November 24th, 2020 (Tuesday) - Room 2

13:10–14:50 (GMT+0)	**S2 Aero-acoustics in turbomachines (Part 1)** Chair: Prof. Michel Roger (Ecole Centrale de Lyon, France)
13:10–13:35	ISROMAC2019-00056 **Rebecca Schäfer*** and Martin Böhle *Validation of the Lattice Boltzmann Method for the simulation of the aerodynamics and aeroacoustics in a centrifugal fan*
13:35–14:00	ISROMAC2019-00034 P. Bernicke and **Prof. Rinie Akkermans** *Hybrid Overset-LES Simulations of Noise Reduction Concepts of Loaded Airfoils*
14:00–14:25	ISROMAC2019-00227 **Dr. Kentaro Hayashi**, S. Nakaye, and S. Nishimura *Lattice Boltzmann Simulation of Industrial Axial Fan Noise*
14:25–14:50	ISROMAC2019-00015 Prof. Michel Roger and **Prof. Stéphane Moreau** *Analytical Modeling of Modulated Rotating-Blade Noise: the Skipping Rope and the Darrieus Wind Turbine*
14:50–15:00	**Break**
15:00–16:40 (GMT+0)	**S2 Aero-acoustics in turbomachines (Part 2)** Chair: Prof. Stéphane Moreau (Université de Sherbrooke, Canada)
15:00–15:25	ISROMAC2019-00130 **Prof. Marlene Sanjose**, Sandra Hub, Frieder Lörcher, and Stéphane Moreau *Noise mechanisms in a radial fan without volute*
15:25–15:50	ISROMAC2019-00166 **Dr. Manuel Henner**, B. Demory, M. Alaoui, M. Laurent, and B. Behey *Effect of blade curvature on fan integration in engine cooling module*
15:50–16:15	ISROMAC2019-00234 **Dr. Till M. Biedermann**, P. Czeckay, N. Hintzen, F. Kameier, and C. O. Paschereit *Aeroacoustic Scaling Laws of Leading Edge Serrations for Rotating Applications*
16:15–16:40	ISROMAC2019-00020 **Prof. Damiano Casalino** E. Grande, G. Romani, D. Ragni, and F. Avallone *Towards the definition of a benchmark for low Reynolds number propeller aeroacoustics*

* Pre-recorded presentation

November 25th, 2020 (Wednesday) - Room 2

13:10–14:50 (GMT+0)	**S2 Aero-acoustics in turbomachines (Part 3)** Chair: Prof. Stéphane Moreau (Université de Sherbrooke, Canada)
13:10–13:35	ISROMAC2019-00114 Keqi Hu, Yuanqi Fang, Yao Zheng, **Dr. Gaofeng Wang**, and Stéphane Moreau *Numerical Investigation of Influence of Entropy Wave on the Pressure Field and Wall Heat Transfer Characteristics of a High-Pressure Turbine Guide Vane*
13:35–14:00	ISROMAC2019-00088 **Dr. Kazuyoto Yamada**, M. Furukawa, S. Sakurada, T. Mizokami, S. Aso, K. Sakoda, and T. Fukui *Effect of Resonant Environment on Discrete Frequency Noise Generation from a Two-Dimensional Airfoil*
14:00–14:25	ISROMAC2019-00044 **Prof. Michel Roger** and Prof. Stéphane Moreau *Tonal-Noise Assessment of Quadrotor-Type UAV Using Source-Mode Expansions*
14:25–14:50	ISROMAC2019-00061 R. S. McKay, S. T. Go, S. Jung, and **Dr Michael J. Kingan** *Noise from Unmanned Aerial Vehicle Contra-Rotating propellers*
14:50–15:00	**Break**
15:00–16:40 (GMT+0)	**S2 Aero-acoustics in turbomachines (Part 4)** Chair: Prof. Michel Roger (Ecole Centrale de Lyon, France)
15:00–15:25	ISROMAC2019-00094 **Ignacio Zurbano Fernandez**, Alain Guédel, Mirela Robitu, and Michel Roger *Analytical prediction of the broadband noise of a plug fan*
15:25–15:50	ISROMAC2020-00060 **Orestis Amoiridis**, Riccardo Zamponi, A. Zarri, J. Christophe, and C. Schram *Localization and characterization of rotating noise sources on axial fans by means of an irregularly shaped microphone array*
15:50–16:15	ISROMAC2019-00050 **Pavel Kholodov** and Stéphane Moreau *Identification of Noise Sources in a Realistic Turbofan Rotor Using Large Eddy Simulation*
16:15–16:40	ISROMAC2019-00087 **Alessandro Zarri**, Julien Christophe, Stéphane Moreau, and Christophe Schram *Sweep-angle effect on low-order acoustic prediction for low-speed fans*

* Pre-recorded presentation

S3 Cavitation and multi-phase flow

Session Description

The session Cavitation and Multiphase flows of ISROMAC 18 aims at gathering, exchanging and sharing information between researchers and engineers about experimental and numerical basic research about cavitation, bubbly flows, droplet flows and free surface flows. Proposals of new numerical and mathematical models, new measuring techniques and newly found characteristics about cavitation and multiphase flows are welcome.

Session Organizers

Yuka Iga

Yuka Iga is working as a Professor at Institute of Fluid Science, Tohoku University, Japan. She received B. S., M.S. and Phd. Eng. from Tohoku University. Her main research interests are cavitation and phase change, especially in cavitation instabilities in liquid propellant rocket turbopump and thermodynamic effect of cavitation in cryogenic fluid.

Mohamed Farhat is Senior Scientist at EPFL-LMH and Head of the Cavitation Research Group. He graduated at Ecole Nationale Supérieure d'Hydraulique et de Mécanique de Grenoble (France) and completed in 1994 a Ph.D. thesis on Cavitation at EPFL Laboratory for Hydraulic Machines. His research is mainly focused on Cavitation and Multiphase Flows, Fluid-Structure Interaction, Free Surface Flows, Hydrodynamics of Turbines and Pumps, Bioreactors and Hemodynamics.

Mohamed Farhat

Shin-Ichi Tsuda

Shin-ichi Tsuda is an associate professor in Department of Mechanical Engineering at Kyushu University, Japan. He received B.S. and M.S. from Tohoku University, and Phd. Eng. from the University of Tokyo. His main research interest is multiscale modeling of cavitation in water and in cryogenic fluids, employing molecular dynamics simulation on bubble nucleation-growth or collapse and CFD simulation around simple bodies. Also he has engaged in ab-initio evaluation of thermophysical properties of liquid rocket propellant such as hydrogen and oxygen.

Invited Talk - Prof. Outi Supponen (ETHZ, Switzerland)

November 24 (Tuesday) - 16:15-16:40

Title: Ultra-high-speed experiments on single cavitation bubbles
Authors: **Outi Supponen** (ETHZ), Danail Obreschkow (UWA) and Mohamed Farhat (EPFL)

Summary:
We present ongoing research efforts to reach a fundamental understanding of the intriguing and violent dynamics of a single cavitation bubble, combining delicate ultra-high-speed experiments with theory. In particular, we present our efforts to characterise the single bubble collapse in great detail, with a focus on their strong shock-wave emissions, high-speed jets, and extreme heating. Overall, these results help in predicting bubble collapse characteristics in known pressure fields and can be useful to better understand the process of cavitation erosion in hydraulic machines and for numerical benchmarking as well.

Invited Talk - Dr. Ali Amini (EPFL, Switzerland)

November 24 (Tuesday) - 15:50-16:15

Title: Recent Advancements in Mitigating Tip Vortex Cavitation
Authors: **Ali Amini** (EPFL) and Mohamed Farhat (EPFL)

Summary:
Tip Vortex Cavitation (TVC) is an important issue in the design and operation of axial hydraulic machines. Despite the large body of knowledge dealing with TVC mitigation techniques, any new flow control strategies are highly sought for. Taking an elliptical NACA 16-020 hydrofoil as the baseline, we have investigated two methods for this purpose: non-planar winglets and flexible trailing threads. It has been shown that a winglet as long as 10Velocity measurements reveal that the suppression effect is achieved by enlarging the viscous core radius while the vortex intensity remains constant. In the second method, it is shown that if a sufficiently flexible thread is attached to the tip of the hydrofoil, not only does it get aligned with the vortex, but it starts to interact with it in a dynamic manner. This dynamic response provokes two interaction modes that lead to TVC alleviation: rotational motion and whipping motion, the latter of which is found superior in TVC attenuation.

Keynote Speech - Prof. Shin-Ichi Tsuda (Kyushu University, Japan)

November 25 (Wednesday) - 11:25-11:50

Title: Large Eddy Simulation of Cavitating Flow around Clark Y-11.7% Hydrofoil Using Two Kinds of Homogeneous Cavitation Model
Authors: **Shin-ichi Tsuda** (Kyushu University), Yuichi Kunishima (Kyushu University), Satoshi Watanabe (Kyushu University)

Summary:
We conducted Large Eddy Simulation (LES) using two kinds of homogeneous cavitation model. One is a typical one-equation model proposed by Okita and Kajishima (2002) and the other is Multi-process model (Tsuda and Watanabe, 2015), which includes four equations against moments of size distribution function of bubbles taking account of main elementary processes in cavitation such as inception/collapse, growth/shrinkage, and so on. The target was cavitating flow around Clark

Y-11.7% hydrofoil with the angle of attack of 8 degree, and we confirmed that the present LES can well reproduce a characteristic unsteadiness of shedding of sheet/cloud cavitation. In addition, we have found that cavitation inception in Okita-Kajishima model occurred around the suction peak point on the hydrofoil while the inception point in Multi-process model was around boundary layer separation point downstream from the suction peak showing qualitative coincidence to experiments. The present result indicates that Multi-process model implemented in LES may have a potential to reproduce the actual cavitation inception.

