



POLISH NATIONAL AGENCY  
FOR ACADEMIC EXCHANGE



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PROGRAMME

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| <p>name of the unit:</p> <h2 style="text-align: center;">DIVISION OF HYDROMACHINES<br/>AND FLUID MECHANICS</h2> <p style="text-align: center;">Institute of Turbomachinery, Lodz University of Technology</p>   |  | <p>symbol:</p> <h2 style="text-align: center;">I-12</h2> <p style="text-align: center;"><a href="http://www.imp.p.lodz.pl">http://www.imp.p.lodz.pl</a></p>  |
| <p>head of the unit:</p> <p style="text-align: center;">Krzysztof Sobczak,<br/>PhD, DSc</p>   | <p>potential promoters:</p> <p style="text-align: center;">Krzysztof Sobczak, PhD, DSc</p> | <p>contact person:</p> <p style="text-align: center;">Krzysztof Sobczak,<br/>PhD, DSc<br/>phone: 48-42-631-23-62<br/><a href="mailto:krzysztof.sobczak@p.lodz.pl">krzysztof.sobczak@p.lodz.pl</a></p>  |
| <p>scope of activities:</p> <p>The main areas of interest and research directions are:</p> <ul style="list-style-type: none"> <li>• design and investigations of small wind turbines: modelling and optimization of rotors, investigations of aerodynamic airfoils, rapid 3D prototyping and measurements of power and thrust of turbine models,</li> <li>• design and investigations of centrifugal pumps: determination of characteristics, testing of transient states (water hammer), flow simulations in pumps and water turbines,</li> <li>• investigations of rotors for small flying vehicles: power and thrust determination; design and development of multi-rotor structures, rotors equipped with winglets, duct augmented rotors, etc.,</li> <li>• measurements in the low-speed wind tunnel: tests of aerodynamic forces, pressure distributions, measurements of velocity and turbulence, flow visualization,</li> <li>• modelling of incompressible and compressible (subsonic and supersonic) flows.</li> </ul>  |  |    |
| <p>present activities:</p> <p>The investigations carried out at the Division are focused on the development of small wind turbines with horizontal and vertical rotation axes (HAWT and VAWT). These works integrate classic methods of rotor design and optimization with data obtained from two research paths: numerical (CFD methods) and experimental (measurements of power and aerodynamic forces as well as flow fields) in our low-speed wind tunnel and in cooperation with scientific and industrial overseas partners. The Division is currently investigating, inter alia, duct augmented wind turbines and vertical axis wind turbines with variable blade geometry. The Power Engineering Students Association conducts the research within the GUST home wind turbine project.</p> <p>The Division members are also conducting research on rotors for small flying vehicles. Concepts of systems of counter-rotating rotors working in channels, blades with a variable pitch, etc. are being developed.</p> <p>Thanks to the experience in conducting investigations employing various techniques (including pneumatic measurements, thermoanemometry, PIV laser flow visualization) and rapid prototyping (3D printing), the Division can conduct aerodynamic tests of a wide range of objects.</p> |  |  |
| <p>future activities:</p> <p>Development of numerical flow models and optimization procedures. Experimental investigations of various designs of wind turbines. Aerodynamic and aeroacoustic measurements of rotors.</p>  |  |  |



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Publications/patents, awards, projects:

- Sobczak K., Obidowski D., Reorowicz P., Marchewka E.: Numerical Investigations of the Savonius Turbine with Deformable Blades, *Energies*, 2020 (DOI: [10.3390/en13143717](https://doi.org/10.3390/en13143717))
- Lipian M., Dobrev I., Karczewski M., Massouh F., Jozwik K.: Small wind turbine augmentation: Experimental investigations of shrouded- and twin-rotor wind turbine systems, *Energy*, 2019 (DOI: [10.1016/j.energy.2019.115855](https://doi.org/10.1016/j.energy.2019.115855))

We conduct the following research projects:

- Twin shrouded rotor for a small aerial vehicle NUTRIA – project Lider XI (2021/01 – 20224/01), <https://www.researchgate.net/project/Twin-shrouded-rotor-for-small-aerial-vehicle-NUTRIA>
- Small Wind Turbine GUST – project of the Power Engineering Students Association, financed by Najlepsi z Najlepszyc!, Łódź Naukowa Łódź Akademicka, <https://www.facebook.com/GUSTprojectPL/>

keywords:

applied aerodynamics; wind turbines; rotors; computational fluid dynamics (CFD); experimental investigations in the wind tunnel; hydraulic machines; pumps; water turbines

List of internship proposal in this research team:

- Modelling of flows based on CFD methods; hybrid, analytical and other models.
- Wind tunnel aerodynamic tests of various objects (wind turbines, rotors, etc.).