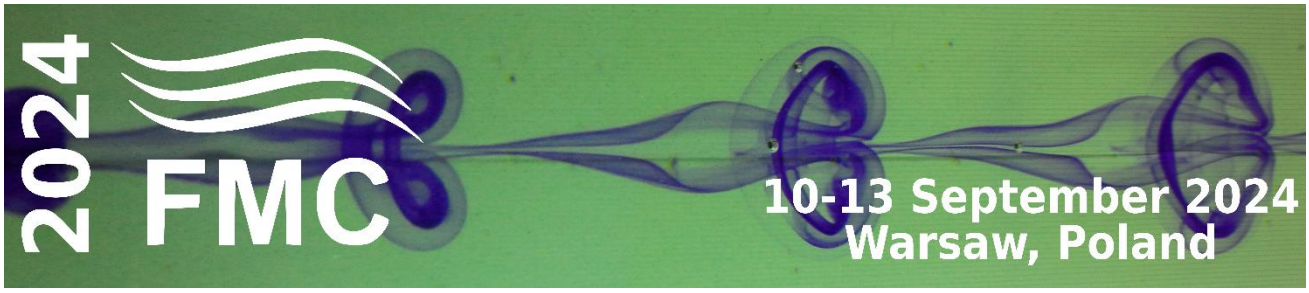

WARSAW UNIVERSITY OF TECHNOLOGY

XXVI FLUID MECHANICS CONFERENCE

CONFERENCE PROGRAMME

Warsaw, POLAND, 10-13 September 2024

FMC 2024 INTERNATIONAL SCIENTIFIC COMMITTEE

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M.Sc. Mariusz Rutkowski

Projekt finansowany ze środków budżetu państwa, przyznanych przez Ministra Edukacji i Nauki w ramach Programu „Doskonała Nauka II”.

Co-financed by the Ministry of Education and Science of the Republic of Poland on the basis of the agreement no. KONF/SP/0407/2023/01 of 01 09 2023, entitled "Support for the organization of the international conference XXVI Fluid Mechanics Conference 2024” carried out as part of the "Excellent Science II Program", Funding of MEiN PLN 118 910.00, Project value PLN 418 010,00.

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European Research Community On Flow, Turbulence And Combustion

Polskie Towarzystwo Mechaniki Teoretycznej i Stosowanej

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Conference Venue

The XXVI FMC 2024 takes place in the central campus of the Warsaw University of Technology, in the Building Rektorska 4.

Address: Warsaw University of Technology, ul. Rektorska 4, 00-665 Warszawa.

GPS: 52.21796 N, 21.0100 E

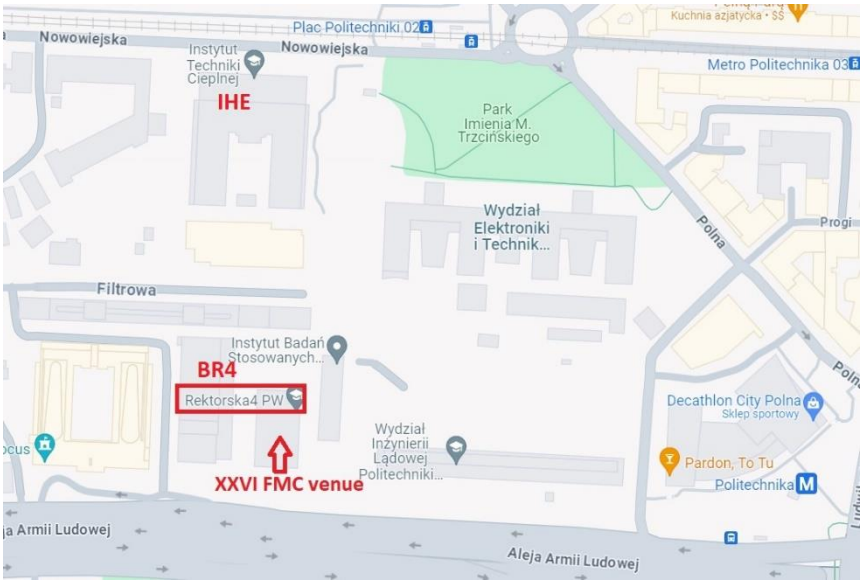
Warsaw University of Technology

Warsaw University of Technology builds upon the traditions of Polish technical universities that used to function in Warsaw – the Polytechnic Institute founded in 1826 thanks to the efforts of Stanisław Staszic and the School of Hipolit Wawelberg and Stanisław Rotwand established in 1895. Warsaw University of Technology started on its own in 1915 thanks to the efforts of the Association for Scientific Courses and the Citizens' Committee of the City of Warsaw. Working uninterruptedly, the University has been producing generations of graduates and has had an increasing number of scientific and technical achievements. It is not only the oldest, but also the best technical university in Poland; in the ranking of Polish universities, it has taken the first place in its category for seventeen years. At Warsaw University of Technology, over 160 student research groups, organisations and associations are active, and the educational offer includes many fields of study (also with English as a medium of instruction).

Conference information

Venue

All plenary lectures as well as the oral and poster sessions take place in the lecture rooms located on 1st and 4th floor of the Building Rektorska 4 (BR4).



Registration and secretariat timetable (the lobby of the BR4)

Tuesday, September 10th, opened from 10.00 to 19.00.
Wednesday, September 11th, opened from 9.00 to 18.00.
Thursday, September 12th, opened from 9.00 to 18.00.
Friday, September 13th, opened from 9.00 to 14.30.

Oral presentations

The maximum allowed time for presentation is 15 minutes with additional 5 minutes for short discussion and transition. Speakers are requested to upload their presentation to the PC or the notebook, available in the assigned conference room, during the coffee break prior to the session. The presentation should be uploaded in .pdf, or .pptx formats.

Poster presentation

The poster size should not exceed the dimensions of A0 format (119 cm in height and 84 cm in width). Posters should be placed on the boards in the hallway on the BR4's 4th floor, on the first day of the FMC2024 and taken away on the last day. A label on the corresponding board will identify your poster place.

Internet Access

Wireless internet access is available in the premises of the conference venue.
LOGIN: konferencja
PASSWORD: 25_sierpien_2024
Link to the Book of Abstracts: link has been sent via e-mail to all registered participants of the conference.

Lunch & Coffee Break

Lunches and coffee breaks will be served in the lobby on the main floor of the BR4.