November 24th, 2020 (Tuesday) - Room 3

15:00−16:40 (GMT+0)	**S3 Cavitation and multi-phase flows (Part 1)** Chairs: Dr Mohamed Farhat (EPFL, Switzerland) Prof. Yuka Iga (Tohoku University, Japan)	
15:00−15:25	ISROMAC2019-00174	K. Kobayashi, Y. Katayama, **Prof. Satoshi Watanabe**, and S. Tsuda
	Experimental investigation on cavity pressure inside sheet cavitation	
15:25−15:50	ISROMAC2019-00023	**Sebastian Klein**, Tobias Traudt, and Michael Oschwald
	Influence of cavitation on the acoustic boundary conditions in water hammer experiments	
15:50−16:15	Invited Talk	**Dr Ali Amini** and Dr Mohamed Farhat
	Recent Advancements in Mitigating Tip Vortex Cavitation	
16:15−16:40	Invited Talk	**Prof. Outi Supponen**, Prof. Danail Obreschkow and Dr Mohamed Farhat
	Ultra-high-speed experiments on single cavitation bubbles	

November 25th, 2020 (Wednesday) - Room 3

10:10−12:15 (GMT+0)	**S3 Cavitation and multi-phase flows (Part 2)** Chairs: Prof. Yuka Iga (Tohoku University, Japan) Prof. Shin-Ichi Tsuda (Kyushu University, Japan)
10:10−10:35	ISROMAC2019-00142 **Koki Sugaya**, Takaho Ochiai, Junnosuke Okajima, and Yuka Iga *Experimental Study of Break-off Frequency in Cavitation Disappearance Phenomenon on NACA16-012 Hydrofoil*
10:35−11:00	ISROMAC2019-00202 **Dr. Takahito Miki**, Keita Fujiyama, Shin-ichi Tsuda, and Tomohiro Irie *Cavitation analysis of a Delft twisted hydrofoil using multi-process cavitation model*
11:00−11:25	ISROMAC2020-00040 **Yoshifumi Mukai**, Taisei Mineshima, Shunsuke Nakai, and Kazuyoshi Miyagawa *Investigation of Fluid Exciting Force on a Hydrofoil under Various Cavitating Flows*
11:25−11:50	Keynote Speech **Prof. Shin-ichi Tsuda**, Yuichi Kunishima and Prof. Satoshi Watanabe *Large Eddy Simulation of Cavitating Flow around Clark Y-11.7% Hydrofoil Using Two Kinds of Homogeneous Cavitation Model*
11:50−12:15	ISROMAC2020-00031 **Dr. Qin Wu**, Yunqing Liu, Biao Huang, and Guoyu Wang *Experimental and numerical investigation of cavitating flow-induced vibration of a flexible hydrofoil*

S4 Cavitation in turbomachines

Session Description

The session Cavitation in Turbomachines of ISROMAC18 mainly refers to cavitation phenomena in all kinds of turbomachinery such as pumps, hydro turbines, propellers and so on. Cavitation in such turbomachines is a very important issue related with pressure oscillations, operation instability and material damage. The purpose of this session is to have common basic knowledge concerning unsteady cavitating turbulent flows among these turbomachines for a better understanding of the complex phenomena. In recent years, computational and experimental techniques have been developed and applied to clarify unsteady cavitating turbulent flows in turbomachines. However, it is important that appropriate numerical models and experimental instruments are prepared to grasp the physics of such complex flows. These technologies and common understanding will be discussed in this forum. The Cavitation in Turbomachines session of ISROMAC18 aims to provide a good opportunity for a broad exchange of recent researches involving (1) basics of bubble dynamics, (2) experimental approaches for cavitation, (3) numerical methodologies, (4) cavitating flow analysis, (5) design and optimization of turbomachines, and (6) cavitation erosion. Any topics related with cavitation in turbomachines are welcome.

Session Organizers

Xianwu Luo

Prof. Xian-Wu Luo is working as a Professor at Department of Energy and Power Engineering of Tsinghua University, Beijing, China. He received his B.S. and M.S. degrees from Tsinghua University, China, and Dr. Eng. from Kyushu Institute of Technology, Japan. He is interested in research and development of turbomachinery such as hydro turbines, pumps, small wind turbines, etc. based on the understanding of internal flow using CFD and experimental results.

Dr Motohiko Nohmi received a doctoral degree of engineering from Waseda university, Japan. He has been working at EBARA Corporation since 1995. His main research topics are fluid mechanics, hydraulic machineries, computational fluid dynamics, experimental fluid dynamics and cavitation. He is a former chairperson of fluid engineering division of the Japan Society of Mechanical Engineers (JSME). He is a JSME Fellow.

Motohiko Nohmi

November 26th, 2020 (Thursday) - Room 3

10:10−11:50 (GMT+0)	**S4 Cavitation in turbomachines (Part 1)** Chair: Dr. Motohiko Nohmi (Ebara Corporation, Japan)
10:10−10:35	ISROMAC2019-00183 **Matteo Tumminia***, Dario Valentini, Giovanni Pace, Ruzbeh Hadavandi, Lucio Torre, Angelo Pasini, and Luca d'Agostino *Maximum Likelihood Identification of Cavitation Instabilities in Axial Inducers*
10:35−11:00	ISROMAC2019-00164 **Yashwant Moganaradjou**, Anindita Apurbaa Phukan, S. Vengadesan, and Dhiman Chatterjee *Numerical investigation of the effect of leakage flow on cavitation in centrifugal pump*
11:00−11:25	ISROMAC2019-00071 Ruizhi Zhang, An Yu, Michihiro Nishi, and **Prof. Xianwu Luo** *Numerical Investigation of Pressure Fluctuation and Cavitation inside a Francis Turbine Draft Tube with Air Admission through a Fin*
11:25−11:50	ISROMAC2020-00028 **Prof. Satoshi Watanabe** and Y. Tsujimoto *One-dimensional stability analysis of cavitation surge in pumps considering phase lag in dynamic cavitation characteristics*
11:50−13:10	**Lunch Break**
13:10−14:25 (GMT+0)	**S4 Cavitation in turbomachines (Part 2)** Chair: Prof. Xianwu Luo (Tsinghua University, China)
13:10−13:35	ISROMAC2019-00218 **Takeshi Sano**, Masamichi Iino, and Satoshi Maeda *Effect of leading edge profile on cavitation performance of mixed flow impeller*
13:35−14:00	ISROMAC2019-00235 **Tsuneda Tomoki**, Shusaku Kagawa, Hiroaki Nakamoto, and Motohiko Nohmi *A Preliminary Study for Numerical Prediction of Cavitation Erosion in Pumps*
14:00−14:25	ISROMAC2019-00186 **Prof. Ryoichi Amano** *Investigation of Cavitation in Kaplan Hydro Turbine Runner Chamber*

* Pre-recorded presentation

S5 Combustion in turbomachines

Session Description

Combustion is typically used as an energy source to drive several kinds of turbomachines such as gas turbines, jet engines and liquid rocket engines. When designing combustion devices for such applications, designers need to take into account efficient mixing of fuel and oxidizer, efficient and stable combustion, and effective cooling methods. The Combustion in Turbomachines session of ISROMAC 18 covers various topics related to combustion as an energy source for turbomachines. Proposals of numerical and experimental analyses, numerical models, measuring techniques, design and optimization of combustion devices, and new findings on combustion and heat transfer phenomena are greatly welcome.

Session Organizers

Hideyo Negishi

Hideyo Negishi is a senior researcher at the research and development directorate of the Japan Aerospace Exploration Agency(JAXA). He has been involved in the development of liquid rocket engines and working on a variety of their numerical simulations, covering combustors, turbopumps, nozzles, pipelines, propellant tanks, and end-to-end liquid rocket engine systems, for about 20 years of his career in JAXA.

The paper of this session is included in S10 General Topics.

S6 Compressors and fans

Session Description

The compressors and fans are used in various industrial domains, from Aeronautics and Automotive industries to household applications. Their use, but also their manufacturing process, represents a significant energy consumption. The design of compressors and fans has evolved to get higher efficiencies, lower noise and extended ranges of efficient use, together with the increasing use of inverters and drive controllers. The different design parameters are becoming more numerous (skew/sweep, tandem machines, counter-rotating machines, ...). The interactions of these machines with their environment (for instance the heat exchanger in an automotive cooling fan system) and their influence on the performance and noise generation are more and more a constraint that must be taken into account from the very conception. The characterization of their transient behavior is also a key parameter for system modeling. Moreover, in the case of compressors, the occurrence of instabilities known as rotating stall and surge limits the operating range. Such unstable phenomena induce a considerable drop of performance in terms of pressure ratio, efficiency and mass flow, also leading to serious mechanical failures. Consequently, a surge margin is usually imposed to prevent the compressor operation from these situations. Both the increase of the stable operating range and the improvement of the surge margin are crucial and represent a real challenge for designers. The Compressors and Fans Session of the ISROMAC 18 Conference is aimed at making a point on recent advances in design and characterization of compressors and fans, which includes: (1) The various design methods and their coupling with optimization algorithms; (2) Experimental and CFD studies dedicated to the characterization of unsteady and off-design behaviors; (3) Passive or active control (blowing/suction, actuators and deformable materials).

Session Organizers

Florent Ravelet is working as an Associate Professor at Arts et Metiers (ENSAM, France), teaching turbomachinery and industrial multiphase flows. His present research at Laboratoire LIFSE (ENSAM) is dedicated to the design and study of subsonic counter-rotating fans and pumps, and to the study of cavitation instabilities at very low Reynolds numbers.

Florent Ravelet

Kazutoyo Yamada is working as an Associate Professor at Iwate University in Japan, teaching turbomachinery. His present research at Iwate University is dedicated to the clarification of unsteady flow phenomena in fans and compressors used for gas turbines, turbochargers and cooling fans in terms of aerodynamic performance improvement and noise reduction.

