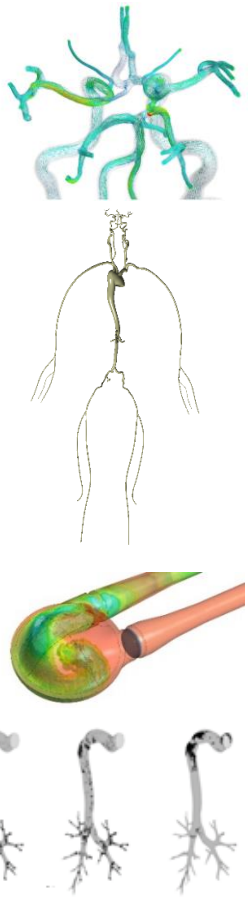
name of the unit:		symbol:
DIVISION OF MEDICAL APPARATUS Institute of Turbomachinery, Lodz University of Technology		I-12 http://www.imp.p.lodz.pl
head of the unit:	potential promoters:	contact person:
Prof. Krzysztof Jóźwik, PhD, DSc	Prof. Krzysztof Jóźwik, PhD, DSc Damian Obidowski, PhD, DSc, TUL Prof.	Damian Obidowski, PhD, DSc, TUL Prof. phone: 48-42-631-23-88 damian.obidowski@p.lodz.pl

scope of activities:

The main areas of interest and research directions are the following problems falling within the general concept of Biomedical Engineering:

- long-term tests of an artificial heart valve with a ring covered with nanocrystalline diamond on the test stand designed at the Institute of Turbomachinery, TUL,
- investigations on conduction of regenerated peripheral nerves in rats and the use of freezing and heating techniques in the removal of focal lesions of the thyroid lobes, conducted in cooperation with the Division of Flow Metrology,
- research on diamond microfluidic devices for DNA and protein analysis within the international MNT ERANET project,
- numerical simulations of the blood flow through arteries in the human body and ventricular assist devices, and of the air flow through the respiratory tract.



present activities:

We prepare personalized anatomical models of the respiratory tract and arterial and vein channels on the basis of the data saved in the DICOM format, obtained during diagnostic tests employing computed tomography. We develop algorithms for automatic segmentation (separation) of appropriate areas from the biomedical images provided, and then we generate spatial models for numerical calculations and construction of phantoms in 3D printing technology.

We carry out numerical and experimental tests of the flow using the PIV (Particle Image Velocimetry) technique and traditional methods, i.e., measurements with ultrasonic flowmeters and pressure transducers.

In numerical investigations, we determine velocity and pressure fields, mass flow rates in individual branches of the system, and predict patterns of particle deposition on the walls of 3D models. We perform numerical simulations in a pulsating flow. We use non-Newtonian rheological models that are close to the physiological properties of blood. We conduct calculations with the use of deformable walls owing to a combination of flow and structural solvers.

future activities:

Development of current and generation of new, more comprehensive numerical models to describe better the properties of blood vessel walls, autocontrol of blood circulation and tissue aging processes.

The portfolio of research groups was created as part of the Programme "STER" – Internationalisation of doctoral schools" as part of the realization of the project "Curriculum for advanced doctoral education & taining – CADET Academy of Lodz University of Technology".

Publications/patents, awards, projects:

- Reorowicz, P., Obidowski, D., Klosinski, P., Szubert, W., Stefanczyk, L., Jozwik, K. (2014). Numerical simulations of the blood flow in the patient-specific arterial cerebral circle region. Journal of Biomechanics, 47(7), 1642-1651.
- Tyfa, Z., Jóźwik, P., Obidowski, D., Reorowicz, P., Jodko, D., Kapka, K., Makosiej R., Czkwianianc E., Jóźwik, K. (2020). Inhaled drug airflow patterns and particles deposition in the paediatric respiratory tract. Acta of Bioengineering and Biomechanics, 22(2), 101-110.

We conduct the following research projects:

- "Prediction of Endovascular Treatment Results by Individualized Numerical Analysis" – project financed by the National Centre for Research and Development, Competition „LIDER X", 01.2020-12.2022;
- "Sol-gel antibacterial layers containing carbon nanoparticles" – International project M-ERA.NET Call 2019, in cooperation with the Technical University of Liberec and PPHU Termex, Ltd., 05.2020 – 05.2023.
- "Creating an absorbable dressing based on active exogenous tropocollagen from fish skins with the addition of modified carbon nanopowders", National Centre for Research and Development, Competition "Application Projects" in cooperation with Sancoll Ltd and Nicolaus Copernicus University in Toruń , 01.2021 – 01.2024.

keywords:

heart valves, extracorporeal heart assist pumps, blood flow tests, blood flow modelling, laser (PIV) flow testing, dialysis fistulas, 3D model reconstruction, DICOM

List of internship proposal in this research team:

- Co-operation during validation tests of FSI-type numerical calculations on the test stand