Seminar of the Chair of Optimization and Control
under prof. Stanisław Migórski
summer semester 2018-2019, Thursday, 10:15-11:45, room 1177

February 28, 2019
Krzysztof Bartosz, Basic principles of virtual element methods, part. 2

The talk was based on the paper:
L. Beirao da Veiga, F. Brezzi, A. Cangiani, G. Manzini, L. D. Marini, and A. Russo, Basic principles of virtual element methods, Math. Models Methods Appl. Sci. 23 (2013), 199-214

Abstract: We present, on the simplest possible case, what we consider as the very basic features of the (brand new) virtual element method. As the readers will easily recognize, the virtual element method could easily be regarded as the ultimate evolution of the mimetic finite differences approach. However, in their last step they became so close to the traditional finite elements that we decided to use a different perspective and a different name. Now the virtual element spaces are just like the usual finite element spaces with the addition of suitable non-polynomial functions. This is far from being a new idea. See for instance the very early approach of E. Wachspress [A Rational Finite Element Basic (Academic Press, 1975)] or the more recent overview of T.-P. Fries and T. Belytschko [The extended/generalized finite element method: An overview of the method and its applications, Int. J. Numer. Methods Engrg. 84 (2010) 253304]. The novelty here is to take the spaces and the degrees of freedom in such a way that the elementary stiffness matrix can be computed without actually computing these non-polynomial functions, but just using the degrees of freedom. In doing that we can easily deal with complicated element geometries and/or higher-order continuity conditions (like C1, C2, etc.). The idea is quite general, and could be applied to a number of different situations and problems. Here however we want to be as clear as possible, and to present the simplest possible case that still gives the flavor of the whole idea.

March 7, 2019
Biao Zheng, Elliptic and Evolutionary Variational-Hemivariational Inequalities with Applications

The presentation was a training before PhD defense of Biao Zheng.

March 14, 2019
Anna Valette, Lojasiewicz inequality at singular points

Abstract: Lojasiewicz inequality asserts that, given a $\mathcal{C}^1$ analytic function $f : (X, a) \to \mathbb{R}$, with X analytic $\mathcal{C}^1$ submanifold of $\mathbb{R}^n$ and $a \in X$, there is a

neighborhood U of a in X, a constant C, and a rational number $\theta \in [0, 1)$ such that for all $x \in U$:
$$|f(x) - f(a)|^\theta \leq C|\nabla_x f|.$$
The known generalizations of Łojasiewicz gradient inequality are devoted to smooth functions.

Some years ago, this inequality was extended by Bolte, Daniilidis and Lewis to continuous and to convex lower semicontinuous subanalytic functions, using techniques of nonsmooth analysis.

In this talk we will explore the case where a does not belong to X but lies in its closure. In particular, the point a might be a singular point of the closure of X. We will prove a Łojasiewicz type inequality which is valid even if X is not locally closed near a. As f does not necessarily extend continuously at a, our approach relies on the study of the asymptotic critical values of the considered function.

March 21, 2019
Krzysztof Winowski, The eigenvalues of divergence operator

March 28, April 4, 2019
Krzysztof Byrski, Cross Entropy Clustering for closed curves and its generalisation to higer dimensional manifolds

Abstract: In my speech I will introduce the concept of the Cross Entropy Clustering for closed curves being the result of my current cooperation with Dr Przemysaw Spurek and Prof. Jacek Tabor. After a brief reminder of the classical Cross Entropy Clustering theory being the foundation of our new method, I will discuss the proposed notion of generalisation of the Gaussian distribution family to the closed curves and finally the higher dimensional closed manifolds embedded in R^n. In the subsequent part of my presentation, I will present the algorithm, which estimates the parameters of the newly introduced model, that optimally approximate the scattering of the arbitrary input data set and consequently partitions the data into the set of disjoint arbitrary dimensional manifolds embedden in R^n.

April 11, 25 2019
Bai Yunru, On the optimal control of variational-hemivariational inequalities

The talk was based on the paper:
Yi-bin Xiao, Mircea Sofonea, On the optimal control of variationalhemivariational inequalities, Journal of Mathematical Analysis and Applications, 475 (2019) 364-384, DOI: 10.1016/j.jmaa.2019.02.046

Abstract: The present paper represents a continuation of [1]. There, a continuous dependence result for the solution of an elliptic variationalhemivariational inequality was obtained and then used to prove the existence of optimal pairs for two associated optimal control problems. In the current paper we complete this study with more

general results. Indeed, we prove the continuous dependence of the solution with respect to a parameter which appears in all the data of the problem, including the set of constraints, the nonlinear operator and the two functionals which govern the variationalhemivariational inequality. This allows us to consider a general associated optimal control problem for which we prove the existence of optimal pairs, together with a new convergence result. The mathematical tools developed in this paper are useful in the analysis and control of a large class of boundary value problems which, in a weak formulation, lead to elliptic variationalhemivariational inequalities. To provide an example, we illustrate our results in the study of an inequality which describes the equilibrium of an elastic body in frictional contact with a foundation made of a rigid body covered by a layer of soft material.

[1] M. Sofonea, Optimal control of variationalhemivariational inequalities, Appl. Math. Optim. (2019), https://doi.org/10.1007/s00245-017-9450-0, in press

May 9, 16, 23, 2019
Meir Shillor, Evolution Differential Equations with Application to Contact Mechanics

Course plan:

- Models of thermal phenomena. The heat equation, derivation and a model problem with initial and boundary conditions
- Melting or solidification, enthalpy formulation, and the process of spot welding
- Thermistors, and In Situ Vitrification
- Electropainting, diffusion, reaction-diffusion models in biology Models with ordinary differential equations, thermostats, oscillations, hysteresis, delays, sliders and springs, suspensions with contact and friction, MSEIR models in epidemiology, and population dynamics
- Rods, beams, contact, friction, adhesion, and damage
- Contact problems with friction, adhesion, and wear

April 25, 2019
Bartosz Soból, Sterowanie lotem statku kosmicznego na orbitę

Abstract: Podczas seminarium sformułuję problem sterowania lotem egzoatmosferycznym statku kosmicznego oraz postaram się sprawdzić istnienie sterowania optymalnego. Referat opieram na fragmencie swojej pracy magisterskiej, w której zajmuję się analizą algorytmu Powered Explicit Guidance, który był przez kilkadziesiąt lat z powodzeniem stosowany przez NASA do wynoszenia na orbitę amerykańskich promów kosmicznych.

Magdalena Żurek, Parts 1 and 3, Oleksandr Malakhov, Parts 2 and 4, Optimization of continuous models

Abstract: The lecture is based on section 13 of the book Ą First Course in Mathematical Modelling"by Giordano, Fox, Horton and is divided into 4 parts, putting emphasis on, respectively,model solution and model sensitivity, combined optimization method (gradient search algorithm), model solution and model sensitivity of equality constrained optimization problems and then graphical optimization.

June 6, 2019

Leszek Gaisński, Multiplicity of positive solutions for an equation with degenerate nonlocal diffusion

Abstract: We consider an elliptic boundary value problem with degenerate nonlocal term. We prove the multiplicity of positive solutions for the problem, where the number of solutions doubles the number of zeros of the degenerate term. The solutions are also ordered according to their L^p-norms.

Based on the paper:
https://www.sciencedirect.com/science/article/pii/S0898122119301038