INTERNATIONAL
CONFERENCE

Optimization and Applications in Control and Data Science

on the occasion of Boris Polyak's 80th birthday

May 13-15, 2015
Moscow – Russia

$(r,s)=0\ \forall\lambda$, т.е. $Ar=0$ +

Тогда

$Ax = As + Ar = AA^T\lambda \geq 0$

Берем $b \geq 0$, $\|b\|=1$ — равном на сф бант

(т.е. c — равн. на ед. сф., $b=|c|$ — по элементно)

Тогда $AA^T\lambda = b$, $\lambda = (AA^T)^{-1}b$, т.е.

$S = \underbrace{A^T(AA^T)^{-1}}_{G} b$!

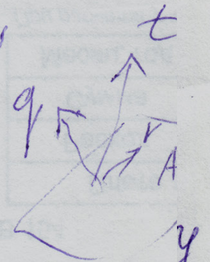
Лучше не так $s = Gb$

$s = \underbrace{GK}_{\tilde{G}}\underbrace{K^{-1}b}_{u} = \tilde{G}u$, u — равн. на ед. сф.

$\tilde{G}$ — нормир.

Генерация r

Берем t равном на ед сфере в R^n, t



$t = q + r$ $\quad Ar=0$, $(q,r)=0$

~~$At = Aq$~~ $\quad (t,q)=\|q\|^2$

$q = A^T\mu \quad At = AA^T\mu$

$\mu = (AA^T)^{-1}At$

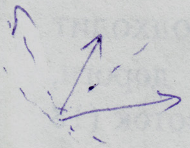
$q = A^T(AA^T)^{-1}At$

$r = t - A^T(AA^T)^{-1}At$ Проверка

$P = I - A^T(AA^T)^{-1}A$

проектор.

Равном генерация точек в S



$z \in R^n \Rightarrow$ проекц на подпр., ортог. a и b:

$z = \lambda a + \mu b + y$ $\quad (y,a) = 0, \ (y,b) = 0$

$(z,a) = \lambda + \mu(a,b)$

$(z,b) = \lambda(a,b) + \mu$ $\quad (a,b) = \alpha$

$\lambda + \alpha\mu = (z,a)$ $\quad \alpha^2\mu - \mu = \alpha(z,a) - (z,b)$ $\quad \alpha^2 < 1$

$\alpha\lambda + \mu = (z,b)$

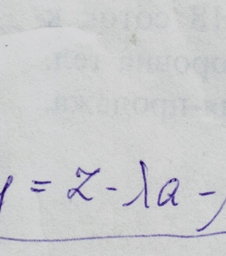
$$\mu = \frac{(z,b) - \alpha(z,a)}{1-\alpha^2}, \quad \lambda = \frac{(z,a) - \alpha(z,b)}{1-\alpha^2} \qquad (1)$$

$$y = z - \lambda a - \mu b \qquad (2)$$

Генерируем z равном. на единич. сфере

Вычисляем y по (1), (2)

Берем $s = y + \gamma_1 a + \gamma_2 b$



$t = \gamma_1 a + \gamma_2 b$ $\quad$ Нужно $(t,a) \geq 0$, $(t,b) \geq 0$

$(t,a) = \gamma_1 + \gamma_2(a,b) \geq 0$ $\quad (a,b) = \alpha$ $\quad \gamma_1 + \gamma_2 \ldots$

$(t,b) = \gamma_1(a,b) + \gamma_2 \geq 0$ $\quad \gamma_1\alpha + \gamma_2$

MIPT

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ИППИ РАН

PREMOLAB

RUSSIAN ACADEMY OF SCIENCES

INSTITUTE FOR INFORMATION TRANSMISSION PROBLEMS (Kharkevich Institute)