Social Events

Welcome party: September 10th, 20.00-23.00, the patio of the Institute of Heat Engineering (IHE), 21/25 Nowowiejska St., GPS: 52.21988 N, 21.00971 E.
Gala dinner: September 12th , 20.00-23.00, in the restaurant "Warszawski Sen", Hala Koszyki, 63 Koszykowa St., GPS: 52.22253 N, 21.01160 E.

Identification badge

Participants are reminded to wear their named badges at all time while in the conference area or conference events. Access will be prohibited to the sessions, coffee breaks and social events if a named badge is not visible. Identification badge is also required to social events.

Invited Lectures

Prof. Krzysztof J. Fidkowski, University of Michigan, Michigan, USA

Krzysztof J. Fidkowski is a Professor of Aerospace Engineering at the University of Michigan. He earned his S.B. in Physics and S.B., S.M, and Ph.D. degrees in Aeronautics and Astronautics from MIT. His doctoral thesis was in computational fluid dynamics and investigated the applicability of high-order discontinuous finite-element methods to aerodynamics simulations over complex geometries. Before joining the University of Michigan in 2008 as an assistant professor, he was a pot-doctoral associate at the Aerospace Computational Design Laboratory at MIT, where he worked on projection-based reduced models. At the University of Michigan, Professor Fidkowski teaches aerodynamics, numerical methods, and computational fluid dynamics. He has received young investigator awards from the Department of Energy and the Air Force Office of Scientific Research. He previously served as chair of the CFD Subcommittee of the AIAA Fluid Dynamics Technical Committee, organized fluids and CFD tracks at multiple AIAA conferences, and is an AIAA Associate Fellow. His primary research field is in algorithmic development for computational fluid dynamics, specifically in the use of adjoint methods for numerical error estimation, mesh adaptation, and uncertainty quantification. In recent work, Professor Fidkowski has studied reduced models of high-order dynamical systems, optimization under uncertainty, machine learning for error estimation and mesh adaptation, panel methods for low-speed aerodynamics, and dynamic closure models for turbulent flows.

Title: Output-based discretization error control in turbulent flow simulations.

Advances in computational power have enabled scale-resolving simulations of turbulent flow, yet the high cost of these simulations prohibits their use in a multi-query setting, such as design optimization. In addition, discretization errors resulting from under-resolved spatial and temporal domains often go unchecked, as a posteriori error estimates do not easily extend to such simulations due to their chaotic nature. As evidenced by recent workshops on high-fidelity discretizations, these errors can significantly impact numerical solutions and prevent the use of such simulations for predictive analysis. We discuss two solutions to this challenge of robust turbulent-flow computation. The first is a mesh adaptation procedure based on the entropy adjoint, which is stable and inexpensive to compute, and which minimizes spurious entropy production in unsteady simulations. The second is a data-driven approach for calculating adjoints by correcting a lower-fidelity model, such as Reynolds-averaged Navier-Stokes (RANS). The corrected RANS equations yield a steady adjoint solution that can be used with unsteady residuals to define an output-based indicator for adaptation. Results for several prototypical aerodynamic problems demonstrate the utility of the proposed methods for estimating and reducing discretization errors.

Prof. Jerzy M. Floryan, Western University, London, Ontario, Canada.

J.M. Floryan is a Professor at Western University, London, Ontario, Canada. He received his Ph.D. in 1980 from Virginia Tech and did postdoctoral work in 1981 at Northwestern University. He was a visiting professor at the City University of Hong Kong, Stuttgart University, Darmstadt Technical University, National University of Singapore, and Beijing Institute of Technology. He was a visiting researcher at DLR Gottingen, National Aerospace Laboratory Tokyo, CERT-ONERA in Toulouse, and Los Alamos National Laboratory. Dr. Floryan's primary professional interests are developing flow management strategies relying on passive and active actuation patterns (roughness, suction, heating, and vibration). He served as President of the Canadian Society for Mechanical Engineering (CSME) and the Canadian Congress of Applied Mechanics (CANCAM). Dr. Floryan is a Fellow of the American Physical Society (APS), the American Society of Mechanical Engineers (ASME), the CSME, the Canadian Aerospace and Space Institute (CASI), the Engineering Institute of Canada (EIC), and the Japanese Society for the Promotion of Science (JSPS), as well as being a NATO Research Fellow (France) and a Science and Technology Agency Fellow (Japan). An AIAA Associate Fellow, he was the winner of the Robert W. Angus Medal (CSME), the Canadian Pacific Railway Engineering Medal (EIC), the McCurdy Award (CASI), the Humboldt Research Prize, Erskine Fellow (New Zealand), and Lady Davis Fellow (Technion). He is the Canadian representative to IUTAM.

Title: On the structured convection.

Natural convection driven by heating patterns is known as structured convection. It gives rise to fascinating new physics. It has been determined so far that it can reduce pressure losses in conduits, intensify mixing, be used to extract energy from the flow (energy harvesting), give rise to thermal drift and nonlinear thermal streaming, can be used for propulsion, used for horizontal pumping (horizontal chimney effect), can be used to create streaks and rolls in shear layers, and can dominate local contamination transport. Patterns of thermal waves offer further exciting applications, from pumping in conduits to wind generation. Combining heating and topography patterns activates the pattern interaction effect, whose strength changes significantly with minor changes in both patterns' relative positions, similar to initial conditions in a chaotic system. The spatial parametric resonance drives such flows' stability, which can give rise to many flow structures, including solitons. Heating patterns frequently occur in nature, e.g., the surface topography (building pattern) and thermally relevant features of this topography, like color variations (color patterns of roofs, streets, and parks) in the urban environment (heat island effect). Similar conditions are encountered in rural environments where local circulation can be driven by different heating rates of forests and lakes and can be modified by terrain topography. Recent progress in the analysis of structured convection will be discussed.