Kazutoyo Yamada

November 26th, 2020 (Thursday) - Room 2

10:10–11:25 (GMT+0)	**S6 Compressors and Fans (Part 1)** Chair: Prof. Kazutoyo Yamada (Iwate University, Japan)
10:10–10:35	ISROMAC2019-00162 **Vu-Dinh Dang**, Prof. Amélie Danlos, Michaël Pereira, Mohammadali Shirinbayan, Florent Ravelet, Farid Bakir, and Abbas Tcharkhtchi *Effects of some settings of rotational-molding process on the aeromechanical performance of an axial fan*
10:35–11:00	ISROMAC2019-00101 **Kenta Tajima**, Hiroshi Miida, Nobumichi Fujisawa, and Yutaka Ohta *The Effect of Unsteady Vortex Behavior on Noise Characteristics in a Centrifugal Compressor*
11:00–11:25	ISROMAC2019-00239 **Isao Tomita** and Masato Furukawa *Design Concept with Tip Leakage Vortex Control for Centrifugal Compressor Flow Stabilization*
11:25–13:10	**Lunch Break**
13:10–14:50 (GMT+0)	**S6 Compressors and Fans (Part 2)** Chair: Dr Florent Ravelet (ENSAM, France)
13:10–13:35	ISROMAC2019-00172 **Dr Van-Thang Nguyen**, Prof. Amélie Danlos, Richard Paridaens, Florent Ravelet, Michael Deligant, Sofiane Khelladi, and Farid Bakir *Experimental study of a centrifugal compressor with two successive and counter-rotating impellers*
13:35–14:00	ISROMAC2019-00026 **Anika Theis**, M. Böhle *Influence of the Rotor Blade Aspect Ratio on the Performance of an Axial Fan*
14:00–14:25	ISROMAC2019-00012 **Aaron Kasper**, Alexander Hergt, Thomas Stürzebecher, Sebastian Grund, Jasmin Flamm, Eberhard Nicke *Flow Structure within an Aggressive S-Shaped Intermediate Compressor Duct*
14:25–14:50	ISROMAC2019-00059 **Jannik Eckel*** and V. Gümmer *Numerical Investigation of Compressor Tandem Aerofoils Featuring Near-Endwall Modification*

* Pre-recorded presentation

S7 Design and optimization of turbomachines

Session Description

Computer aided optimization (CAO) have been applied to the design of all kinds of aerodynamic, hydrodynamic parts of turbomachinery such as compressors, pumps, hydro turbines and so on. Recent progress of computer technologies and developments of simulation software includes single and multi-objective optimization of single area (performance for example), interdisciplinary (or Multi-disciplinary) optimization approaches considering plural objectives such as aero/hydro performance, mechanical reliability, operational stability, costs of production etc. The use of new optimization approaches such as adjoint method, topological optimization has also significantly increased in the last decade. These approaches should become more and more important in the future to undertake further challenges and to produce "breakthrough" design featuring high performance and high reliability with compact size etc. The Design and optimization of turbomachines session of ISROMAC 18 aims at providing opportunity to present and discuss recent researches about optimization methods and experimental validation of these methods, and their application to design of turbomachinery. Any topics related to design and optimization of turbomachines are welcomed.

Session Organizers

Hiroyoshi Watanabe

Dr. Hiroyoshi Watanabe is a General Manager at Technology Development Department, Strategy & Technology Management Division, Fluid Machinery & Systems Company, Ebara Corporation, Japan. He received his B.S. and M.S. degrees from KEIO University, and Dr. Eng. from University of Kyushu, Institute of Technology, Japan. He is now in charge of the development and application of fundamental technologies for fluid machinery at Ebara Corporation

Dr. Hiroyoshi Watanabe is a General Manager at Technology Development Department, Strategy & Technology Management Division, Fluid Machinery & Systems Company, Ebara Corporation, Japan. He received his B.S. and M.S. degrees from KEIO University, and Dr. Eng. from University of Kyushu, Institute of Technology, Japan. He is now in charge of the development and application of fundamental technologies for fluid machinery at Ebara Corporation

Satoshi Kawasaki

November 26th, 2020 (Thursday) - Room 4

10:10–11:50 (GMT+0)	**S7 Design and Optimization of turbomachines (Part 1)** Chair: Dr. Hiroyoshi Watanabe (Ebara Corporation, Japan)
10:10–10:35	ISROMAC2020-00029 **Ujjwal Shrestha*** and Young-Do Choi *Optimization of J-Groove shape for the suppression of swirl flow in the draft tube of Francis hydro turbine*
10:35–11:00	ISROMAC2019-00147 **Ryo Watanabe**, Kazuyoshi Miyagawa, Mohammad Hossein Khozaei, Naoki Yamaguchi, Toshitake Masuko *Optimization procedure for a Francis Turbine Runner using 2D Through-Flow Analysis*
11:00–11:25	ISROMAC2020-00163 **Koray Sevinc** *Aerodynamic design optimization of a bellmouth shaped air intake for jet engine testing purposes and its experiment based validation*
11:25–11:50	ISROMAC2019-00228 **Yosuke Misono** T. Kuboyama, Y. Moriyoshi, and T. Yamada *Improvement in accuracy of engine cycle simulations by using a turbocharger prediction model instead of measured efficiency map*
11:50–12:45	**Lunch Break**
12:45–14:00 (GMT+0)	**S7 Design and Optimization of turbomachines (Part 2)** Chairs: Mr. Satoshi Kawasaki (Japan Aerospace Exploration Agency (JAXA), Japan) Dr Byungjin An (Ebara Corporation, Japan)
12:45–13:10	ISROMAC2019-00199 **Samuel Sudhof**, Uemura Norimichi, Masaharu Uchiumi *Supervised Learning for Generating Fair Curves with Curvature Boundary Conditions*
13:10–13:35	ISROMAC2019-00032 **Lisa Hühn**, Julius Wilhelm, Corina Schwitzke, Hans-Jörg Bauer *Extensive experimental and analytical investigation of the aerodynamic flow field of labyrinth seals with innovative liner configurations*
13:35–14:00	ISROMAC2019-00102 **Alessandro Apollonio**, A. Anderlini, D. Valentini, G. Pace, A. Pasini, M. V. Salvetti, and L. d'Agostino *Turbopump Design: Comparison of Numerical Simulations to an Already Validated Reduced-Order Model*
14:00–14:50	**Workshop on inverse design based multi-point optimization**

* Pre-recorded presentation

Workshop on inverse design based multi-point optimization

Live Presentation by Dr J. Zhang, Advanced Design Technology Ltd.

Participants:
Dr H. Watanabe, Ebara Corporation, Prof M. Zangeneh, University College London

Summary:
In this live demonstration, the set up of a multi-point optimization of a mixed flow pump impeller by using a 3D inverse design method, which generates the blade shape for a specified distribution of blade loading, will be presented.

The workshop starts with the key targets for the optimization and briefly presents how the inverse design method can be used to parametrize the blade geometry by using blade loading distribution. One key aspect for successful optimization is the way the range of design parameters are selected. The way the inverse design method facilitates the choice of range of design parameters is presented. In total 5 design parameters are used to parametrize the blade shape and the Design of Experiment method Optimal Latin Hypercube is used to create design matrix consisting of 22 geometries.

These geometries are then run at two operating points of 100% design of design flow and 40% of design flow. Three cases could not be converged in CFD and hence a surrogate model was formed by using the 19 converged cases. The surrogate model used was Kriging. The process of using the surrogate model to obtain a trade off between the two efficiencies or Pmin (as a measure of cavitation) will be shown live during the workshop. The resulting blade shapes and flow field as predicted by the inverse design method will be shown. Also shown will be the results of validation of the surrogate model by CFD. Audience participation and question and answer opportunity to be provide at each stage of the set up of the optimization.

S8 Experimental techniques applied to turbomachines

Session Description

The continuous development of more advanced and sophisticated experimental techniques over the past decades has enabled a better understanding and control of the complex flow phenomena occurring in turbomachines, leading to the improvement of their reliability and efficiency. However, the new challenges faced by turbomachines manufacturers and designers, notably in terms of efficiency improvement, noise reduction, low-carbon power generation, operating range extension and flexibility, still require continuous improvements and developments of advanced experimental techniques. The session Experimental Techniques applied to Turbomachines of ISROMAC 18 is the opportunity for academic and industrial researchers and engineers to exchange and share their knowledge and experience about new advancements in terms of experimental techniques, original experiments on turbomachines on both the reduced scale model and real machines and new insights on complex flow phenomena occurring in turbomachines.

This session welcomes presentations covering advanced experimental techniques applied to turbomachines especially on (but not limited to) "Optical approach for flow visualization and velocity measurements", "Unsteady pressure, velocity and flow rate measurement", "Multi-point pressure and temperature measurement", "Radial and axial force measurement for turbomachinery", "flow control and flow instabilities mitigation" etc. Presentations about experiments on fundamental flow dynamics are also welcome.

Session Organizers

Shigeyuki Tomimatsu

Shigeyuki Tomimatsu is working as a Manager of the R&D Center in DMW Corporation. He received his M.S. degree from Kansai University and Dr. Eng. from Niigata University. His research interests are CFD and quantitative flow visualization for turbomachinery.

Teiichi Tanaka is working as a Professor at National Institute of Technology, Kumamoto College, Japan. He received his B.S., M.S. degrees and Dr. Eng. from Kyushu Institute of Technology, Japan. His research interests include unsteady characteristics of turbomachinery, cavitation in cryogenic pump based on understanding of internal flow using experimental and CFD results.