INTERNATIONAL
CONFERENCE

Optimization and Applications in Control and Data Science

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PROGRAM COMMITTEE:
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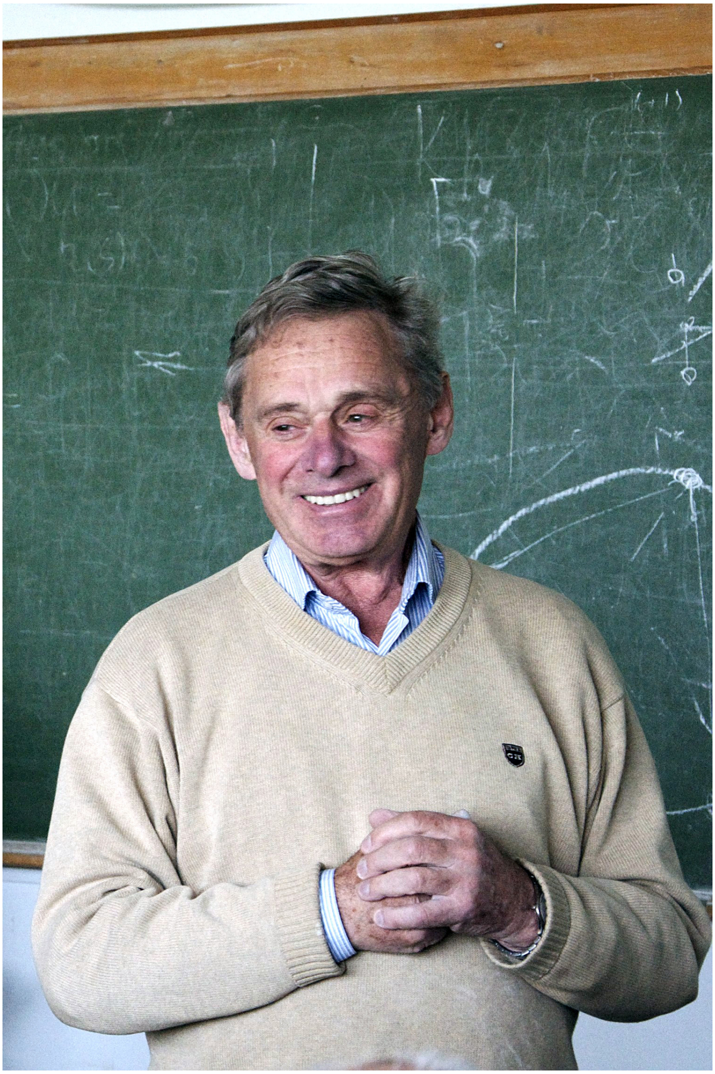
- Institute for Information Transmission Problems of Russian Academy
  of Sciences (IITP RAS)

Dear friends,
welcome to Moscow!
I'm happy to see
you again!
Boris Polyak



Optimization and Applications in Control and Data Science

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of Boris Polyak's 80th birthday

INVITED SPEAKERS

MAXIM BALASHOV (*Moscow Institute of Physics and Technology, Russia)*

BOB BARMISH (*University of Wisconsin, USA)*

SHANKAR BHATTACHARYYA (*Texas A&M University, USA)*

STEPHEN BOYD (*Stanford University, USA)*

PATRIZIO COLANERI (*Politecnico di Milano, Italy)*

FABRIZIO DABBENE
(*Institute of Electronics, Computer and Telecommunication Engineering, Turin, Italy)*

ROLAND HILDEBRAND
(Weierstrass Institute for Applied Analysis and Stochastics, Germany)

ALEXANDER IOFFE *(Technion, Israel)*

ANATOLI JUDITSKY *(Université J. Fourier, Grenoble, France)*

VLADIMIR KHARITONOV *(Saint-Petersburg State University, Russia)*

ALEXANDER KULESHOV *(Institute for Information Transmission Problems, Russia)*

CONSTANTINO LAGOA *(The Pennsylvania State University, USA)*

ANDERS LINDQUIST *(Royal Institute of Technology, Sweden)*

ALEXANDER MATASOV *(Moscow State University, Russia)*

BORIS MORDUKHOVICH *(Wayne State University, USA)*

ARKADI NEMIROVSKI *(Georgia Tech, USA)*

YURII NESTEROV
(Center for Operations Research and Econometrics, Louvain-la-Neuve, Belgium)

ROMAN POLYAK *(Technion, Israel)*

ANDREY POLYAKOV *(Inria Lille - Nord Europe, France)*

ROBERTO TEMPO
(Institute of Electronics, Computer and Telecommunication Engineering, Turin, Italy)

VADIM UTKIN *(The Ohio State University, USA)*

KONSTANTIN VORONTSOV
(Dorodnicyn Computing Centre of Russian Academy of Sciences, Moscow, Russia)

$f_i(x) = \frac{1}{2}(A_i x, x) - (b_i, x) \qquad x \in R$

$f(x) = \begin{pmatrix} f_1(x) \\ \cdots \\ f_m(x) \end{pmatrix} \qquad f: R^n \to R^m$

$n \geq m$

$F = \{ f(x) : \|x\| \leq \varepsilon \} \subset R^m$

Теор. О вып. обр. мал. шар.

$f'(0)$ - матр. ранга m

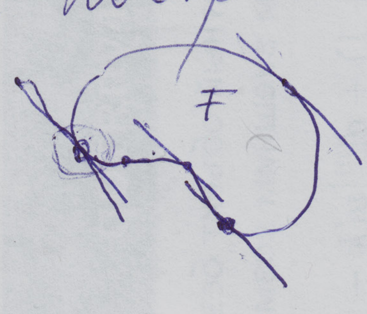
$\sigma > 0$ наим. синг. знач. $f'(0)$

f' - Lip L

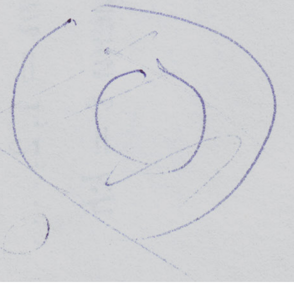
$\varepsilon < \frac{2\sigma}{L} \Rightarrow F$ вып.