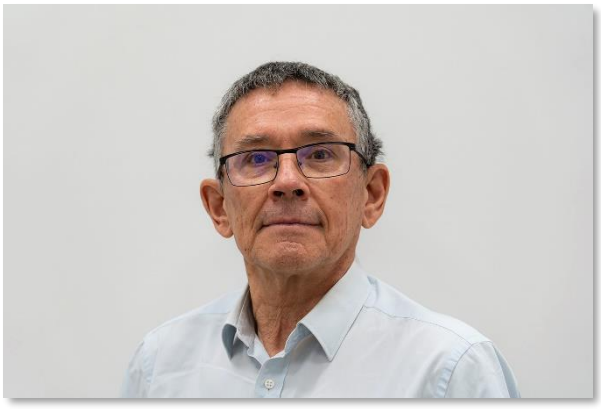
Prof. Genta Kawahara, Osaka University, Osaka, Japan

Prof. Genta Kawahara received his B.S., M.S. and Ph.D. degrees from Osaka University. He was a visiting scholar at Center for Turbulence Research, NASA Ames Research Center/Stanford University before being appointed to an associate professor at Kyoto University in 2001 and a professor at Osaka University in 2005. Currently, he is an associate editor of Journal of Fluid Mechanics and an editor-in-chief of Fluid Dynamics Research. His research interests are in turbulence, subcritical transition to turbulence, simple invariant solutions to the Navier-Stokes equation and turbulent heat transfer.

Title: Ultimate states of turbulent thermal convection and shear flow.

Turbulent heat transfer is reviewed for thermal convection (or shear flow) between horizontal (or parallel) permeable walls. It is shown that wall permeability can lead to the so-called ultimate state in which a wall heat flux is independent of thermal diffusivity or kinematic viscosity. In the ultimate state of thermal convection (or shear flow) between permeable walls, large-scale thermal plumes (or spanwise rolls) are induced even in the vicinity of the walls. These large-scale thermal and flow structures fully extend in the fluid layers, yielding the ultimate heat transfer.

Prof. Luis Pablo Ruiz-Calavera, Airbus & Universidad Politécnica de Madrid



Prof. Luis Pablo Ruiz-Calavera is currently the Executive Expertise Leader for Aerodynamics at Airbus and the associated professor at Universidad Politécnica de Madrid. He received his PhD in Aerodynamics from Universidad Politécnica de Madrid. Since 1984 he has held several positions, including Researcher at Instituto Nacional de Técnica Aeroespacial, HO Aerodynamics at Airbus Military and Vice-president HO Flight Physics at Airbus Defence and Space. Within these roles, he has participated in and successfully lead many aerospace research and development projects.

Title: Some aerodynamic challenges of the future sustainable commercial aircraft

The Aviation Industry has committed to net-zero carbon emissions in global civil operation by 2050. To achieve this goal the next generation of commercial aircraft will need to incorporate new technologies to significantly increase the aerodynamic efficiency and to make use of new types of power plants and energy sources. This will result in the need to evolve the aircraft configuration and to bring to a robust operational standard technologies that have so far not been routinely used on large airlines. Industry is actively exploring these concepts while developing the technology bricks that would enable them. This talk will review some of these technologies in the aerodynamics field and will present Airbus' view on the still existing gaps that need to be matured before they find practical implementation in the future sustainable commercial aircraft.

Prof. Spencer Sherwin, Imperial College London, London, UK

Professor Spencer Sherwin is Head of Department and Professor of Computational Fluid Mechanics in the Department of Aeronautics at Imperial College London. Currently, he is an associate editor of Journal of Fluid Mechanics. He received his MSE and PhD from the Department of Mechanical and Aerospace Engineering Department at Princeton University. Prior to this he received his BEng from the Department of Aeronautics at Imperial College London. Professor Sherwin leads an active research group specializing in the development and application of parallel high order spectral/hp element methods (Nektar++) for flow around complex geometries with a particular emphasis on vortical and bluff body flows and biomedical modelling of the cardiovascular system. He has been closely involved in industrial application of these methods through partnerships with McLaren Racing, Airbus and Rolls Royce. Currently Professor Sherwin is Principal Investigator on the EPSRC funded Platform for Research in Simulation Methods.

Title: Advancing spectral/hp element high fidelity simulation of incompressible and compressible flows.

Advanced high order methods using Spectral/hp element discretization including Galerkin, Discontinuous Galerkin (DG) and Flux Reconstruction (FR) formulations are gaining notable interest in both the academic and industrial sectors. The compact nature of the approach is not only attractive from the perspective of implementation on modern computational hardware but also provides a consistent geometric and spatially localized accuracy unlike many high order finite volume methods. These features make the methodology attractive in complex geometry flows involving transitional and turbulent boundary layers demanding a high level of accuracy for high end engineering applications that commonly arise in the automotive and aeronautical sectors. In this presentation, we will present our current work on developing and advancing spectral/hp element incompressible and compressible flow solvers for industry relevant, high-fidelity applications. The demands of handling “industrial strength” complex geometries at high Reynolds numbers presents a number of challenges both in terms high order mesh generation, stabilization of marginally resolved flows and maintaining computational efficiency. In this presentation we will highlight our on-going efforts to address all these challenges and demonstrate the suitability of the approach for a number of representative examples.

Daniele Simoni, Prof., University of Genova

Prof. Daniele Simoni is the Head of the Aerodynamics and Turbomachinery Laboratory of the University of Genova. He graduated in Mechanical Engineering at the University of Genova with honours (09/2005). He received his PhD in Fluid Machinery from the University of Genova in 2009. He became Full Professor at the University of Genova in 2020. Since 2023 he is Coordinator of the Ph. D course in "Machine and Systems Engineering for Energy, Environment and Transport". Prof. Daniele Simoni developed expertise in the design of open and closed loop wind tunnels, and in the design of turbomachinery and aeroengine components. He is expert on the application and data analysis of advanced measuring techniques for the investigation of time-dependent unsteady and distorted flow fields developing into turbomachinery components, such as laser Doppler Velocimetry, Time Resolved Particle Image Velocimetry, Fast Response Aerodynamics Pressure Probes, as well as hot-wire and hot-film anemometers. He developed acquisition and post-processing techniques for data reduction and identification of reduced order model by means of Proper Orthogonal Decomposition, Dynamic Mode Decomposition and wavelet techniques.

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Title: The role of experiments and data reduction techniques in the tuning of different transition models.