Teiichi Tanaka

Arthur Favrel

Arthur Favrel is working as a Researcher and Assistant Professor at Waseda Research Institute for Science and Engineering of Waseda University, Japan. After his M.Sc. degree obtained at UCBL (Lyon, France) in Mechanical Engineering, he got his PhD degree at Ecole Polytechnique Fédérale de Lausanne in Switzerland in 2016. His research interests include the investigation of cavitation flows and instabilities occurring in turbomachines by means of experiments, CFD simulation and 1D modelling.

November 25th, 2020 (Wednesday) - Room 4

10:10–11:25 (GMT+0)	**S8 Experimental techniques applied to turbomachines**	
	Chairs:	Dr Shigeyuki Tomimatsu (DMW Corporation, Japan) Prof. Teiichi Tanaka (National Institute of Technology, Kumamoto College, Japan)
10:10–10:35	ISROMAC2019-00110	**Prof. Yu Ito** *The world's first test facility that enables the visualization of cavitation on a rotating inducer in both cryogenic and ordinary fluids*
10:35–11:00	ISROMAC2019-00030	**Silvio Chemnitz** and Reinhard Niehuis *Accurate Boundary Layer Measurements using Hot-Wire Anemometry - Improvements and Error Analysis*
11:00–11:25	ISROMAC2019-00082	**Prof. Teiichi Tanaka**, Takeshi Toyomoto, Kosuke Nasu, and Michiya Tabaru *Transient Characteristics of a Centrifugal Pump at Rapid Startup*

S9 Fluid-structure interaction in turbomachines

Session Description

The field of Fluid Structure Interactions is crucial to get high reliability rotating machines. We are pleased to organize an ISROMAC 18 session about this important topic and welcome participants from both academic institutions and industry. This sessions' topics include: fluid exciting force, flow instability, fluid-structure interaction, high and low cycle fatigue, vibration and noise and countermeasures, computational and experimental approaches and so on. We will be pleased to discuss about your research during the symposium.

Session Organizers

Kazuyoshi Miyagawa

Kazuyoshi Miyagawa is working as a professor at the Department of Applied Mechanics and Aerospace Engineering of WASEDA University, Tokyo, Japan. He received his B.S. and M.S. degrees from WASEDA University, and Dr. Eng. from Osaka University, Japan. He is interested in research and development of turbomachinery such as hydro turbines, pumps, compressors based on an understanding of internal flow and unsteady flow phenomena using CFD and experimental results.

Koichi Yonezawa is working as a Research Scientist at Central Research Institute of Electric Power Industry (CRIEPI), Japan. He received B.S., M.S. and Ph.D from Osaka University. His main research topics are cavitation instabilities and sand erosion in hydro turbines, aerodynamics of rotorcrafts, and thermo-fluid dynamics in steam and gas turbines.

Koichi Yonezawa

Takeshi Sano

Takeshi Sano is working as a fluid dynamics researcher in Mitsubishi Heavy Industries, Ltd. He studies pump instability and got his M.S. from Osaka university. Currently, he is taking care of many research fields, such as cavitation, multiphase flow, and fluid structure interaction, as a research manager.

November 24th, 2020 (Tuesday) - Room 3

10:10–11:50 (GMT+0)	**S9 Fluid-structure interaction in turbomachines (Part 1)** Chair: Dr. Koichi Yonezawa (Central Research Institute of Electric Power Industry, Japan)
10:10–10:35	ISROMAC2019-00139 **Dr Antoine Placzek*** *Assessment of single passage simulations for the aeroelastic stability of a multistage centrifugal compressor*
10:35–11:00	ISROMAC2019-00219 **Shinji Fukao**, Kensuke Futahasji, Ryuichi Umehara, and Takeo Baba *Evaluation of self-induced oscillation of the flow control valve by fluid structure interaction analysis*
11:00–11:25	ISROMAC2019-00161 **Anna Bru Revert***, Paul F. Beard, John W. Chew, and Sebastiaan Bottenheim *Sealing Performance of a Turbine Rim Chute Seal Under Rotationally-Induced Ingestion*
11:25–11:50	ISROMAC2019-00215 **Ryosuke Mori**, Kazushi Ajiro and Kazuyoshi Miyagawa *Characteristics of fluid exciting force due to blade row interaction of a propeller turbine*
11:50–13:10	**Lunch Break**
13:10–14:50 (GMT+0)	**S9 Fluid-structure interaction in turbomachines (Part 2)** Chair: Dr. Takeshi Sano (Mitsubishi Heavy Industries, Japan)
13:10–13:35	ISROMAC2019-00198 **Dr. Koichi Yonezawa**, K. Nishimura, T. Sano, K. Miyagawa, and Y. Tsujimoto *Sloshing of Fluid between Rotating Inner Vertical Shaft and Stationary Outer Casing*
13:35–14:00	ISROMAC2019-00022 **Matthias Schuff**, Virginie Anne Chenaux *Coupled Mode Flutter of a Linear Compressor Cascade in Subsonic and Transonic Flow Conditions*
14:00–14:25	ISROMAC2019-00209 **Kazufusa Tsutaya**, Z. Liu, M. Kubo, and K. Miyagawa *Mitigation method for pressure fluctuations induced by acoustic resonance*
14:25–14:50	ISROMAC2019-00038 **Keisuke Matsumoto**, Tomoyuki Hayashi, Bungo Iwase, Kazuyoshi Miyagawa, Hideaki Kawaguchi, Hidetoshi Chiba, and Hikaru Masuda *Characteristics prediction of a tilting pad journal bearing by using fluid-structure coupled CFD*

* Pre-recorded presentation

S10 General topics

Session Description

This session is organized for all submissions which do not neatly fit into any other category.

Session Organizers

Nak-Joong Lee is working as a assistant professor at the Department of Applied Mechanics and Aerospace Engineering of WASEDA University, Tokyo, Japan. He received his B.S, M.S and Dr. Eng. From Korea Maritime and Ocean University, Korea. He is interested in hydropower, ocean energy, fluid machinery and computational fluid dynamics.

Nak-Joong Lee

Gabriel Taillon is currently studying as a 3rd year Doctoral student in Miyagawa Laboratory. He first obtained his B.S in engineering physics at Polytechnique Montréal, Canada, followed by a M.S where he studied the cavitation erosion resistance of hard coatings. His present research is about novel ways to model cavitation erosion based on statistical analysis of impacts. He is the Webmaster of the ISROMAC2020 conference.

Gabriel Taillon

November 23rd, 2020 (Monday) - Room 4

10:10−11:50 (GMT+0)	**S10 General topics (Part 1)** Chair: Dr. Nakjoong Lee (Waseda University, Japan)
10:10−10:35	ISROMAC2019-00128 **Chisato Ichihara**, D. Yamaguchi., R. Kobayashi, K. Nishibe, K. Yokota, and K. Sato *Control of Jet Structure Utilizing the Change in the Outlet Velocity Distribution with Time*
10:35−11:00	ISROMAC2019-00076 **Yu Tamanoi**, Y. Watanabe, R. Kobayashi, and K. Sato *Jet Direction Control Using Secondary Flows*
11:00−11:25	ISROMAC2019-00066 **Dr. Jay Unadkat** and Dr. Zahir Hussain *On the stability of boundary-layer flow over a rotating cone in an enforced axial free stream*
11:25−11:50	ISROMAC2019-00014 **Dr. Zahir Hussain** and Prof. Stephen J. Garrett *On the stability of boundary-layer flow over a rotating cone using new solution methods*
11:50−13:10	**Lunch Break**
13:10−14:00 (GMT+0)	**S10 General topics (Part 2)** Chair: Gabriel Taillon (Waseda University, Japan)
13:10−13:35	ISROMAC2019-00167 **Alexandre Mauricio**, W. Wang, J. Antoni, and Prof. Konstantinos Gryllias *Advanced signal processing techniques for helicopter's gearbox monitoring*
13:35−14:00	ISROMAC2019-00035 **Artur Schimpf**, Y. Gu, and M. Böhle *Analysis of Flow Models for Aerostatic Thrust Bearings with Porous Material*

S11 Hydraulic machines and systems

Session Description

Hydropower is one of the most important renewable energy sources to produce green electricity. Turbines, pump turbines and storage pumps are the backbone of every hydraulic system and perform an enormous task every day to support our daily lives. Hydraulic machines satisfy local requirements worldwide. The rapid growth of knowledge and the fact that know-how can be found all over the world makes research in this field unique. Local requirements shape local research and development. In consequence, the issues scientifically investigated in Europe can differ from the ones studied in America (USA and Canada) or China for example. General topics such as Pumped Storage or the lifetime of components are studied by universities worldwide. But specific, regional research topics broaden the horizons of each participant, as does the exchange of ideas on these general, global topics.

In addition, hydropower is now facing new challenges in terms of flexibility and operating range extension due to the increasing integration of intermittent, renewable energy sources, such as wind and solar, into the electrical network.

Therefore, the exchange of knowledge and experience in renowned conferences, as ISROMAC, is important, as it enables an exceptional network of worldwide activities. Scientists and engineers from universities and industrial companies worldwide are invited to participate in the Hydraulic Machines and Systems session of ISROMAC 18 to share their knowledge, new insights and new developments.

Session Organizers

Eduard Doujak

Dr. Eduard Doujak graduated in mechanical engineering from the TU Wien and works since 1995 as an Assistance Professor at the TU Wien / Institute for Energy Systems and Thermodynamics in Austria. His major research fields are multistage pumped turbine sets for small hydro applications, refurbishment of old plants and the investigation of the impact of off-design operations on the runner residual lifetime.

Prof. Shuhong Liu is working as a Professor at Tsinghua University (Beijing, China), teaching Applied Fluid Mechanics. Her major is Fluid Machinery and Fluid Engineering. Research objects include hydraulic turbines, pump-turbines, pumps, hydraulic couplings, blood pumps, focusing on complex internal flows, i.e., cavitation, multiphase flows, and flow instabilities.