$m = 2$, $\exists \lambda_1 A_1 + \lambda_2 A_2 > 0 \Rightarrow F$ вып.

Как построить ∂F независ. от



$\sum a f_i(x) \to \min\limits_{\|x\| \leq 1}$



Вероятн.

Dear Friends and Colleagues!

We are very happy to have you here at the conference organized on the occasion of Professor Boris Polyak's 80th anniversary.

Original and always elegant ideas generated by Prof. Polyak and published in Russian and international journals and conferences deeply influenced important areas of optimization, control, and systems theory. The diversity of research directions which Boris was and is interested in is indeed impressive. First of all, this is optimization theory, which charmed him since the early 1960s and is still a principal motivating and propelling force of his research (variational and extremal problems and optimal control were also in the scope of keen interest of Boris by that time); then comes stochastic approximation, regression models, estimation and identification in the 1970-1980s; parametric robustness, randomized methods, quadratic transformations in the 1990s; superstability, ellipsoidal estimation, control of chaos, low-order controller design, classical *D*-decomposition revisited, rejection of exogenous disturbances in linear systems, LMIs, ℓ_1-optimization, PageRank, random walks, multi-objective optimization, quadratic mappings revisited, etc., etc.

Perhaps it is not an exaggeration to say that Prof. Polyak's personality and charisma are even more impressive; there are dozens of scientists all over the world which were made addicted to research by Boris and are happy to consider themselves as his students and followers. There is no need to list all ranks and awards that Prof. Polyak carries; Boris does not care much about most of them. He is always and truly excited with the research itself, which brings challenge, fun, and fascination to him over the decades. Therefore, to celebrate this jubilee and make Boris pleased, this meeting is primarily targeted at exchanging new ideas and discussing new trends in the research directions of his interest.

We thank you again for accepting the invitation to participate and believe the conference will be a success. Let's have fun!

Sincerely,
Program Committee

$T^{\uparrow T}$

$(A_i x, x) = \langle A_i, xx^T \rangle = \langle A_i, X \rangle \quad X \geq 0$

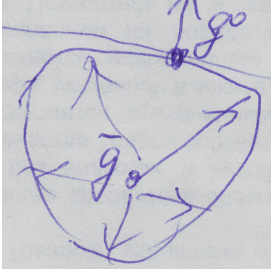
$\langle A_1, X \rangle$

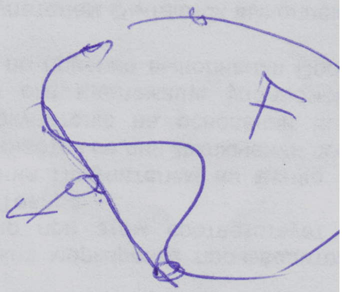
$X \geq 0, \ \mathrm{Tr}\, X \leq 1$ } $\subset R^m$ X - решка

$\langle A_m, X \rangle \quad g = AX$

conv F

$g^0 \in \partial G$





$N = c$

$\bar{g} \in \mathrm{Int}\, G$

$X = \mu I \quad \mu < 1 \quad \bar{g} = AX \in R^m$

$\lambda_k h$ | H - симм.

$\|H\| = 1 \quad h = AH$

— boundary oracle

PROGRAM

Wednesday, May 13

10:00 – 11:45 Registration
11:45 – 12:00 Opening
12:00 – 13:30 Session I

12:00 – 12:30 STEPHEN BOYD
Domain-Specific Languages for Convex Optimization

12:30 – 13:00 ANDERS LINDQUIST
Moment Problems and Optimization: Review and Recent Update of a Global-Analysis Approach to Problems in Systems and Control

13:00 – 13:30 VADIM UTKIN
Filippov Method for Optimization with Non-Smooth Penalty Functions

13:30 – 15:00 Lunch break
15:00 – 16:30 Session II

15:00 – 15:30 PATRIZIO COLANERI
Stability and Optimization of Dual Switching Linear Positive Systems

15:30 – 16:00 VLADIMIR KHARITONOV
Lyapunov Matrices for Time-Delay Systems

16:00 – 16:30 ANDREY POLYAKOV
Robust Stabilization with Time Constraints: Implicit Lyapunov Function Approach

16:30 – 17:15 Coffee break
17:15 – 18:15 Session III

17:15 – 17:45 ANATOLI JUDITSKY and ARKADI NEMIROVSKI
Adaptive Estimation by Convex Optimization

17:45 – 18:15 BOB BARMISH and SHIRZAD MALEKPOUR
When the Expected Value is not Expected

10:00 – 11:30 Session IV

10:00 – 10:30 ROBERTO TEMPO
Randomization and Gossiping in Social Networks

10:30 – 11:00 ALEXANDER KULESHOV
Constructing the Low-Dimensional Data Representations in Data Analysis

11:00 – 11:30 KONSTANTIN VORONTSOV
Multicriteria Regularization for Probabilistic Topic Modeling of Large Text Collections