The Reynolds averaged Navier Stokes-based CFD solvers require closure strategies for the estimation of the Reynolds stress tensor, providing an eddy viscosity affecting the momentum transfer processes of the mean flow. Different turbulence and transition schemes have been developed in the past, especially for prediction of transitional boundary layer flows, relying on different assumptions and ability to predict transitional and turbulent flows of various applications. However, irrespective of the specific kind of numerical scheme considered, such model strategies necessarily require empiricisms to properly set the key terms appearing in the set of transport equations, definitively adopted to provide an accurate estimation of the eddy viscosity. In the present work, an experimental data base spanning a large Design of Experiments devoted to tuning of possibly different transition closure schemes will be described in detail. This large database has been acquired in the last years in the Laboratory of Aerodynamics and Turbomachinery of the University of Genova. It includes more than 90 combinations of the most influencing parameters affecting transition, like the flow Reynolds number, the adverse pressure gradient and the free-stream turbulence intensity. Time-Resolved Particle Image Velocimetry (TR-PIV) has been used to characterize the response of the boundary layer transition process to variation of the inflow parameters. Data have successively been further reduced to provide closure elements required by different transition models. The spot production rate source term appearing in the $\gamma - Re\theta$ model, the energy transfer rate appearing in the Laminar Kinetic Energy (LKE) transition model and the apparent viscosities characterizing the Pope's tensorial expansion are a few examples that will be discussed in detail during this presentation. The focus will be also paid to the reduction techniques and machine learning algorithms used to identify parsimonious models able to maximize their generalizability. Additional examples involving schemes for parallelized codes will be also discussed.

THEMATIC SESSIONS

Aerodynamics and Hydrodynamics: sessions 9 and 12
Combustion and Reactive Flows: session 1
Computational Fluid Dynamics: sessions 4, 7 and 10
Experimental Methods: session 2
Flow Control and Optimization: session 11
Multiphase Flows and Complex Fluids: sessions 3 and 6
Turbulence and Transition: sessions 5 and 8

XXVI FMC PROGRAMME DAY AFTER DAY

Tuesday, September 10th, 2024	
from 10.00	Registration **BR4 lobby**
11.00-11.45	XXVI FMC Opening Ceremony **Room 1.01 Syriusz**
11.45-12.30	**Prof. J.M. Floryan,** Western University, London, Canada **On the structured convection** *Chairman: Prof. J. Szumbarski* **Room 1.01 Syriusz**
12.30-14.00	**Lunch (BR4 lobby)**
14.00-17.00	**Young researchers Prof. J. W. Elsner's competition** *Chairman: Prof. J.M. Floryan* **Room 1.01 Syriusz**
17:00-17:30	**Coffee break (BR4 lobby)**
17:30-18:15	Poster teasers session *Chairman: Dr. T. Bobiński* **Room 1.01 Syriusz**
18:15-19:00	Young researchers J. W. Elsner's jury meeting **Room 1.01 Syriusz**
20.00-23.00	Get-together party **Patio in the Institute of Heat Engineering (IHE) Nowowiejska 21/25**

<table>
<tr><th colspan="4">Wednesday, September 11th, 2024</th></tr>
<tr><td>09.00-9.45</td><td colspan="3">Prof. G. Kawahara, Osaka University, Osaka, Japan
Ultimate states of turbulent thermal convection and shear flow
Chairman: Prof. J. Pozorski
Room 1.01 Syriusz</td></tr>
<tr><td>9.45-10.15</td><td colspan="3">Coffee break (BR4 lobby)</td></tr>
<tr><td>10.15-12.15</td><td>Session #1
Combustion and Reactive Flows
Chairman:
Prof. W. Wróblewski
Room 4.01 Polaris</td><td>Session #2
Experimental Methods
Chairman:
Prof. W. Elsner
Room 4.04 Kapella</td><td>Session #3
Multiphase Flows and Complex Fluids
Chairman:
Prof. J. Pozorski
Room 1.01 Syriusz</td></tr>
<tr><td>12.15-13.45</td><td colspan="3">Lunch (BR4 lobby)</td></tr>
<tr><td>13.45-14.30</td><td colspan="3">Prof. K.J. Fidkowski, University of Michigan, Michigan, USA
Output-based discretization error control in turbulent flow simulations
Chairman: Prof. S. Kubacki
Room 1.01 Syriusz</td></tr>
<tr><td>14.30-16.30</td><td>Session #4
Computational Fluid Dynamics
Chairman:
Prof. S. Sherwin
Room 4.01 Polaris</td><td>Session #5
Turbulence and Transition
Chairman:
Prof. G. Kawahara
Room 4.04 Kapella</td><td>Session #6
Multiphase Flows and Complex Fluids
Chairman:
Prof. P. Korczyk
Room 1.01 Syriusz</td></tr>
<tr><td>16.30-18.00</td><td colspan="3">Coffee break / Poster display (in the hallway on 4th floor in BR4)</td></tr>
<tr><td>18.00-19.00</td><td colspan="3">Meeting of the Fluid Mechanics Section of the Committee of Mechanics PAS
Room 4.07 Adara</td></tr>
</table>

<table>
<tr><th colspan="4">Thursday September 12th, 2024</th></tr>
<tr><td>09.00-9.45</td><td colspan="3">Prof. S. Sherwin, Imperial College London, London, UK
Advancing spectral/hp element high fidelity simulation of incompressible and compressible flows
Chairman: Prof. A. Tyliszczak
Room 1.01 Syriusz</td></tr>
<tr><td>9.45-10.15</td><td colspan="3">Coffee break (BR4 lobby)</td></tr>
<tr><td>10.15-12.15</td><td>Session #7
Computational Fluid Dynamics
Chairman:
Prof. A. Tyliszczak
Room 1.01 Syriusz</td><td>Session #8
Turbulence and Transition
Chairman:
Prof. J.M. Floryan
Room 4.01 Polaris</td><td>Session #9
Aerodynamics and Hydrodynamics
Chairman:
Prof. L.P. Ruiz-Calavera
Room 4.04 Kapella</td></tr>
<tr><td>12.15-13.45</td><td colspan="3">Lunch</td></tr>
<tr><td>13.45-14.30</td><td colspan="3">Prof. L.P. Ruiz-Calavera,
Airbus/Universidad Politécnica de Madrid
Some aerodynamic challenges of the future sustainable commercial aircraft
Chairman: Dr P. Baj
Room 1.01 Syriusz</td></tr>
<tr><td>14.30-16.30</td><td colspan="3">Sponsors' Session
Chairman: Prof. J. Szumbarski
Room 1.01 Syriusz</td></tr>
<tr><td>16.30-18.00</td><td colspan="3">Coffee break / Poster display</td></tr>
<tr><td>20.00-23.00</td><td colspan="3">Conference gala dinner (Restaurant "Warszawski Sen", 63 Koszykowa St.)</td></tr>
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<table>
<tr><th colspan="4">Friday, September 13th, 2024</th></tr>
<tr><td>09.00-9.45</td><td colspan="3">Prof. D. Simoni, University of Genova
The role of experiments and data reduction techniques in the tuning of different transition models
Chairman: Prof. S. Malinowski
Room 1.01 Syriusz</td></tr>
<tr><td>9.45-10.15</td><td colspan="3">Coffee break</td></tr>
<tr><td>10.15-12.15</td><td>Session #10
Computational Fluid Dynamics
Chairman:
Prof. M. Marek
Room 4.01 Polaris</td><td>Session #11
Flow Control and Optimization
Chairman:
Prof. K.J. Fidkowski
Room 1.01 Syriusz</td><td>Session #12
Aerodynamics and Hydrodynamics
Chairman:
Prof. D. Simoni
Room 4.04 Kapella</td></tr>
<tr><td>12.15-13.45</td><td colspan="3">Lunch</td></tr>
<tr><td>13.45-14.15</td><td colspan="3">Closing of the Conference
Room 1.01 Syriusz</td></tr>
</table>

