Bahçeşehir University, Istanbul, Turkey
Analysis & PDE Center, Ghent University, Ghent, Belgium
Institute Mathematics & Math. Modeling, Almaty, Kazakhstan

"Analysis and Applied Mathematics"

Weekly Online Seminar

Seminar leaders:
Prof. Allaberen Ashyralyev (BAU, Istanbul),
Prof. Michael Ruzhansky (UGent, Ghent),
Prof. Makhmud Sadybekov (IMMM, Almaty)

Date: **Tuesday, November 15, 2022**
Time: 14.00-15.00 (Istanbul) = 12.00-13.00 (Ghent) = 17.00-18.00 (Almaty)

Zoom link: https://us02web.zoom.us/j/6678270445?pwd=SFNmQUlvT0tRaH-lDaVYrN3l5bzJVQT09, **Conference ID:** 667 827 0445, **Access code:** 1

Speaker:

Prof. Dr. Fadi Awawdeh
The Hashemite University, Jordan

Title: Regularization of Ill-Posed Inverse Problems

Abstract: Ill-posed inverse problems are at the core of many challenging applications in the natural sciences, medicine and life sciences, as well as in engineering and industrial applications. The talk illustrates the potential difficulties with reversing the process; namely, given a measured state of the model, try to determine what exact equation could have produced this outcome. We will primarily consider operator equations $Au = y$, with the operator $A : X \to Y$ mapping between function spaces X and Y. We assume that the operator equation is ill-posed in the sense that small perturbations of y can lead to arbitrarily large perturbations on u (or even lead to non-existence of a solution). To obtain a stable estimate of the solution of such problems, it is often necessary to implement a regularization strategy. This requires the solution approach to satisfy some regularizing properties, i.e., be stable even for noisy data y^δ with $\|y^\delta - y\| \leq \delta$ in place of y and yield reconstructions y^δ that converge to the exact solution $u^\dagger$ as $\delta \to 0$. Regularization techniques are the subject of this talk and we will attempt to highlight two approaches that are wide-spread in the literature: (i) Variational methods are based on minimizing a weighted sum of a discrepancy term and a suitable regularization term (Tikhonov regularization) or on minimizing one of these terms under a constraint on the other (Ivanov or Morozov regularization, respectively); (ii) Iterative methods construct a sequence of iterates approximating the solution $u^\dagger$.

References:

[1] *B. Kaltenbacher & W. Rundell, Regularization of a backwards parabolic equation by fractional operators. Inverse Problems & Imaging,* ***13*** *(2019), 401-430.*

[2] *B. Hofmann, B. Kaltenbacher, C. Pöschl, O. Schezer, A convergence rates result for Tikhonov regularization in Banach spaces with non-smooth operators. Inverse Problems,* ***23*** *(2007), 987-1010.*

[3] *B. Kaltenbacher, A. Neubauer, O. Schezer, Iterative regularization methods for nonlinear ill-posed problems. Radon Series on Computational & Applied Mathematics. de Gruyter, Berlin, 2008.*

[4] *F. Werner, On convergence rates for interatively regularized Newton-type methods under a Lipschitz-type nonlinearity condition. Journal of Inverse & Ill-posed Problems,* ***23*** *(2015), 75-84.*

Biography:

Fadi Awawdeh – is now professor of Mathematics at the Hashemite University, Jordan. He received his Ph.D. in Applied Mathematics in 2006. After brief stints as an instructor at the Hashemite University and as a visiting Assistant Professor at Al-Ahliyya Amman University (2006) he was appointed to the Department of Mathematics at The Hashemite University in 2007 as an Assistant Professor. He was promoted to Full Professor in 2018. He spent 4 years leave as an Associate Professor in the Department of Mathematics and Statistics at Dhofar University in Oman (2014-2018) and one year as a visiting professor in the Department of Mathematics and Statistics at Zayed University in UAE (2018-2019).

Awawdeh has made over 40 scholarly contributions, including nearly 30 peer-reviewed research papers. He has also edited chapters of books and proceedings. He has served as a reviewer for many prestigious international journals indexed by ISI. He has served as supervisor for PhD and MSc students. Awawdeh presented many talks in international conferences and reviewed a number of funded projects for international bodies. He was the PI for funded projects.

Awawdeh research interests lie in the area of Numerical Analysis, ranging from theory to design to implementation. He has collaborated actively with researchers in several other disciplines of applied mathematics, particularly soliton solutions of integrable systems. Current research emphasizes the use of high accuracy numerical schemes to: 1) study differential and integral equations; 2) identify parameters in identification problems; and 3) construct numerical Gaussian processes for nonlinear PDEs.