11:30 – 12:15 Coffee break
12:15 – 13:15 Session V

12:15 – 12:45 FABRIZIO DABBENE
On Simple Approximations of Semialgebraic Sets and their Applications

12:45 – 13:15 CONSTANTINO LAGOA
Semidefinite Programming for Chance Constrained Optimization over Semialgebraic Sets

13:15 – 14:45 Lunch break
14:45 – 15:45 Session VI

14:45 – 15:15 ALEXANDER MATASOV and PAVEL AKIMOV
Detection of Jumps by Means of ℓ_1-norm Approximation

15:15 – 15:45 YURII NESTEROV
Structural Optimization: New Perspectives for Increasing Efficiency of Numerical Schemes

15:45 – 17:00 Panel Discussion: «Back to the future»
19:00 – Conference dinner

10:00 – 11:30 Session VII

10:00 – 10:30 SHANKAR BHATTACHARYYA
Linear Systems: A Model Free Approach to Design

10:30 – 11:00 ALEXANDER IOFFE
Variational Analysis View of Necessary Optimality Conditions

11:00 – 11:30 ROMAN POLYAK
Nonlinear Equilibrium vs Linear Programming

11:30 – 12:15 Coffee break
12:15 – 13:45 Session VIII

12:15 – 12:45 MAXIM BALASHOV
The Clarkson-Polyak Modulus of Convexity and its Applications

12:45 – 13:15 ROLAND HILDEBRAND
Geometric Aspects of Barriers for 3-Dimensional Cones

13:15 – 13:45 BORIS MORDUKHOVICH
Optimal Control of a Perturbed Sweeping Process

13:45 – 15:15 Lunch break

Неподв. т.　　　　нелин. отображение

$x^* = g(x^*)$　　$g: R^n \to R^n$

Сущ. и ед. н. т.: Пр. сж. отобр.

$\|g(x) - g(y)\| \le q\|x - y\|$　　$q <$

$x^{k+1} = g(x^k)$　　$x^k \to x^*$

Сущ.: пр. Шаудера

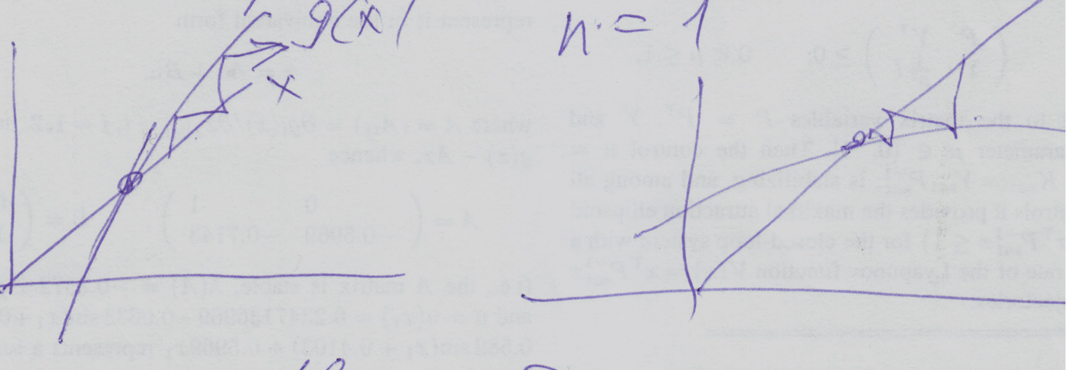
$g: V \to V \subset R^n$　　V – вып. зам.

x^* сущ., не ед. Посл. не сход.

: $x^* = g(x^*)$, $\rho(g'(x^*)) < 1$

Тогда посл. пр. лок. сход. со

геом. пр.



Метод Ньютона

Детективно

ABSTRACTS

MAXIM BALASHOV
Moscow Institute of Physics and Technology State University, Russia

The Clarkson-Polyak Modulus of Convexity and its Applications

In 1936 J.A. Clarkson gave the definition of the modulus of convexity for a Banach space. In 1966 B.T. Polyak [1] generalized Clarksons definition and introduced the concept of modulus of convexity for an arbitrary convex closed bounded subset. The concept of B.T. Polyak appeared to be very useful not only in the field of optimization (for estimate of the rate of convergence for minimization sequences), but also in theoretical fields, mainly for the question of stability of functionals.

In the present talk I will mention two results, where the concept of Polyak's modulus of convexity is essential. The first one is about the «dual» description of strongly convex sets in the real Hilbert space. The second result is about estimate for the error of external polyhedral approximation of a strictly convex compact in $\mathbb{R}^n$ in the Hausdorff metric. The estimate for the error is given in terms of Polyak's modulus.

[1] B.T. Polyak, Existence theorems and convergence of minimizing sequences in extremum problems with restrictions, Soviet Math, 7, (1966), 72-75.