DETAILED SCHEDULE OF PRESENTATION SESSIONS

Young researchers Prof. J. W. Elsner's competition

Tuesday, 14.00-17:00, *Room 1.01*

Chairman: Prof. J.M. Floryan

14:00 Turbulent Coherent Structures in Thermal Vortex Rings.
P. Jędrejko, J.-I. Yano, M. Wacławczyk

14:25 Control of turbulent boundary layer separation using a sinusoidal-type wavy-wall.
P. Kamiński, A. Tyliszczak

14:50 Impact of flashing conditions on impinging-jet sprays.
B. Kaźmierski, Ł. Kapusta

15:15 Numerical investigation of local aerosol deposition in a real scale T-junction of a ventilation network.
R. Ploix, J. Malet, E. Gehin

15:40 Evaluation of hot-wire measurement accuracy in turbulent boundary layers under strong adverse pressure gradient conditions.
M. Romańczyk, A. Dróżdż, W. Elsner

16:05 Aeroacoustic analysis of propeller rotor noise using the porous FW-H acoustic analogy.
T. Suresh, O. Szulc, P. Flaszynski

16:30 Rectangular waveguide cavities as cloaks for cylindrical obstacles.
D. Żyła, T. Bobinski

Poster teasers session

Tuesday, 17.30-18.15, *Room 1.01.*

Chairman: Dr T. Bobiński

1. Preliminary wind tunnel testing of a racing motorcycle using a scale model.
   K. Balcerzak, B. Potęga
2. Fluid Dynamics of Flow around Various Cylinders Geometries.
   R. Gnatowska, K. Gumowski, P. Niegodajew, K. Gajewska
3. Multiphase flow analysis in horizontal pipe - numerical issues.
   P. Marczak, M. Jaszczur
4. Experimental analysis of fractal distributors.
   A. Merdjani, N. Kizilova
5. Extending Channelflow: Incorporating Temperature Effects in Poiseuille and Couette Flows.
   K. Michałowski, S. Gepner
6. Fractal-Type Structures for Heat Exchangers: A CFD Investigation of Tube Geometry Influence.
   A. A. Muhsen, N. Kizilova, B. H. Attiya
7. Numerical Investigation of Gas Injection into the Crossflow for High Reynolds Number.
   S. B. Naqvi, M. Matyka

8. Time dependence of similarity functions in the atmospheric boundary layer.
   J. Nzotungishaka, M. Waclawczyk and J-I. Yano
9. Surrogate model of missile's flight control surface aerodynamics.
   B. Olszański
10. Optimisation of the design of Formula SAE car aerodynamics.
    T. Polski, M. Żyto, M. Płatek Ł. Rybakowski, M. Bartoszek, G. Spruch, R. Szulejko, E. Podlevski
11. *Composition tracking of CO2-rich streams in large-scale pipeline networks under steady-state conditions.*
    A. Osiadacz, Ł. Kotyński, F. Uilhoorn, T. Bleschke, M. Kwestarz and M. Chaczykowski

Session #1, **Combustion and Reactive Flows**

Wednesday, 10.15-12.15, September 11th, 2024

Room 4.01

Chairman: Prof. W. Wróblewski

10.15 Investigation of steam-diluted hydrogen combustion in a counter-current nozzle configuration using LES.
A. Wawrzak, A. Tyliszczak

10.35 Revisiting homogeneous modeling with volume averaging theory: structured catalysts for steam reforming and CO2 methanation.
J. A. M. Méndez, B. Dorneanu, H. Schmidt, H. Arellano-García

10.55 A high-order LES of a flow in complex geometry.
K. Wawrzak, A. Wawrzak, A. Bogusławski, A. Tyliszczak

11.15 Numerical modelling of a rotary shock wave compression heat engine with a rotating detonation wave combustion chamber.
J. Piechna, M. Szudarek, A. Piechna

11.35 Swirl Effect Assessment on NOx Formation for CH4/H2/NH3 Flame under MILD Condition.
A. Mardani, K. C. Kim

11.55 Some theoretical problems of creation the mathematic model of joint treatment of wastewaters with organic contaminants and nitrogen compounds by method of biofiltration.
S. Telyma, O. Oliynyk (online)

Session #2, **Experimental Methods**

Wednesday, 10.15-11.55, September 11th, 2024

Room 4.04

Chairman: Prof. W. Elsner

10.15 Integrated Approaches in Microfluidic Design for Enhanced Droplet Manipulation and Biological Insights.
P M Korczyk, T Kurniawan, S Błoński, B Kupikowska-Stobba

10.35 Influence of micro- and mesoscale on the permeability characteristics of 3D printed porous objects.
K. Bukowski, Ł. Klotz

10.55 PIV measurement of model nuclear fuel rod bundle.
D. Duda, V. Yanovych, V. Uruba

11.15 Experimental Challenges of Nano and Microfluidics.
T. Kowalewski

11.35 Mapping the efficiency of a novel rotating arc-wall inline mixer.
M. Kiwan, E. Younes, C. Castelain, T. Burghelea

Session #3, **Multiphase Flows and Complex Fluids**

Wednesday, 10.15-12.15, September 11th, 2024

Room 1.01

Chairman: Prof. J. Pozorski

10.15 Collision efficiency of cloud droplets considering electrostatic and hydrodynamic interactions.
A. Michel, B. Rosa, A. Ababaei

10.35 On improving the spatial resolution of the statistical model of the interphase region.
T. Wacławczyk

10.55 Interaction of liquid droplets with micro-structured and nanostructured surfaces.
N. Kizilova

11.15 Impact of pipe inclination on fill height for partially filled pipes used in a custom slurry transport rig.
A. Bose, D.J. Borman, T.N. Hunter, J.T. Spencer, C.J. Cunliffe