Shuhong Liu

Shouichiro Iio

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Prof. Shouichiro Iio graduated in mechanical engineering from Miyazaki University, Japan. He worked from 2004 to 2011 as an Assistant Professor and is an Associate Professor since 2011 at Shinshu University/ Fluid Control Laboratory in the Department of Mechanical Systems Engineering. His primary research fields are Small Hydro Turbines, Water Hydraulic Components and Cavitation.

November 23rd, 2020 (Monday) - Room 1

10:10–11:25 (GMT+0)	**S11 Hydraulic Machines and Systems (Part 1)** Chair: Prof. Shouichiro Iio (Shinshu University, Japan)	
10:10–10:35	ISROMAC2019-00176	**X. Meng***, M. Guo, Zhigang Zuo, M. Nishi, and S. H. Liu *Numerical Simulation of the flows in a wide-angle diffuser with a short splitter vane*
10:35–11:00	ISROMAC2019-00150	L. Yu, H. C. Zhang, H. Chen,**Dr. Zhigang Zuo***, and S. H. Liu *Numerical study on flows in an inducer with varying pitch considering cavitation instability*
11:00–11:25	ISROMAC2019-00182	**Dr. Miao Guo ***, Huijun Zou, Baoyu Chen, Zhigang Zuo, and Shuhong Liu *Experimental performance of a pump and the related vortices in a pump intake of a model pump station*
11:25–13:10	**Lunch Break**	
13:10–14:50 (GMT+0)	**S11 Hydraulic Machines and Systems (Part 2)** Chair: Prof. Shuhong Liu (Tsinghua University, China)	
13:10–13:35	ISROMAC2019-00153	**Naoto Ogawa**, M. Goto, S. Iio, T. Kitahora, Y. D. Choi, and M. Inagaki *Performance improvement of cross-flow turbine with a cylindrical cavity and guide wall*
13:35–14:00	ISROMAC2019-00141	**Prof. Hironori Kikugawa**, Y. Kawano, M. Shuto, and A. Furukawa *Improvement of compact Darrieus-type hydraulic turbine for extra low head by changing inlet shape*
14:00–14:25	ISROMAC2020-00042	**Yuya Ishii**, W. Takahashi and K. Miyagawa *Proposal of a design method for Francis turbines operated in a wide range of flow rates*
14:25–14:50	ISROMAC2019-00185	**Shengbing Li**, Z. Zuo, J. Fang, B. Zhu and S. Liu *Strategic planning of the 1000MW units of Baihetan powerstation*
14:50–15:00	**Break**	

* Pre-recorded presentation

November 23rd, 2020 (Monday) - Room 1

15:00−16:40 (GMT+0)	**S11 Hydraulic Machines and Systems (Part 3)** Chair: Prof. Eduard Doujak (TU Wien, Austria)
15:00−15:25	ISROMAC2019-00144 **Takuji Hosotani**, Toru Shigemitsu, Yuki Kawaguchi, Takuya Inamoto, Takeru Ishiguro, and Ding Nan *Influence of meridional plane shape on performance and internal flow of high head contra-rotating small hydroturbine*
15:25−15:50	ISROMAC2019-00221 **Dr. Nakjoong Lee**, Young-Cheol Hwang, Morihito Inagaki, and Kazuyoshi Miyagawa *Design Optimization of High Specific Speed Prototype Francis Turbine by Design of Experiments*
15:50−16:15	ISROMAC2019-00008 **Dr. Markus Lenarcic**, A. Gehrer *Study on S-shape instabilities and pressure pulsations in reversible pump-turbines: Conflictive mechanisms behind a varying rotor-stator distance and development of a new guide vane design for improving transient behavior during turbine start-up and in case of load-rejection*
16:15−16:40	ISROMAC2019-00018 **Johannes Junginger**, O. Kirschner, and S. Riedelbauch *Measurements of fast transitions at a reversible pump turbine model in closed-loop test rig*

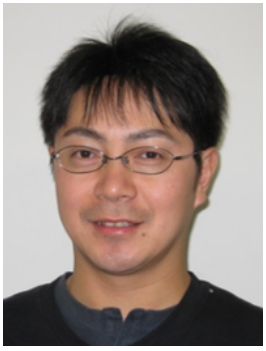
S12 Liquid rocket engines

Session Description

Rocket propulsion is a kind of jet propulsion device that generates propulsive force by ejecting a loaded substance called a propellant. Liquid rocket engines usually consist of turbomachines, combustion chambers and nozzles, propellant tanks, propellant supply devices, etc.

The rocket engine has a high energy density and is a complex system to achieve high propulsion performance. Therefore, each engine element is required to have high reliability in addition to strict design and manufacturing specifications. Rocket engines are accompanied by complex physical phenomena, and unsteady phenomena are likely to occur in many engine components. The Liquid Rocket Engines session of ISROMAC 18 will cover various topics related to liquid rocket engines. In addition, submissions of systems and elements related to aircraft engines and future propulsion systems are welcome.

Session Organizers



Masaharu Uchiumi

Masaharu Uchiumi is a Professor at Muroran Institute of Technology (MuIT), Japan. He was been engaged in research and development of rocket engines, especially turbomachinery, at JAXA and MuIT. He is also conducting research in the area of combustion and turbomachinery for hybrid rocket, jet engine, air-breathing engine, and detonation engine.

Dr. Angelo Pasini carried out his PhD in chemical propulsion at Pisa University. Since September 2006, he has been working at the Chemical Propulsion Laboratory of Sitael, formerly Alta, (Pisa, Italy), mainly on green propellant rockets and on experimental campaigns on pumps for liquid propulsion rockets. His fields of interest are Turbomachinery, Cavitation, Rotordynamics and Flow Instabilities in Space Rockets Turbopumps, Non-Toxic Propellants and Catalytic Beds for Hydrogen Peroxide Decomposition. He is currently Assistant Professor of Space Propulsion at Pisa University.

Angelo Pasini

November 25th, 2020 (Wednesday) - Room 1

13:10−14:50 (GMT+0)	**S12 Liquid rocket engines (Part 1)** Chair: Prof. Masaharu Uchiumi (Muroran Institute of Technology, Japan)
13:10−13:35	ISROMAC2019-00210 **Hiromitsu Kakudo**, Takashi Yokoyama, and Satoshi Takada *Heat generation of ball bearing for rocket-engine turbopump in low-temperature gas hydrogen*
13:35−14:00	ISROMAC2019-00100 **Sota Kondo**, Moena Kanamaru, Satoshi Kawasaki, and Yuka Iga *Influence of Rotational Speed of an Inducer on the Propagation Velocity of Super-synchronous Rotating Cavitation*
14:00−14:25	ISROMAC2020-00041 **Bungo Iwase**, Keisuke Masumoto, Tomoyuki Hayashi, Kazuyoshi Miyagawa, Satoshi Kawasaki *Characteristics of axial thrust of an unshrouded impeller equipped with balance piston system*
14:25−14:50	ISROMAC2019-00156 **Luca Sales** and Prof. Angelo Pasini *Definition and Validation of Cavitating Rocket Turbopump Transmission Matrices for Modular Multi Actuator Disk Approach*
14:50−15:00	**Break**
15:00−17:05 (GMT+0)	**S12 Liquid rocket engines (Part 2)** Chair: Prof. Angelo Pasini (University of Pisa, Italy)
15:00−15:25	ISROMAC2019-00064 **Kazuki Yasuda**, D. Nakata, and M. Uchiumi *Experimental study on temperature change by cavitation accompanying self-pressurization of propellant for small rocket engines*
15:25−15:50	ISROMAC2019-00212 Julian Dominic Pauw, Oskar J. Haidn and **Alexander Rabl** *Experimental Investigation of Turbopump Components for Space Applications*
15:50−16:15	ISROMAC2019-00038 Max Axel Müller, **Tobias Traudt**, Stefan Schlechtriem *Numerical calculation of the Rotordynamic Coefficients of a LOX-Turbopump Seal for the LUMEN LOX/LNG demonstrator rocket engine*
16:15−16:40	ISROMAC2019-00029 **Anirudh Mukund Saraf**, Tobias Traudt, Michael Oschwald *LUMEN Turbopump: Preliminary Thermal Model*
16:40−17:05	ISROMAC2019-00140 **Robson Hahn**, R. H. S. Hahn, J. Deeken, M. Oschwald, and S. Schlechtriem *Turbine Design and Optimization Tool for LUMEN Expander Cycle Demonstrator*

S13 Marine energy and propulsion systems

Session Description

Oceans cover more than 70.6% of the earth's surface and are in constant and somewhat predictable movement (tides), making them a huge source of renewable energy. Marine energy systems use turbine and rotating machinery. For example, oscillating water column (OWC) based wave energy system uses wells and impulse turbines. The tidal and marine current systems use axial or cross flow turbines. The ocean thermal energy conversion (OTEC) system is a bit complex and uses a turbine and a pump. The osmotic system uses a turbine to harvest energy. Similarly, many other rotating machines are being used to harvest such energy. This session is also including technologies of marine propulsion systems such as propeller and pump-jet. This session will comprise conceptual development, experiments, numerical, installation and review related papers. Authors are encouraged to submit relevant works and disseminate knowledge to the communities on marine energy and propulsion systems.

Session Organizers

Manabu Takao is working as a Professor at National Institute of Technology (NIT), Matsue College, Japan. He got his M.S. degree and Dr. Eng. from Saga University, Japan. His research interests include fluid machinery and renewable energy utilization and he is particularly engaged in the research and development of air turbines used for oscillating water column-based wave energy converter.