BOB BARMISH and SHIRZAD MALEKPOUR
University of Wisconsin, USA

When the Expected Value is not Expected

For a random variable *X* with probability distribution which is highly skewed, the classical expected value may significantly overstate or understate what can reasonably be expected. To make matters worse, the picture of the gamble at hand may be further distorted when a classical risk measure such as the varianceis also included in the analysis. For example, for problems involving financial profit or component lifetimes, large deviations of *X* to the right of its mean may be highly desirable. With the above considerations in mind, in this talk, we describe a new reward-risk pair, the Conservative Expected

Value (CEV) and Conservative Semi-Variance (CSV), which we believe more reasonably represents the quality of a gamble involving a random variable X whose distribution may be highly skewed. Whereas the CEV definition is entirely new, the CSV is motivated by measures typically used in finance to discriminate between downside and upside variation in X. In addition to providing the motivation and definitions for these measures, we illustrate their calculation for a number of classical probability distributions and we describe some properties of this pair which suggest that this new theory is mathematically rich and potentially useful in a number of applications.

SHANKAR BHATTACHARYYA
Texas A&M University, USA

Linear Systems: A Model Free Approach to Design

This paper describes recent results developed by us on the problem of adding design elements to an unknown linear system in order to satisfy various design objectives. We show that a few measurements strategically processed can extract these control or decision parameters directly without constructing a model of the system. The result is based on an extension and generalization of Thevenin's Theorem of classical circuit theory and is applicable to electrical, mechanical, civil, chemical and aeronautical engineering as well as biological, ecological and economic systems. Extremal designs as well as fault tolerant design are also possible for unknown models. The theory will be illustrated by examples.

STEPHEN BOYD
Stanford University, USA

Domain-Specific Languages for Convex Optimization

Specialized languages for describing convex optimization problems, and associated parsers that automatically transform them to canonical form, have greatly increased the use of convex optimization in applications. CVX and CVXPY, for example, allow users to rapidly prototype applications based on solving (modest size) convex optimization problems. In this talk I will describe the general methods used in such systems, and describe methods by which they can be adapted for large-scale problems.

PATRIZIO COLANERI
Politecnico di Milano, Italy

Stability and Optimization of Dual Switching Linear Positive Systems

Linear positive systems are characterized by state variables that remain nonnegative whenever initialized in the positive orthant. They naturally arise in the description of biological systems (e.g., compartmental models), population dynamics, traffic modeling, chemical reactions, queue processes, etc. In many applications some parameters of the matrices that describe the system may jump among a finite number of values. For instance, in a multi-plant networked control problem, two different types of parameter commutations can be studied: a stochastic signal, that models the random behaviour of the network, and a control switching signal that is the scheduling variable deciding which plants are currently attended in closed-loop. Another example is the control of the viral load in HIV infection, where the control signal is a switching signal associated to a certain therapy whereas the exogenous stochastic switching signal may represent the change of parameters associated with the viral proliferation or infection rates or even the topology of the network that express the cross influence of the various genotypes. The resulting «dual switching» system offers intriguing research issues due to the interplay between the two switching signals. For this class of systems we study the stochastic stability (and stabilization) problem and the computation (and optimization) of certain input-output norms. The derivation of the results is based on the choice of suitable co-positive Lyapunov functions. Simulation results are provided.

FABRIZIO DABBENE
Institute of Electronics, Computer and Telecommunication Engineering, Turin, Italy

On Simple Approximations of Semialgebraic Sets and their Applications

Many uncertainty sets encountered in control systems analysis and design can be expressed in terms of semialgebraic sets, that is, as the intersection of sets described by means of polynomial inequalities. Important examples are for instance the solution set of linear matrix inequalities or the Schur/Hurwitz stability domains. These sets often have very complicated shapes (non-convex, and even non-connected), which renders very difficult their manipulation. It is therefore of considerable importance to find simple enough approximations of these sets, able to capture their main characteristics while maintaining a low level of complexity. For these reasons, in the past years several convex approximations, based for instance on hyperrectangles, polytopes, or ellipsoids have been proposed. In this talk, we move a step further, and propose possibly non-convex approximations, based on a so-called polynomial superlevel set (PSS) of a single positive polynomial of given degree. We show how these sets can be easily approximated by minimizing the ℓ_1-norm of the polynomial over the semialgebraic set, subject to positivity constraints. Intuitively, this corresponds to the trace minimization heuristic commonly encountered in minimum volume ellipsoid problems. From a computational viewpoint, we design a hierarchy of linear matrix inequality (LMI) problems to generate these approximations, and we provide theoretically rigorous convergence results, in the sense that the hierarchy of outer approximations converges in volume (or, equivalently, almost uniformly) to the original set. Two main applications of the proposed approach are considered. The first one aims at reconstruction/approximation of sets from a finite number of samples. In the second one, we show how the concept of polynomial superlevel set can be used to generate samples uniformly distributed on a given semialgebraic set.