11.35 Droplet surfing on a boundary layer - origin of droplet shape oscillation.
M. Klamka, T. Bobinski

11.55 Forces acting on a pendant drop on a small pillar.
M. Arogeti, A. Vinod, M. Tadmor

Session #4, **Computational Fluid Dynamics**

Wednesday, 14.30-16.10, September 11th, 2024

Room 4.01

Chairman: Prof. S. Sherwin

14.30 Isotropy of numerical errors in the context of implicit large eddy simulation.
A. Kajzer

14.50 Quantification of laminar mixing efficiency using ‘strange eigenmodes’ approach.
J. Fabisiak, S. Gepner

15.10 Heat transfer of laser-illuminated gold nanorod platforms distributed in a flow germicidal chamber.
P. Radomski, D. Kreft, P. Ziółkowski, I. Mukha, J. Zieliński, D. Mikielewicz

15.30 Numerical modelling of gas flow in random packed bed with a helical flow deflector.
M. Marek

15.50 Numerical simulation of two-phase flow in OpenFOAM software.
S. Koval, N. Dimitrieva (online)

Session #5, **Turbulence and Transition**

Wednesday, 14.30-16.30, September 11th, 2024

Room 4.04

Chairman: Prof. G. Kawahara

14.30 Turbulent cascades in the Atmospheric Boundary Layers.
M. Wacławczyk, J. L. Nowak, J. C. Vassilicos, S. Król, S. P. Malinowski

14.50 Atmospheric turbulence: anisotropic, nonstationary and intermittent. What can we do?
S.P. Malinowski, M. Wacławczyk, J. Nowak, S. Król, R. Grosz

15.10 Influence of porous material on the flow behind backward-facing step - experimental study.
K. Bukowski, K. Gumowski, Ł. Klotz

15.30 Replicating environmental flows with an active grid.
P. Baj, P. Czubak, B. Załęcki, A. Czaplińska

15.50 A shear flow in counter-rotating Taylor-Couette configuration.
E. Tuliszka-Sznitko

16.10 Large Eddy Simulation of turbulent flow at the entrance to an annular pipe section.
P. Prusiński, S. Kubacki

Session #6, **Multiphase Flows and Complex Fluids**

Wednesday, 14.30-16.30, September 11th, 2024

Room 1.01

Chairman: Prof. Piotr Korczyk

14.30 Particle clustering and velocity statistics in large-eddy simulations of isotropic turbulence.
M. Rajek, J. Pozorski

14.50 Estimation of Droplet size using Pressure Oscillation-based approach in Microfluidics by Simulations.
B.B. Khan, S.K. Thamida, A.B. Vir

15.10 Utilizing a pressure-based CFD solver for modelling wet steam flow in low-pressure turbine stages: a predictive approach to assessing flow losses.
S. Shabani, M. Majkut, S. Dykas, K. Smolka

15.30 Numerical simulation of the oil-water flow in a horizontal pipe in a stratified flow regime.
D. Asendrych

15.50 Liquid-gas flow modelling in horizontal pipe.
M. Jaszczur, P. Marczak, R. Hanus, A. Golijanek-Jędrzejczyk, A. Andruszkiewicz, M. Zych

16.10 Time-resolved imaging of reactive transport instability during multiphase flow in porous media.
M. Dzikowski, P. Szymczak

Session #7, **Computational Fluid Dynamics**

Thursday, 10.15-11.55, September 12th, 2024

Room 4.01

Chairman: Prof. A. Tyliszczak

10.15 Dissimilar heat transfer enhancement in pipe flow with deep axial grooves.
S. Motoki, G. Kawahara

10.35 Numerical evaluation of mass diffusive compressible fluids flows models.
T. Bodnar

10.55 Code coupling for the Tube Support Plate clogging in steam generators.
A. Couvez, S. Gyuran, N. Leterrier, P. Omnes, E. Saikali

11.15 Numerical investigation of Air Flow Within a Human Nasal Cavity.
P. Niegodajew

11.35 Semiempirical model of the acoustics of a supersonic jet upon collision with a perpendicular wall.
V. Oliynik, T. Batutina (online)

Session #8, **Turbulence and Transition**

Thursday, 10.15-11.35, September 12th, 2024

Room 1.01 Chairman: Prof. J.M. Floryan

10.15 Anisotropic turbulence in marine cumulus clouds.
S. Król, S. Malinowski

10.35 Tracking invariant solutions of the Navier-Stokes equations within spectral element framework.
S. Gepner, G. Kawahara

10.55 Global instabilities on ROTEX-T cone-flare model in hypersonic flow at high altitude cruise conditions.
K. Dylewicz, V. Theofilis

11.15 URANS numerical analysis of turbulence intensity influence on laminar separation bubble in the case of the NACA0018 airfoil.
J. Michna, K. Rogowski

Session #9, **Aerodynamics and Hydrodynamics**

Thursday, 10.15-11.55, September 12th, 2024

Room 4.04

Chairman: Prof. L.P. Ruiz-Calavera

10.15 Effect of yaw angle on wind turbine power generation and velocity in the wake.
F. Wasilczuk, K. Pietrzycka, R. Szewczuk, P. Flaszynski

10.35 On Streamwise Vorticity Dynamics in Circular Cylinder Wake.
V. Uruba, P. Prochazka, D. Duda

10.55 Validation of Yamaguchi-Ichikawa water hammer model.
K. Urbanowicz, C. Di Nucci, B. K. Sharma, K. Ashok, S. Krajewski

11.15 Velocity profile correction in the analytical model of flow between disks of Tesla turbine.
K. Rusin, W. Wróblewski, E. H. Malekshah, M. Pahlavanzadeh, S. Rulik

11.35 Assessment of Wind Conditions in Urban Spaces: A Case Study of Warsaw Downtown.
M. Pisula, M. Poćwierz

Sponsors' Session

Thursday, 14.30-16.30, September 12th, 2024

Room 1.01

Chairman: Prof. J. Szumbarski

1. CIM-mes Projekt Sp. z o. o.
   A. Jaworski, Numerical modelling in space applications
2. Symkom Sp. z o. o.
   M. Szudarek, AI Meets Simulation: Elevating Engineering simulations with ANSYS
3. Symkom Sp. z o. o.
   P. Turos, ANSYS STK: Design of Aerospace Systems and Air Defense Missions
4. Łukasiewicz-Institute of Aviation/Industry Contact Point Smart and Clean Mobility
   Jakub Kapuściński, Horizon Europe opportunities for facing CFD challenges
5. Eurotek/Dantec
   K. Dörner, Dantec Dynamics systems in Macro and Micro Experimental Fluid Dynamics
6. EC TEST Systems Sp. z o. o.
   J. Spisak, Fluid flow simulation and validation with PIV method of fluidic oscillator