Manabu Takao

Abdus Samad is an Associate professor at Indian Institute of Technology Madras (IITM), India, and he works mainly on marine energy, fluid mechanics and fluid machines. He is a fellow of ASME and a fellow IMechE. He reported more than 100 documents in Scopus and authored a book on Fluid Machinery (Wiley, 2019). He conducted several conferences, workshops and a seminar at IITM. He has several patents on fluid machinery and energy.

Abdus Samad

November 26th, 2020 (Thursday) - Room 1

10:10–11:50 (GMT+0)	**S13 Marine Energy and propulsion systems (Part 1)** Chair: Prof. Abdus Samad (Indian Institute of Technology Madras, India)
10:10–10:35	ISROMAC2019-00196 B. Ranjith, P. Madhan Kumar, **Prof. Manabu Takao**, and Abdus Samad *High-Performance Ocean Energy Harvesting Turbine Design - A Strategy of Compound Leaning*
10:35–11:00	ISROMAC2019-00105 Prof. Manabu Takao, **Kotaro Kanetsuki**, M. M. A. Alam, S. Okuhara, and Y. Kinoue *Comparative Study on Starting Characteristics of Turbines for Wave Energy Conversion*
11:00–11:25	ISROMAC2019-00096 Y. Hayamizu, **Keisuke Kitano**, T. Suzuki, S. Morita, S. Ohtsuka, M. Takao, Y. Kinoue, and T. Setoguchi *A Straight-Bladed Vertical-Axis Turbine for Wave Energy Conversion: Effect of Guide Vane Geometry on Performance*
11:25–11:50	ISROMAC2019-00106 **Keito Matsumoto**, M. Takao, S. Okuhara, M. M. A. Alam, A Takami, and Y. Kinoue *A Twin Impulse Turbine for Wave Energy Conversion - Performance Improvement by Means of Fluidic Diode*
11:50–13:10	**Lunch Break**
13:10–14:25 (GMT+0)	**S13 Marine Energy and propulsion systems (Part 2)** Chair: Prof. Manabu Takao (National Institute of Technology, Matsue College, Japan)
13:10–13:35	ISROMAC2019-00093 **Masaki Sakaguchi**, Prof. Yoichi Kinoue, T. Murakami, N. Shiomi, Y. Imai, S. Nagatam and M. Takao *Bi-Directional Impulse Turbine with Spiral Flow Collector for Tidal Energy Conversion*
13:35–14:00	ISROMAC2020-00006 Naoya Isatake, Kousuke Yamanouchi, **Prof. Hiromitsu Hamakawa**, Eru Kurihara, and Hidechito Hayashi *Fundamental Study on Improvement of Performance of Wells Turbine Blade*
14:00–14:25	ISROMAC2019-00037 **Lei Shi**, Bayeul-Laine Annie-Claude, and Coutier-Delgosha Olivier *Numerical simulations of unsteady vortical flows around a cycloidal propeller*

S14 Heat and mass transfer & Transport phenomena

Session Description

When considering processes in automotive and aeronautics or production, the transport of mass, heat and energy is very important. The transported mass can cause vibrations, which influence the whole process and can reduce its efficiency. The change of mass, energy and momentum must be considered carefully for the mechanical modelling in process and chemical engineering, where rotating machines are frequently used. For a proper modelling the application of a control volume and the dimensionless analysis is useful.

The transport phenomena addressed in this session will mainly focus on the vibrations induced by heat and mass transport. Specially pulsating heat transfer in pipes, axial moving materials like belt drives, conveyor belts and transversally loaded beams are subject to vibrations. Typically, the interaction with rotating systems must be considered for the coiling process of strips and sheets. The flow of liquid through moving pipes and other types of fluid-structure interaction present in chemical and biological processes are further subjects for this session. The boundary conditions for moving materials are considered to be non-material. Parametric excitation and stability are important if the variation of the tension force, the length and the motion at the boundary is defined time-dependent. Suitable time-integration algorithms compute an appropriate numerical solution of these non-linear dynamic systems combining first and second order differential equations within a short computation time and guarantee convergence and accuracy of results.

This session provides a frame for researchers, scientists and engineers to exchange information and to present innovative problems in the field of heat and mass transfer as well as transport phenomena.

Session Organizers

Helmut J. Holl

Helmut J. Holl is working as an Assistant Professor at the Institute of Technical Mechanics at the Johannes Kepler University of Linz, Austria. He developed a time-integration procedure for the application in nonlinear rotor-dynamic systems including substructuring and variable mass systems. His current research is in the field of the interaction of axially moving structures, fluid-structure interaction and variable mass systems. Furthermore, he holds lectures in rotor-dynamics and numerical and experimental methods in mechanics.

Yu Ito works as an Associate Professor at the Department of Aeronautics and Astronautics at the University of Tokyo. She concurrently serves as a Visiting Associate Professor at Tokyo Institute of Technology, and as a Lecturer at Waseda University. She studied at the University of California, Berkeley. Her specialties are aerospace propulsion systems, gas turbines, turbomachinery, heat exchangers, and heat transport devices, with a focus on compressible flows, cryogenic flows, supercritical fluid flows, and heat transfer between these and solids.

Yu Ito

November 24th, 2020 (Tuesday) - Room 4

10:10–11:50 (GMT+0)	**S14 Mass and Heat Transfer & transport phenomena (Part 1)** Chair: Prof. Helmut J. Holl (Johannes Kepler University of Linz, Austria)
10:10–10:35	ISROMAC2019-00053 **Simon van Buren** and W. Polifke *Enhanced longitudinal heat transfer in oscillatory channel flow - A theoretical perspective*
10:35–11:00	ISROMAC2019-00214 **Prof. Helmut J. Holl** and Gottfried Simon *Transport of heat and material properties in Continuous Casting of Steel*
11:00–11:25	ISROMAC2019-00099 Dr. Yasutaka Hayamizu, **Akihiro Nakamura**, T. Hyakutake, T. Gonda, S. Morita, S. Ohtsuka, and S. Yanase *Particle Behavior in Curved Microchannels: Aspect Ratio Effects*
11:25–11:50	ISROMAC2020-00019 **Junnosuke Okajima**, Masaki Ito, and Yuka Iga *Influence of Heat Transfer from Heated NACA0015 Hydrofoil on Cavitating Flow*
11:50–13:10	**Lunch Break**
13:10–14:50 (GMT+0)	**S14 Mass and Heat Transfer & transport phenomena (Part 2)** Chair: Prof. Yu Ito (The University of Tokyo, Japan)
13:10–13:35	ISROMAC2019-00194 Victoria Simader and **Prof. Helmut J. Holl** *Reduction of the unbalance excited vibrations during the resonance passage of a rotor*
13:35–14:00	ISROMAC2019-00124 **Philipp Brodbeck** *Experimental determination of turbocharger heat flows for validation of a power separation approach*
14:00–14:25	ISROMAC2019-00098 **Dominik Hofer**, Michael Krieger, and Martin Kirchhofer *High resolution 2.5D PIV measurements of the flow fields generated by small fans*
14:25–14:50	ISROMAC2019-00193 **Prof. Helmut J. Holl** and Lukas Keplinger *Bending and torsion vibrations of a beam excited by a moving load*
14:50–15:00	**Break**
15:00–16:40 (GMT+0)	**Mass and Heat Transfer & transport phenomena - Discussion** Chairs: Prof. Helmut J. Holl (Johannes Kepler University of Linz, Austria) Prof. Yu Ito (The University of Tokyo, Japan)

S15 Positive displacement machines

Session Description

Positive displacement rotating machines share a significant place in industrial and commercial applications. These include screw, scroll, vane, rotary and other types of machines. This session of ISROMAC 18 is dedicated to a wide range of topics related to transport phenomena and the dynamics of positive displacement rotating machinery, including, but not limited to, compressors, expanders, pumps and other fluid machinery. Lower order modelling as well as experimental techniques applied to positive displacement rotating machines will be explored: multi-phase flows, cavitation, rotor dynamics, heat transfer, conjugate heat transfer, Computational Fluid Dynamics among others. We welcome academics, students, industrialists and any other interested participants to submit a technical paper, to share their knowledge and participate in discussions with experts from all over the world. Selected papers will be published in the special issue of the Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering dedicated to ISROMAC.

Session Organizers

Ahmed Kovacevic

Professor Ahmed Kovacevic holds prestigious Howden Chair in Engineering Design and Compressor Technology at City, University of London. His work is dedicated to the development of design excellence in academia and industry which he does through researching, teaching and collaborating with industry in numerical modelling, analysis and design of Positive Displacement Machines. He is director of the renowned Centre for Compressor Technology and chair of the International conference on Compressors and their Systems at City, University of London.

Davide Ziviani

Prof. Davide Ziviani is a Research Assistant Professor at the Ray W. Herrick Laboratories, Purdue University, and serves as the Associate Director of the Center for High Performance Buildings (CHPB). He has extensive expertise in the modeling and testing of thermal systems and their components, including positive displacement compressors and expanders, organic Rankine cycles for waste heat recovery, as well as advanced conventional and disruptive HVAC&R technologies for residential and commercial applications. Prof. Ziviani received his Doctoral degree in Electromechanical Engineering from the University of Ghent in Belgium.