ROLAND HILDEBRAND

Weierstrass Institute for Applied Analysis and Stochastics, Germany

Geometric Aspects of Barriers for 3-Dimensional Cones

A logarithmically homogeneous barrier F on an n-dimensional regular convex cone K defines a Hessian metric on the interior of K. This metric is the direct product of a trivial 1-dimensional radial factor and a non-trivial $(n-1)$-dimensional factor corresponding to the level surfaces of F. If $n = 3$, then the non-trivial factor is a Riemann surface. The uniformization theorem and other results form Riemann surface theory then become applicable. We present some results which are relevant for this situation, deduce non-trivial consequences and pose some open questions.

ALEXANDER IOFFE
Technion, Israel

Variational Analysis View of Necessary Optimality Conditions

I shall describe a «non-variational» approach to necessary optimality conditions that can be applied to a broad spectrum of smooth and non-smooth extremal problems. As an application of the approach I shall sketch a new (shorter and more transparent) proof of Clarke's maximum principle for optimal control problems with differential inclusions, so far the most general result of that sort.

ANATOLI JUDITSKY
Université J. Fourier, Grenoble, France

ARKADI NEMIROVSKI
Georgia Tech, USA

Adaptive Estimation by Convex Optimization

We consider the problem as follows: given 1) a compact set $X \in \mathbb{R}^n$, an affine mapping $x \mapsto A(x)$, a parametric family $p_\mu(\cdot)$ of probability densities; 2) K i.i.d. observations of the random variable ω, distributed with the density $p_{A(x)}(\cdot)$ for some (unknown) $x \in X$, estimate the value $g^T x$ of a given linear form at x.

It is known that for several families $p_\mu(\cdot)$, with an additional assumption of convexity of X, the minimax affine estimation is nearly optimal, with an absolute constant factor. Here we extend the minimax theory for estimating linear functionals to the case of estimation of a class of nonlinear functionals over a finite union of convex parameter sets. Namely, we propose two nearly optimal (nonlinear) estimation routines for this setting and consider a general construction of adaptive estimators over families of non-embedded parameter classes.

VLADIMIR KHARITONOV
Saint-Petersburg State University, Russia

Lyapunov Matrices for Time-Delay Systems

In this talk an overview of the theory of Lyapunov matrices for time-delay systems will be given. First we define the fundamental matrix of such a system, and provide an explicit expression for the solutions of the system. The general scheme for the computation of quadratic functionals with prescribed time derivatives along the solutions of the time-delay system is presented. It is shown that these functionals are defined by special Lyapunov matrices. The matrices are natural counterpart of the classical Lyapunov matrices that appear in the computation of Lyapunov quadratic form for delay-free linear system. A substantial part of the talk is devoted to the analysis of basic properties of the Lyapunov matrices. Finally, we make use of the quadratic functionals in order to derive exponential estimates of the solutions of time-delay systems, robustness bounds for perturbed systems, evaluation of quadratic performance indices.

ALEXANDER KULESHOV

Institute for Information Transmission Problems, Russia

Constructing the Low-Dimensional Data Representations in Data Analysis

Many Data Analysis tasks deal with data which are presented in high-dimensional spaces, and the 'curse of dimensionality' phenomenon is often an obstacle to the use of many methods for solving these tasks. To avoid this phenomenon, various dimensionality reduction algorithms are used as the first key step in solving these tasks. The algorithms transform the original high-dimensional data into lower dimensional representations in such a way that the initial task can be reduced to a lower dimensional one. The dimensionality reduction problems have varying formulations depending on their initial statistical learning tasks. The talk contains a short review of such formulations. A new geometrically motivated algorithm that solves the formulated problems is presented. The algorithm uses essentially the solutions of various optimization problems, including the fundamental results of B.T. Polyak.

CONSTANTINO LAGOA

The Pennsylvania State University, USA

Semidefinite Programming for Chance Constrained Optimization over Semialgebraic Sets

In this talk, we introduce a class of «chance optimization» problems where one aims at maximizing the probability of a set defined by polynomial inequalities. These problems are, in general, nonconvex and computationally hard. With the objective of developing systematic numerical procedures to solve such problems, a sequence of convex relaxations based on the theory of measures and moments is provided, whose sequence of optimal values is shown to converge to the optimal value of the original problem. Indeed, we provide a sequence of semidefinite programs of increasing dimension which can arbitrarily approximate the solution of the original problem. Numerical examples are presented to illustrate the computational performance of the proposed approach.