Session #10, **Computational Fluid Dynamics**

Friday, 10.15-11.55, September 13th, 2024

Room 4.01

Chairman: Prof. M. Marek

10.15 Step-by-step CFD validation of turbulent particle transport and deposition in industrial bends.
J. Malet, R. Ploix, E. Géhin

10.35 High performance least-squares spectral/hp element method solvers for fluid dynamics problems.
J. Gałecki, J. Szumbarski

10.55 Application of CFD airflows to aid nasal obstruction diagnosis.
B. Kopiczak, K. Karbowski, K. Nering, Z. Malecha, R. Chrzan, J. Gawlik, A. Sucherska, J. Szaleniec, J. Karbowski

11.15 Application of the model of trapped vortices to the control of flow around a bridge pear.
I. Gorban (online)

11.55 Improvement of the aerodynamic performance using the developed method of energy-efficient flow control.
N. Yurchenko, P. Vynogradskyy, R. Pavlovskyy (online)

Session #11, **Flow Control and Optimization**

Friday, 10.15-11.35, September 13th, 2024

Room 1.01

Chairman: Prof. K.J. Fidkowski

10.15 LES of flow dynamics downstream of new type bluff bodies.
L. Caban, A. Wawrzak, A. Tyliszczak, D. Thévenin

10.35 Machine learning-supported CFD optimization of heat transfer in a pipe with a corrugated wall shape.
P. Kamiński, Y. Li, K. Wawrzak, A. Tyliszczak, B. Noack

10.55 Airfoil design in separated ultra-low Reynolds flows using a shear stress-based inverse design method.
Z. Drafsh, M. Nili-Ahmadabadi, M. Y. Ha

11.15 Box-Spline parametrisation of motion kinematics in aerodynamic optimisation of flapping motion.
M. Rutkowski, Ł. Łaniewski-Wołłk

Session #12, **Aerodynamics and Hydrodynamics**

Friday, 10.15-11.35, September 13th, 2024

Room 4.04

Chairman: Prof. D. Simoni

10.15 Aerodynamic and aeroacoustic analysis of a model UAV propeller.
O. Szulc, P. Flaszyński, T. Suresh

10.35 Aerodynamic Multipoint Aircraft Design Including Aeroelastic Wing Deformation.
K. Kubryński

10.55 Analysis of turbulent flow separation control method using wall corrugation under different flow history.
A. Dróżdż, V. Sokolenko, W. Elsner

11.15 Creation and verification of a large Vertical Axis Wind Turbine airfoil class.
J. Wiśniewski, J. Szumbarski

TIME LAYOUT OF PARALLEL THEMATIC SESSIONS

Parallel sessions #1 – #3, September 11th, Wednesday, 10.15-12.15

Session #1 **Combustion and Reactive Flows** Room 4.01 Chairman: *Prof. W. Wróblewski*	Session #2 **Experimental Methods** Room 4.04 Chairman: *Prof. W. Elsner*	Session #3 **Multiphase Flows and Complex Fluids** Room 1.01 Chairman: *Prof. J. Pozorski*
Investigation of steam-diluted hydrogen combustion in a counter-current nozzle configuration using LES. *A Wawrzak, A Tyliszczak*	Integrated Approaches in Microfluidic Design for Enhanced Droplet Manipulation and Biological Insights. *P M Korczyk, T Kurniawan, S Błoński, B Kupikowska-Stobba*	Collision efficiency of cloud droplets considering electrostatic and hydrodynamic interactions. *A Michel, B Rosa, A Ababaei*
Revisiting homogeneous modeling with volume averaging theory: structured catalysts for steam reforming and CO2 methanation. *J A M Méndez, B Dorneanu, H Schmidt, H Arellano-García*	Influence of micro- and mesoscale on the permeability characteristics of 3D printed porous objects. *K Bukowski, Ł Klotz*	On improving the spatial resolution of the statistical model of the interphase region. *T Wacławczyk*
A high-order LES of a flow in complex geometry. *K Wawrzak, A Wawrzak, A Bogusławski, A Tyliszczak*	PIV measurement of model nuclear fuel rod bundle. *D Duda, V Yanovych, V Uruba*	Interaction of liquid droplets with micro-structured and nanostructured surfaces. *N Kizilova*
Numerical modelling of a rotary shock wave compression heat engine with a rotating detonation wave combustion chamber. *J Piechna, M Szudarek, A Piechna*	Experimental Challenges of Nano and Microfluidics. *T Kowalewski*	Impact of pipe inclination on fill height for partially filled pipes used in a custom slurry transport rig. *A Bose, D J Borman, T N Hunter, J T Spencer, C J Cunliffe*
Swirl Effect Assessment on NOx Formation for CH4/H2/NH3 Flame under MILD Condition. *A. Mardani, K. C. Kim*	Mapping the efficiency of a novel rotating arc-wall inline mixer. *M Kiwan, E Younes, C Castelain, T Burghelea*	Droplet surfing on a boundary layer - origin of droplet shape oscillation. *M Klamka, T Bobinski*
Some theoretical problems of creation the mathematic model of joint treatment of wastewaters with organic contaminants and nitrogen compounds by method of biofiltration. *S Telyma, O Oliynyk (online)*		Forces acting on a pendant drop on a small pillar. *M Arogeti, A Vinod, M Tadmor*