November 25th, 2020 (Wednesday) - Room 3

13:35–14:50 (GMT+0)	**S15 Positive displacement fluid machinery (Part 1)** Chair: Prof. Ahmed Kovacevic (University of London, UK)
13:35–14:00	ISROMAC2019-00191 David Rowinski, Karan Bansal, and **Prof. Davide Ziviani** *Modeling and Validation of Single Screw Expander Using a Modified Cut-Cell Method*
14:00–14:25	ISROMAC2019-00126 **Prof. Craig Bradshaw**, Davide Ziviani, and Eckhard A. Groll *Discussion of Numerical Methods used in Positive Displacement Comprehensive Mechanistic Models: Case Study using the Z-Compressor*
14:25–14:50	ISROMAC2020-00023 **Sonawat Arihant**, Young-Seok Choi, Kyung Min Kim, and Jin-Hyuk Kim *Sensitivity analysis of clearance for Positive Displacement Hydro Turbine*
14:50–15:00	**Break**
15:00–15:50 (GMT+0)	**S15 Positive displacement fluid machinery (Part 2)** Chair: Prof. Davide Ziviani (Purdue University, USA)
15:00–15:25	ISROMAC2019-00108 **Prof. Ahmed Kovacevic** and Dr. Sham Rane *Challenges in 3D CFD Modelling of Rotary Positive Displacement Machines*
15:25–15:50	ISROMAC2019-00168 **Dr. Fabio Fatigati**, M. Di Bartolomeo, D. Di Battista, R. Cipollone *Development and numerical assessment of a regulation strategy for Sliding Rotary Vane Expander based on revolution speed variation*
15:50–16:40	**Discussion**

S16 Pumping machinery

Session Description

This session provides an opportunity for a series of technical presentations on all aspects of pumping machinery and pumping function from research and development perspectives, for all categories and sizes of pumps, including centrifugal, axial-flow and other kinds of rotodynamic pumps as well as rotary and reciprocating positive displacement pumps. Topics of this session will include (but not limited to) the design, selection, applications, installations, operation and maintenance of pumps, internal fluid flow analysis, experimental analysis including flow visualization, stability, complex fluid flow phenomena, cavitation and multi-phase flows, rotordynamics, fluid-structure interaction, and so on.

Session Organizers

Satoshi Watanabe

Satoshi Watanabe received his Ph.D. in Mechanical Engineering from Osaka University, Japan in 1997. Currently, he is a Professor at Department of Mechanical Engineering, Kyushu University (Fukuoka, Japan). His research interest lies in the field of hydraulic machinery from the development of new types of machines to the fundamental flow physics, especially cavitating flow

Young-Seok Choi received his B.S. degree from Seoul National University in 1988, and his M.S. and Ph.D. in Mechanical Engineering from the same university in 1990 and 1996, respectively. He is currently a Principal Researcher in Korea Institute of Industrial Technology (KITECH) and a Professor at University of Science and Technology (UST). His research interests include Computational Fluid Dynamics and design optimization of turbomachinery.

Young-Seok Choi

November 24th, 2020 (Tuesday) - Room 1

10:10–11:50 (GMT+0)	**S16 Pumping Machinery (Part 1)** Chair: Prof. Satoshi Watanabe (Kyushu University, Japan)
10:10–10:35	ISROMAC2019-00017 **Jun Feng** and Prof. Martin Böhle *Feasibility study for the application of a neural network for operating condition detection of a centrifugal pump*
10:35–11:00	ISROMAC2019-00200 **Yohei Tanaka**, T. Kitabata, K. Nasu, S. Watanabe, S. Ohashi, and A. Sakata *Effect of suction pipeline resistance on cavitation surge in a turbopump with inducer*
11:00–11:25	ISROMAC2019-00146 **Xueyi Song**, Weiping Yu, Xiaohui Pan, and Xianwu Luo *Energy balance analysis for a canned motor pump used for heat supply system*
11:25–11:50	ISROMAC2019-00180 **Taiki Takamine**, S. Nakano, S. Watanabe, and H. Watanabe *Effect of Axial Offset of Rotor on Thrust Characteristics of a Centrifugal Pump*
11:50–13:10	**Lunch Break**
13:10–14:50 (GMT+0)	**S16 Pumping Machinery (Part 2)** Chair: Prof. Satoshi Watanabe (Kyushu University, Japan)
13:10–13:35	ISROMAC2019-00178 Zheng Bian, Sean McClean, **Prof. Adolfo Delgado**, and Abhay Patil *Development of A High Load Cacpacity Test Rig to Evaluate the Static Performance of Process Fluid-Lubircated Thrust Bearings*
13:35–14:00	ISROMAC2019-00070 **Yong-In Kim***, Sung Kim, Hyeon-Mo Yang, Kyoung-Yong Lee, Yong-Kab Lee, and Young-Seok Choi *A Comparative Study on Accurate Prediction of Cavitation Characteristics for Head Drop in a Mixed-flow Pump with Steady- and Unsteady-state Analysis*
14:00–14:25	ISROMAC2019-00197 **Akihiro Ikuta**, Naruki Nitta, Kazuyoshi Miyagawa, Yasushi Shinozuka, Shigeyuki Tomimatsu *Influence of Forward skew vane angle on positive slope characteristics of mixed flow pumps*
14:25–14:50	ISROMAC2019-00208 **Daisuke Sugiyama**, Asuma Ichinose, Tomoki Takeda, Kazuyoshi Miyagawa, Hideyo Negishi, and Atsuhiro Tsunoda *Investigation of Internal Flow in Centrifugal Pump Diffuser using Laser Doppler Velocimetry (LDV) and Computational Fluid Dynamics*

* Pre-recorded presentation

November 25th, 2020 (Wednesday) - Room 1

10:10−12:15 (GMT+0)	**S16 Pumping Machinery (Part 3)**
	Chair: Prof. Young-Seok Choi (Korea Institute of Industrial Technology, Korea)
10:10−10:35	ISROMAC2019-00031 **Medi Bayat** and H. L. Sørensen *Evaluation of natural frequency, Campbell diagram and forced torsional vibration of deepwell pumps for the marine, oil and gas industry*
10:35−11:00	ISROMAC2019-00039 **Yuan Li**, Hua Chen, Xiangjun Li, Minghe Jiang, Guinian Wan *The influence of casing treatment on the performance of a centrifugal pump*
11:00−11:25	ISROMAC2019-00206 **Yumeno Inaba**, Asuma Ichinose, Kazuyoshi Miyagawa, Masamichi Iino, and Takeshi Sano *Investigation of flow structure in a narrow clearance of a low specific speed centrifugal impeller*
11:25−11:50	ISROMAC2019-00220 **Takuma Kawahara**, Hideaki Takamiya, Hitoshi Motono, Yasuhiro Hotta, and Kazuyoshi Miyagawa *Influence of engine torque fluctuations on performance characteristics of pumps mounted on vehicles*
11:50−12:15	ISROMAC2020-00016 **Prof. Ling Zhou**, Yang Yang, Ling Bai, Wei Li, Weidong Shi *Inter-stage Difference of Pressure Pulsation in an Electrical Submersible Pump*

S17 Rotor and structural dynamics in turbomachines

Session Description

Modern advanced turbomachines play an important role in industry, transport and energy transfer. To overcome numerous and various challenges, such as cost reduction, higher performance and efficiency, lower energy losses, operation in adverse conditions or prolongation of the service life, research into the dynamical behavior of rotor system for high reliability and safety is critically important. This session targets all areas and aspects of rotor and structural dynamics in machinery, such as modeling, prediction and control of its dynamical behavior. Both laboratory investigations and field case studies are welcomed. Their approaches could be analytical, numerical or experimental.

Session Organizers

Tsuyoshi Inoue

Tsuyoshi Inoue is a Professor with the Department of Mechanical Systems Engineering, Nagoya University. He received B.S., M.S., and Ph.D. degrees in Electric-Mechanical engineering from Nagoya University of Nagoya, Japan. His research interests include nonlinear dynamics, rotor dynamics, vibration analysis and fault diagnostics, vibration control, and dynamics of fluid-structure interaction.

Jaroslav Zapoměl is a Professor at the Department of Applied Mechanics of the VSB - Technical University of Ostrava and at the Department of Dynamics and Vibration of the Institute of Thermomechanics in Prague. He received his scientific and academic degrees at the Technical University of Ostrava and the Brno University of Technology. His research interests include rotor dynamics, semi-active controllable rotor support elements using smart lubricants, nonlinear vibration, material damping, application of advanced materials in mechanical systems.

Jaroslav Zapomel

Yusuke Watanabe

Yusuke Watanabe is working as a researcher at EBARA Corporation, Japan. He received Ph.D. degree in Mechanical Engineering from Kansai University, Japan. His research interests include rotor dynamics, self-excited vibration, dynamics of fluid-structure interaction, diagnosis method and industrial use of these technologies.

November 23rd, 2020 (Monday) - Room 3

10:35−11:50 (GMT+0)	**S17 Rotor and structural dynamics in turbomachines (Part 1)** Chairs: Prof. Tsuyoshi Inoue (Nagoya University, Japan) Dr Yusuke Watanabe (Ebara Corporation, Japan)
10:35−11:00	ISROMAC2019-00075 **Takafumi Suzuki**, Jotaro Chiba, Shota Yabui, Shigeyuki Tomimatsu, and Tsuyoshi Inoue *Analysis of Morton Effect Induced Vibration based on Transfer Function Model: Influence of L/D ratio of Journal Bearing and Rotational speed*
11:00−11:25	ISROMAC2019-00065 **Dr. Hideyuki Inoue**, S. Yabui, and T. Inoue *The Characteristics of Rotordynamic Forces generated by Mechanical Seals*
11:25−11:50	ISROMAC2020-00014 **Teruaki Yamawaki**, C. Yoshimine, T. Nakano, Y. Waki, Y. Sumi *Development of High Specific Load Direct Lubricated Two Pads Journal Bearing*
11:50−13:10	**Lunch Break**
13:10−14:50 (GMT+0)	**S17 Rotor and structural dynamics in turbomachines (Part 2)** Chairs: Prof. Tsuyoshi Inoue (Nagoya University, Japan) Dr Yusuke Watanabe (Ebara Corporation, Japan)
13:10−13:35	ISROMAC2019-00054 **Gudeta Benti***, David Rondon, Rolf Gustavsson, and Jan-Olov Aidanpää *Numerical and experimental study on the dynamic bearing properties of a four-pad and eight-pad tilting pad journal bearings in a vertical rotor*
13:35−14:00	ISROMAC2019-00045 **David Rondon***, G. Benti, J. O. Aidanpää, and R. Gustavsson *Rotordynamic characterization of tilting-pad bearings with eight pads in vertical rotors*
14:00−14:25	ISROMAC2019-00157 Federico Bertelli, **Prof. Angelo Pasini**, and R. Bottai *Influence of Fluid-Induced Forces on Cavitating Turbopumps Rotordynamics in Forced Whirl Experiment*
14:25−14:50	ISROMAC2019-00073 **Kai Becker**, Wolfgang Seemann *Nonlinear behaviour of a hydrodynamically supported rotor under the combined influence of imbalance and self-excitation*