ANDERS LINDQUIST
Royal Institute of Technology, Sweden

Moment Problems and Optimization: Review and Recent Update of a Global-Analysis Approach to Problems in Systems and Control

Moment problems are ubiquitous in science and engineering and have had a profound impact on the development of modern mathematical analysis. Power moments of probability measures play an important role in statistical modeling and in its application to information theory, communications, signals and systems. Applications of the trigonometric moment problem to systems and control also have a long and fruitful history, including the rational covariance extension problem. Analytic interpolation problems are an important class of moment problems with applications to circuit theory, power systems, robust control, signal processing, spectral processing, spectral estimation, model reduction, and stochastic realization theory. A common feature arising in applications to systems and control is that the desired solution needs to be a rational positive measure of a bounded degree, allowing it to be implemented by a finite dimensional device. These moment problems are typically underdetermined and give rise to families of particular solutions, and finding a solution that also satisfies a natural optimality criterion or design specification is an important general problem. While this non-classical version of the moment problem is decidedly nonlinear, there exists a natural, universal family of strictly convex optimization criteria defined on the convex set of particular solutions. Taking a global-analysis approach, where one studies the family of solutions as a whole, provides

a powerful paradigm for smoothly parameterizing, comparing and shaping the solutions based on various additional design criteria. It also enables us to establish the smooth dependence of solutions on problem data, thereby facilitating tuning of solutions.

ALEXANDER MATASOV and PAVEL AKIMOV
Moscow State University, Russia

Detection of Jumps by Means of ℓ_1-norm Approximation

The state estimation problem is considered for a linear dynamic system under a non-classical assumption that some entries of state vector admit jumps in their trajectories. The estimation problem is solved by means of ℓ_1-norm or mixed ℓ_1/ℓ_2-norm approximation. For the implementation of ℓ_1-norm (ℓ_1/ℓ_2-norm) approximation, a dynamic iterative algorithm is proposed. This algorithm is based on weight and time recursions and demonstrates the high efficiency. It well identifies the rare jumps in the state vector and has some advantages over more customary methods in the typical case of a large amount of measurements. Non-optimality levels for current iterations of the algorithm are constructed. Computation of these levels allows to check the accuracy of iterations.

BORIS MORDUKHOVICH
Wayne State University, USA

Optimal Control of a Perturbed Sweeping Process

We study a new class of optimal control problems of the sweeping (Moreau) process governed by state-constrained differential inclusions described by the normal cone mapping to a controlled convex moving set in finite dimensions. Various versions of the sweeping process have a great many applications to mechanics, physics, economics, and other branches of applied sciences, while control problems have not been considered for them till the recent time.

This talk presents brand new developments on optimal control of a sweeping process with perturbations based on the method of discrete approximations and advanced tools of first-order and second-order variational analysis and generalized differentiation. In this way we justify a numerical technique to find suboptimal controls of the perturbed sweeping process under consideration and derive necessary optimality conditions for exact optimal solutions.

YURII NESTEROV
Center for Operations Research and Econometrics, Louvain-la-Neuve, Belgium

Structural Optimization: New Perspectives for Increasing Efficiency of Numerical Schemes

In this talk we present some new methods for smooth convex optimization, which are based on random coordinate update strategies. We show that for many important problems their total efficiency estimates are never worse than the bounds for Black Box schemes. At the same time, we present some problem classes, for which the new bounds improve the old ones by a factor of square root of the dimension.

ROMAN POLYAK
Technion, Israel

Nonlinear Equilibrium vs Linear Programming

For a long time Linear Programming (LP) was used for solving resource allocation problems (RAP), – the centerpiece of economics. In 1975 L.V. Kantorovich and T.C. Koopmans shared the Nobel Prize in Economics «for their contributions to the theory of optimal allocation limited resources.» When LP is used for RAP both the prices for goods and the recourses availability are fixed, given a priori and independent on the production output and prices for the resources. It might lead to solutions, which are not practical, because the prices for goods are not consistent with the production output and the recourses availability are not consistent with their prices.
We consider an alternative to LP approach for RAP, which is based on Nonlinear Equilibrium (NE). The NE is a generalization of Walras-Wald equilibrium, which is equivalent to J. Nash equilibrium in n-person concave game. NE is free from the basic LP drawbacks.

Finding NE is equivalent to solving a variation inequality (VI) on the Cartesian product of the primal and dual non negative octants, projection on which is a simple operation, that require matrix by vector multiplication. For solving the VI we consider two methods: projected pseudo-gradient

(PPG) and extra pseudo-gradient (EPG), for which projection is the main operation at each step. The convergence and complexity for both methods under various assumptions on the input data will be considered. Both PPG and EPG can be viewed as pricing mechanisms for establishing economic equilibrium.

ANDREY POLYAKOV
Inria Lille - Nord Europe, France

**Robust Stabilization with Time Constraints:
Implicit Lyapunov Function Approach**

The talk is devoted to robust stabilization of quasi-linear systems with time constraints on state transitions. The Implicit Lyapunov Function (ILF) method allowing implicit definition of finite-time stabilizing feedback is considered. The ILF approach provides simple restrictions to control parameters given by Linear Matrix Inequalities (LMI). It admits an application of different LMI-based control design techniques. As an example, a minimum-time ILF-based control design is formalized as Semi-Definite Programming Problem. The practical implementation of the ILF-based control algorithm needs a proper digital realization. One of them is discussed in this talk.