Parallel sessions #4 – #6
September 11th, Wednesday, 14.30-16.30

Session #4 **Computational Fluid Dynamics** Room 4.01 Chairman: *Prof. S. Sherwin*	Session #5 **Turbulence and Transition** Room 4.04 Chairman: *Prof. G. Kawahara*	Session #6 **Multiphase Flows and Complex Fluids** Room 1.01 Chairman: *Prof. Piotr Korczyk*
Isotropy of numerical errors in the context of implicit large eddy simulation. *A Kajzer*	Turbulent cascades in the Atmospheric Boundary Layers. *M Wacławczyk, J L Nowak, J C Vassilicos, S Król, S P Malinowski*	Particle clustering and velocity statistics in large-eddy simulations of isotropic turbulence. *M Rajek, J Pozorski*
Quantification of laminar mixing efficiency using 'strange eigenmodes' approach. *J Fabisiak, S Gepner*	Atmospheric turbulence: anisotropic, nonstationary and intermittent. What can we do? *S Malinowski, M Wacławczyk, J Nowak, S Król, R Grosz*	Estimation of Droplet size using Pressure Oscillation-based approach in Microfluidics by Simulations. *B B Khan, S K Thamida, A B Vir*
Heat transfer of laser-illuminated gold nanorod platforms distributed in a flow germicidal chamber. *P Radomski, D Kreft, P Ziółkowski, I Mukha, J Zieliński, D Mikielewicz*	Influence of porous material on the flow behind backward-facing step - experimental study. *K Bukowski, K Gumowski, Ł Klotz*	Utilizing a pressure-based CFD solver for modelling wet steam flow in low-pressure turbine stages: a predictive approach to assessing flow losses. *S Shabani, M Majkut, S Dykas, K Smolka*
Numerical modelling of gas flow in random packed bed with a helical flow deflector. *M Marek*	Replicating environmental flows with an active grid. *P Baj, P Czubak, B Załęcki, A Czaplińska*	Numerical simulation of the oil-water flow in a horizontal pipe in a stratified flow regime. *D Asendrych*
Numerical simulation of two-phase flow in OpenFOAM software. *S Koval, N Dimitrieva (online)*	A shear flow in counter-rotating Taylor-Couette configuration. *E Tuliszka-Sznitko*	Liquid-gas flow modelling in horizontal pipe. *M Jaszczur, P Marczak, R Hanus, A Golijanek-Jędrzejczyk, A Andruszkiewicz, M Zych*
	Large Eddy Simulation of turbulent flow at the entrance to an annular pipe section. *P Prusiński, S Kubacki*	Time-resolved imaging of reactive transport instability during multiphase flow in porous media. *M Dzikowski, P Szymczak*

Parallel sessions #7 – #9
September 12th, Thursday, 10.15-11.55

Session #7 **Computational Fluid Dynamics** Room 4.01 Chairman: *Prof. A. Tyliszczak*	Session #8 **Turbulence and Transition** Room 1.01 Chairman: *Prof. J.M. Floryan*	Session #9 **Aerodynamics and Hydrodynamics** Room 4.04 Chairman: *Prof. L.P. Ruiz-Calavera*
Dissimilar heat transfer enhancement in pipe flow with deep axial grooves. *S Motoki, G Kawahara*	Anisotropic turbulence in marine cumulus clouds. *S Król, S Malinowski*	Effect of yaw angle on wind turbine power generation and velocity in the wake. *F Wasilczuk, K Pietrzycka, R Szewczuk, P Flaszynski*
Numerical evaluation of mass diffusive compressible fluids flows models. *T Bodnar*	Tracking invariant solutions of the Navier-Stokes equations within spectral element framework. *S Gepner, Genta Kawahara*	On Streamwise Vorticity Dynamics in Circular Cylinder Wake. *V Uruba, P Prochazka, D Duda*
Code coupling for the Tube Support Plate clogging in steam generators. *A Couvez, S Gyuran, N Leterrier, P Omnes, E Saikali*	Global instabilities on ROTEX-T cone-flare model in hypersonic flow at high altitude cruise conditions. *K Dylewicz, V Theofilis*	Validation of Yamaguchi-Ichikawa water hammer model. *K Urbanowicz, C Di Nucci, B K Sharma, K Ashok, S Krajewski*
Numerical investigation of Air Flow Within a Human Nasal Cavity. *P Niegodajew*	URANS numerical analysis of turbulence intensity influence on laminar separation bubble in the case of the NACA0018 airfoil. *J Michna, K Rogowski*	Velocity profile correction in the analytical model of flow between disks of Tesla turbine. *K Rusin, W Wróblewski, E H Malekshah, M Pahlavanzadeh, S Rulik*
Semiempirical model of the acoustics of a supersonic jet upon collision with a perpendicular wall. *V Oliynik, T Batutina (online)*		Assessment of Wind Conditions in Urban Spaces: A Case Study of Warsaw Downtown. *M Pisula, M Poćwierz*

Parallel sessions #10 – #12
September 13th, Friday, 10.15-11.55

Session #10 **Computational Fluid Dynamics** Room 4.01 Chairman: *Prof. M. Marek*	Session #11 **Flow Control and Optimization** Room 1.01 Chairman: *Prof. K.J. Fidkowski*	Session #12 **Aerodynamics and Hydrodynamics** Room 4.04 Chairman: *Prof. D. Simoni*
Step-by-step CFD validation of turbulent particle transport and deposition in industrial bends. *J Malet, R Ploix, E Géhin*	LES of flow dynamics downstream of new type bluff bodies. *L Caban, A Wawrzak, A Tyliszczak, D Thévenin*	Aerodynamic and aeroacoustic analysis of a model UAV propeller. *O Szulc, P Flaszyński, T Suresh*
High performance least-squares spectral/hp element method solvers for fluid dynamics problems. *J Gałecki, J Szumbarski*	Machine learning-supported CFD optimization of heat transfer in a pipe with a corrugated wall shape. *P Kamiński, Y Li, K Wawrzak, A Tyliszczak, B Noack*	Aerodynamic Multipoint Aircraft Design Including Aeroelastic Wing Deformation. *K Kubryński*
Application of CFD airflows to aid nasal obstruction diagnosis. *B Kopiczak, K Karbowski, K Nering, Z Malecha, R Chrzan, J Gawlik, A Sucherska,J Szaleniec, J Karbowski*	Airfoil design in separated ultra-low Reynolds flows using a shear stress-based inverse design method. *Z Drafsh, M Nili-Ahmadabadi, M Y Ha*	Analysis of turbulent flow separation control method using wall corrugation under different flow history. *A Dróżdż, V Sokolenko, W Elsner*
Application of the model of trapped vortices to the control of flow around a bridge pear. *I Gorban (online)*	Box-Spline parametrisation of motion kinematics in aerodynamic optimisation of flapping motion. *M Rutkowski, Ł Łaniewski-Wołłk*	Creation and verification of a large Vertical Axis Wind Turbine airfoil class. *J Wiśniewski, J Szumbarski*
Improvement of the aerodynamic performance using the developed method of energy-efficient flow control. *N Yurchenko, P Vynogradskyy, R Pavlovskyy (online)*		