* Pre-recorded presentation

S18 Steam and gas turbines

Session Description

Gas and steam turbines are complex and comprehensive systems composed of many elements. In the near future, gas turbines for power generation will play a role to compensate for output fluctuations of renewable energy sources. It is necessary to solve technical problems such as high efficiency over a wide load range and reduction of the start-up time. Technological innovations on gas turbines for aviation are also required to develop electric aircrafts as well as supersonic aircrafts. Steam turbines, which are external combustion engines, can use a variety of primary energies such as fossil fuels, biomass, solar, geothermal and nuclear energy, and thus play a major role in the power generation systems. Therefore, improving the performance, safety and controllability of gas and steam turbines is an urgent issue directly linked to CO2 reduction, transportation safety, measures in emergency. In addition, many interesting and complex phenomena related with aerodynamics, multiphase flow dynamics, thermodynamics, rotor dynamics, heat transfer, control, etc. are observed in gas and steam turbines. The scope of this session covers all scientific and engineering topics related with gas and steam turbines.

Session Organizers

Tetsuya Sato

Tetsuya Sato is a Professor at Department of Applied Mechanics and Aerospace Engineering of WASEDA University in Japan. After receiving a Ph.D. degree from the University of Tokyo in 1992, he developed hypersonic aerospace propulsion systems such as an air turbo ramjet engine (ATREX) and precooled turbojet engine (PCTJ) in the Japan Aerospace Exploration Agency (JAXA). Presently, his field of research is the thermal-fluid dynamics of aerospace propulsion systems.

Prof. Jae Su Kwak received his B.S. and M.S. degrees in Mechanical Engineering from Korea University in 1996 and 1998, respectively. He then received his Ph.D. degree from Texas A&M University in 2002 and joined the Aeropropulsion department in Korea Aerospace Research Institute (KARI). Professor Kwak is currently a Professor at the School of Aerospace and Mechanical Engineering at Korea Aerospace University in Goyang-City, Korea. His main research interests include gas turbine heat transfer and cooling, heat transfer in propulsion system, and enhancement of heat transfer.

Jae Su Kwak

November 25th, 2020 (Wednesday) - Room 2

10:10−11:00 (GMT+0)	**S18 Steam and gas turbines** Chairs: Prof. Tetsuya Sato (Waseda University, Japan) Prof. Jae Su Kwak (Korea Aerospace University)	
10:10−10:35	ISROMAC2019-00113	**Akiyoshi Masaki**, S. Ogushi, R. Tsuruta, D. Nishiwaki, T. Sato, K. Okai, J. Kazawa, D. Masaki, and M. Harada
	Assessment of the Influence of Boundary Layer Ingestion (BLI) on the Axial Fan	
10:35−11:00	ISROMAC2019-00143	**Daisuke Ito**, Susumu Nakano, Yu Matsuzaki, Yoichi Takeda
	Effects of plate edge thickness on breakup patterns and coarse droplet generation when a water film splashes from the plate edge into airflows	

S19 Turbocharging systems

Session Description

This session focuses on recent research and development on Turbochargers and Turbocharging. Turbocharging has enabled internal combustion engine to meet emission requirements and improve efficiency and power density of the engine for decades. Now facing the challenges posed by recent and future emission regulations and market trends, more reliable turbocharging systems with higher efficiency are mandatory. Also, as power trains are becoming more diversified, various air management and waste-heat recovery systems based on turbomachinery are needed and under development. The session will address the new challenges facing the industry and discuss new ideas and share experiences.

Session Organizers

Chen Hua

Dr Hua Chen is a Professor of Mechanical Engineering at Dalian Maritime University in Dalian, China, since January 2017. He was Technical Director of National Laboratory of Engine Turbocharging Technology at Tianjin, China, for four years between 2013 and 2016. He obtained his BSc degree and MSc degree in China in early 1980s. He studied turbocharger turbine at UMIST, England between 1987 to 1990 and obtained his PhD degree. In UK he first worked at Imperial College and later jointed Honeywell Turbo Technologies. He was a Senior Principal engineer, manager, and standard executive of Honeywell, and received several awards from Honeywell for his engineering work. He was a Distinguished Visiting Fellowship of Royal Society of Engineering, UK in 2015. Dr Chen's research interest is on aerodynamics of radial turbomachinery. He has published more than 60 papers at peer reviewed conferences and journals, held more than 10 US and EU patents and several Chinese ones.

Hideaki Tamaki

Dr Hideaki Tamaki is a Senior Technical Advisor of Technology and Intelligence Integration at IHI. He is also teaching aerodynamics of turbomachinery and fluid mechanics as a part- time instructor at a few universities. Dr Tamaki obtained his Bachelor degree and Master of Engineering at Tokyo Institute of Technology in Japan. He joined Ishikawajima-Harima Heavy Industries (predecessor of IHI) in 1984. Since then he has been engaging aerodynamic design of radial turbomachines, in particular centrifugal compressors for various applications including turbochargers. He obtained his doctoral degree of engineering at Tokyo Institute of Technology in 2000. He has published many papers at conferences and journals, held 8 US patents. He received ASME ASIA 1997 Best Paper Award and 2012 ASME IGTI Best Technical Paper Award.

November 23rd, 2020 (Monday) - Room 2

13:10–14:50 (GMT+0)	**S19 Turbocharging system (Part 1)** Chair: Prof. Chen Hua (Dalian Maritime University, China)
13:10–13:35	ISROMAC2019-00213 **Dr. Hideaki Tamaki**, Satoshi Oouchida, Masaru Unno *EFD (Experimental Fluid Dynamics) Application in Radial Turbomachines*
13:35–14:00	ISROMAC2019-00040 **Yu Wang**, Hua Chen, Chao Ma, and Jinhui Sun *Aerodynamic and Mechanic Analyses of An Asymmetric Scalloped Radial Turbine*
14:00–14:25	ISROMAC2019-00111 **Yu Wang**, Hua Chen, Chao Ma, and Jinhui Sun *Effects of Misalignment of Turbine Wheels with Housing/Heat Seal*
14:25–14:50	ISROMAC2019-00024 **Dr. Georges Salameh**, Guillaume Goumy, Pascal Chesse *Water cooled turbocharger compressor heat transfer model initialization: adiabatic map generation*
14:50–15:00	**Break**
15:00–15:50 (GMT+0)	**S19 Turbocharging system (Part 2)** Chair: Dr. Hideaki Tamaki (IHI Corporation, Ltd., Japan)
15:00–15:25	ISROMAC2019-00222 **Yohei Nakamura**, Kazuyoshi Miyagawa, Yasuo Moriyoshi, and Tatsuya Kuboyama *Development of turbocharger engine system using 3D and 1D simulation to achieve 50% brake thermal efficiency*
15:25–15:50	ISROMAC2019-00179 **Yuji Asanaka**, K. Kobayashi, M. Sakakibara, Y. Itagaki, Y. Nakamura, and K. Miyagawa *Effect of Pulsating Flow on Surge Frequency of a Turbocharger Compressor*

S20 Wind energy

Session Description

The Wind Energy session will cover energy conversion, energy storage, and usage methods for large and small windmills. We expect research results from design, experiments, simulations, and actual measurements for use in electric power and mechanical energy. It includes research on loads to ensure safety as well as efficiency. In addition, papers on wind characteristics, topics related to wind power generation in each country, and introductions of representative projects are also welcomed.

Session Organizers

Akihiro Honda is working as a Director and Professor at Institute of Regional Innovation of HIROSAKI University, Aomori, Japan. He received his B.S., M.S. degree and Dr. Eng. from KYOTO University, Japan. He is interested in aerodynamics of wind turbines using CFD, experimental tests and field observations.

Akihiro Honda

Takao Maeda is working as a Professor at Mechanical Engineering Division of MIE University, Mie, Japan. He received his B.S., M.S. degrees and Dr. Eng. from NAGOYA University, Japan. He is interested in aerodynamics of wind turbines using wind tunnel and field experiments.

Takao Maeda

November 23rd, 2020 (Monday) - Room 2

10:10−11:25 (GMT+0)	**S20 Wind Energy** Chairs: Prof. Akihiro Honda (Hirosaki University, Japan) Prof. Takao Maeda (Mie University, Japan)
10:10−10:35	ISROMAC2019-00025 — T. Maeda, Y. Kamada, T. Tada, M. Hanamura, N. Goshima, **Pham Huu Hoang**, K. Iwai, A. Fujiwara, and M. Hosom *Effect of Icing Airfoil on Aerodynamic Performance of Horizontal Axis Wind Turbine*
10:35−11:00	ISROMAC2019-00177 — A. Honda and **Nanako Sasanuma** *Investigation of wind properties at MUTSU Bay and TSUGARU Strait JAPAN*
11:00−11:25	ISROMAC2019-00175 — **Jose de Jesus Monjardin-Gomez**, R. Gómez-Martínez, R. Campos-Amezcua, R. Sánchez-García, L. G. Trujillo-Franco, A. Campos-Amezcua, H. F. Abundis-Fong *Numerical and experimental analysis of the turbulence impact on small wind turbines performance*