ROBERTO TEMPO
Institute of Electronics, Computer and Telecommunication Engineering, Turin, Italy

Randomization and Gossiping in Social Networks

In this lecture, we study opinion formation in social networks. In particular, we introduce and analyze a novel mathematical model which describes the evolution of multidimensional opinions based on interactions of actors in a community. This application falls under a general framework aiming at the construction of algorithms for distributed computation over networks. The key ingredients of randomization and time-averaging are exploited, together with a local gossiping communication protocol, to obtain the convergence of these distributed algorithms to the global synchronous dynamics. Finally, we discuss the connections between opinion formation and centrality measures in complex networks.

VADIM UTKIN
The Ohio State University, USA

Filippov Method for Optimization with Non-Smooth Penalty Functions

The exact solution of an optimization problem can be found without increasing the dimension (in contrast to the Lagrange method) with finite coefficients of nonsmooth penalty functions (in contrast to smooth penalty functions with asymptotic tending to the solution only, if the gains tend to infinity). However the conventional gradient procedure leads to differential equations with discontinuous right hand parts and ambiguity of system behavior on discontinuity surfaces in the system state. Different methods of solution continuation are discussed and it is shown that all of them result from the method by Filippov if the implementation model of discontinuity is known.

KONSTANTIN VORONTSOV
Dorodnicyn Computing Centre of Russian Academy of Sciences, Moscow, Russia

Multicriteria Regularization for Probabilistic Topic Modeling of Large Text Collections

Probabilistic topic modeling of text collections is a powerful tool for statistical text analysis based on the preferential use of graphical models and Bayesian learning. Additive regularization for topic modeling (ARTM) is a recent semi-probabilistic approach, which provides a much simpler inference for many models previously studied only in the Bayesian settings. Instead of building a purely probabilistic generative model of text we regularize an ill-posed problem of stochastic matrix factorization by maximizing a weighted sum of the log-likelihood and additional criteria. Additive regularization makes topic models easier to design, infer, combine, and explain, thus reducing barriers to entry into topic modeling research field.

FOR NEW IDEAS

$g \in \partial G$

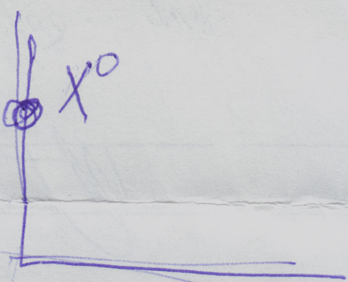
$\min_{g \in} (c, g) = (c, \ldots$

$(c, g) = ($

$(c, g) \geq (c, g^0)$

$\sum c_i \langle A_i, X \rangle = \langle A, X \rangle \geq \langle A, X^0 \rangle$

Лемма Найти $A = \sum c_i A_i$



$A \geq 0 \quad \langle A, X^0 \rangle = 0$

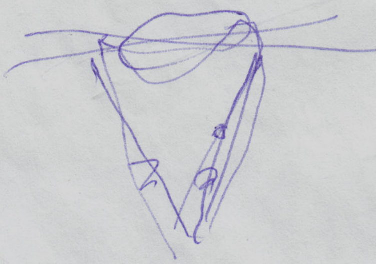
$\sum c_i A_i \geq \lambda I$

$\sum c_i \langle A_i, X^0 \rangle = 0$

$\{x : \|x\| \le 1\}$ $\quad F = f(B) \quad m \ge 3$

C, и или нет?

й невыл



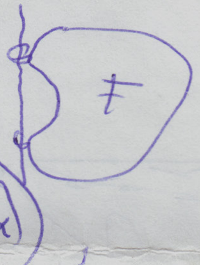
$A = \sum c_i A_i \quad \underline{\lambda} = \lambda_1 = \lambda_2 < \lambda_3 \ldots \le \lambda_n$

$e_1 \perp e_2 \qquad e_n$

$\underline{\lambda} < 0, \quad f^1 = f(e_1), \quad f^2 = f(e_2), \quad f^{12} = \begin{pmatrix} (A_1 e_1, e_2) \\ (A_m e_1, e_2) \end{pmatrix}, \quad f^1 \ne f^2, \ f$

F невыл.

$\min_{\varphi \in F}(c, f) = \min_{\|x\| \le 1}(\underbrace{\sum c_i A_i}_{A} x, x) = \underline{\lambda} =$



$= (c, f^1) = (c, f^2) = (c, f(x_\alpha)),$

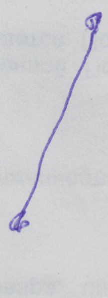
$e_1 + \alpha_2 e_2, \quad \alpha_1^2 + \alpha_2^2 = 1,$

$f(x_\alpha)$ - эллипс невырожд

m

$\alpha_i e_i \quad \alpha_i \ne 0 \quad i \ge 2 \qquad x \ne x_\alpha$ точки ...

$> (c, f(x_\alpha)) = \underline{\lambda}$



$A = \sum c_i A_i \quad 0 = \lambda_1 = \lambda_2 < \lambda_3 \ldots$