Seminar Partial Differential Equations
by dr hab. Anna Ochal & prof. dr hab. Piotr Zgliczynski
winter semester 2020-2021, Tuesday, 12:15-13:45

October 6, 13, 20, 2020
Jakub Banaśkiewicz, Attractors for non-autonomous subquintic weakly damped wave equation

Abstract: In this part, I will talk about energy estimation and the existence of Shatah-Struwe solutions for subquintic non-autonomous weakly damped wave equation. In particular, I will describe Strichartz's estimations for the linear weakly damped wave equation and use the continuation method to induce these estimations on a non-linear case.

October 27, November 3, 10, 2020
Robert Szczelina, Conley Index and some applications in PDEs

Abstract: We will present the idea of Conley Index, then some applications (mainly) in PDEs.

Based on the work: Phillipo Lappicy, Ćonley's index and connection matrices for non-experts"(arxiv:1901.05565v3)

Some extra reading: Conley Index part from the book Joel Smoller, Śhock Waves and Reaction—Diffusion Equations".

November 17, 24, 2020
Piotr Kalita, A Hopf bifurcation in the planar Navier-Stokes equations

A talk is based on the paper by G. Arioli and H. Koch https://arxiv.org/abs/2009.12762

December 1, 2020
Sohail Dayo, Solving high dimensional PDEs by using Machine Learning

December 8, 15, 2020
Jacek Kubica, Proof of the pitchfork bifurcation in the Kuramoto-Sivashinsky equation

Abstract: We will sketch proof of the pitchfork bifurcation for $\mu = 1$ in the Kuramoto-Sivashinsky equation $u_t = (u^2)_x - u_{xx} - \mu u_{xxxx}$ with odd and periodic boundary conditions. Our goal is to show that bifurcation occurs at the origin and to completely describe the dynamics near to bifurcation.

December 22, 2020, January 12, 19, 2021
Krzysztof Winowski, Dynamical systems and Liapunov stability

A talk is based on Chaper 4 of the book: Geometric Theory of Semilinear Parabolic Equations, Dan Henry.

January 26, 2021
Maciej Manna, DNS and LES Simulations for Particle-Laden Turbulent Flows with Two-Way Momentum Coupling

Abstract: Turbulent fluid flows with particles dispersed within it are common occurrence in nature, as well as in many technological processes. Important example of such case are atmospheric clouds that consist of small droplets of water aerosol suspended in air. Understanding the interplay between air (fluid) and aerosol (particles) is crucial to understanding atmospheric phenomena. Performing numerical simulations on a fine scale is one way of studying such phenomena and obtaining statistics, such as collision kernels, that may be used as parameterisations for models used on larger scales. Direct Numerical Simulation (DNS) is a relatively precise method that is viable for such simulations, although they require a lot of computational resources, making larger simulations still completely out of reach. For that reason, Large-Eddy Simulations (LES) are also employed, as they use parametrisation for small-scale turbulent phenomena, which reduces required grid size (and, thus, computational complexity) at the cost of some precision and physical fidelity. This talk summarizes part of the project of the National Science Center (NCN) OPUS14/2017: "Turbulent flow analysis with the dispersion phase - the impact of two-sided coupling of momentum and gravity on particle motion statisticsśupervised by Prof. Bogdan Rosa (IMGW-PIB). It focuses on comparing the precision of DNS and LES methods for obtaining statistics of particles in turbulent flows that involve two-way momentum coupling between particles and fluid.