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On Hölder Continuity of Approximate Solutions to Set-valued Equilibrium Problems

L. Q. Anh¹, N. H. Danh², P. T. Duoc³, and T. N. Tam⁴

Abstract: In this talk, we study set-valued equilibrium problems in normed spaces. Using the linear scalarization technique, we establish sufficient conditions for Hölder continuity of approximate solution mappings to such problems. Applications to set-valued variational inequality problems are also discussed.

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Well-posedness for an Economic Equilibrium Problem

L. Q. Anh¹, P. T. Duoc², and T. N. Tam³

Abstract: In this talk, we study an economic equilibrium problem. Besides investigating the existence of the solutions, we establish sufficient conditions for well-posedness property of the concerning problem under suitable assumptions. Our results are new and different from the previous ones in the literature.

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Qualitative Properties of Solutions to Uncertain Multi-Objective Optimization Problems

L. Q. Anh¹, T. Q. Duy², D. V. Hien³ and T. T. T. Mai⁴

Abstract: This talk deals with uncertain multi-objective optimization problems. We present several concepts of efficiency for the such problems. Based on set order relations we establish the relationships between uncertain multi-objective optimization problems and set-optimization ones. Finally, qualitative properties of solutions to the reference problems are investigated via the corresponding ones to set-optimization problems.

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Stability of Efficient Solutions to Set Optimization Problems

L. Q. Anh¹, D. V. Hien², and T. K. Nguyen¹

Abstract: In this talk, we consider efficient solutions to set optimization problems. Under suitable assumptions, sufficient conditions for upper and lower stability of such solutions are established. Namely, any convergent sequence of efficient solutions to perturbed problems has the limit as an efficient solution of the original problem. Conversely, for each efficient solution of the original problem, there exists an equivalent one that is a limit point of a sequence of efficient solutions to perturbed problems. Our results are new or improve the existing ones in the literature.

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Levitin-Polyak Well-posedness for Vector Mixed Quasivariational Inequalities of the Minty Type

L. Q. Anh¹ and N. V. Hung²

Abstract: In this paper, we introduce the concepts of Levitin-Polyak well-posedness for vector mixed quasivariational inequality in the sense of Minty, and we show that under suitable conditions, the equivalence between the Levitin-Polyak well-posedness and the existence of solutions such problems is given. Moreover, we also propose the gap function for these problems and use it to study criterion of the Levitin-Polyak well-posedness for vector mixed quasivariational inequalities.

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Existence Conditions and Stability Analysis for Parametric Optimal Control Problems

L. Q. Anh¹, T. H. Ngung¹, T. N. Tam², and V. T. Tai³

Abstract: In this talk, we study parametric optimal control problems with linear state equation and control constraints. By an appropriate setting, we reduce these problems to parametric optimization ones. Under suitable assumptions, we establish the existence of solutions and the continuity of solution mappings to the problems.

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Stability Analysis for Switched Discrete-Time Linear Singular Systems of Index-1

P. K. Anh¹, P. T. Linh¹, D. D. Thuan², and S. Trenn³

Abstract: During the past several years, there has been increasing interest in stability analysis and design for switched systems, which occur in diverse real-life applications. Switched linear singular systems are an important class of switched systems, which arises from, for example, electrical networks and economic systems. For switched dynamical systems, the switching may be induced by unpredictable change of system dynamics, such as a sudden change of system structure due to the failure of a component. In these cases, in order to keep the system working, it is necessary for the system to be stable under arbitrary switching. In this report, we study the stability of arbitrarily switched discrete-time linear singular (SDLS) systems of the form

$$E_{\sigma(k)}x(k+1) = A_{\sigma(k)}x(k),$$

where $\sigma : \mathbb{N} \cup \{0\} \rightarrow I_N := \{1, 2, \dots, N\}$, $N \in \mathbb{N}$, is a switching signal taking values in the finite set I_N ; $E_i, A_i \in \mathbb{R}^{n \times n}$ are given matrices, and $x(k) \in \mathbb{R}^n$ are unknown vector for all $k \in \mathbb{N}$. Suppose that the matrices E_i are singular for all $i = 1, 2, \dots, N$.

The index-1 notion for a SDLS system is introduced and the existence and uniqueness of solutions to the corresponding initial-value problem is established.

Based on the joint spectral radius of a finite set of matrix pencils, as well as common quadratic Lyapunov functions (CQLF), some necessary and sufficient conditions are established for exponential stability. Besides, the exponential stability for SDLS systems satisfying some commutation condition is also established. Several illustrative examples are given.

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A Parallel Subgradient Method Extended to Variational Inequalities Involving Nonexpansive Mappings

P. N. Anh¹, N. D. Hien², and N. X. Phuong³

Abstract: In this paper, we propose and analyze the convergence of new iteration methods for finding a common point of the solution set of a class of pseudomonotone variational inequalities and the fixed point set of a finite system of nonexpansive mappings in a real Hilbert space. The idea of this algorithm is to combine the subgradient method with the parallel splitting-up techniques. The main iteration step in the proposed methods uses only one projection and does not require any Lipschitz continuous condition for the cost mapping. The convergent results are also extended to a pseudomonotone equilibrium problem involving a finite system of nonexpansive mappings. Finally, some numerical examples are developed to illustrate the behavior of the new algorithms with respect to existing algorithms.

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Subgradient Proximal-like Algorithm for Multivalued Variational Inequalities

P. N. Anh¹, H. P. Tu², N. D. Truong², H. T. C. Thach³

Abstract: In this paper, we propose and analyze the convergence of a new subgradient proximal-like algorithm for solving monotone and Lipschitz continuous multivalued variational inequalities. The algorithm is a variant of the proximal-like method and the subgradient method. By choosing suitable parameter sequences of proximal steps and of subgradient stepsizes, we show the convergence of the subgradient proximal-like algorithm. Moreover, the proof of the convergence does not require the prior knowledge of a Lipschitz continuity constant of the cost operator.

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Strong Convergence of Explicit Extragradient Methods for Bilevel Equilibrium Problems in Hilbert Spaces

P. N. Anh¹, T. V. Thang², and T. D. Cong³

Abstract: In this paper, we introduce a new explicit extragradient algorithm for finding a solution of an equilibrium problem over the solution set of another equilibrium problem which usually is called bilevel equilibrium problems in a real Hilbert space. The proposed algorithm is based on the extragradient method and the auxiliary problem principle. The strong convergence of the algorithm is established under mild assumptions. Several experiments have been done to check the performance of the algorithm and also to compare it with others.

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Iterative Algorithms for Zeros of Maximal Monotone Operators on Hilbert Spaces Optimization and Scientific Computing

N. Buong¹ and P. T. T. Hoai²

Abstract: In this paper, for a maximal monotone operator on a real Hilbert space with a nonempty set of zeros, we introduce two new strongly convergent explicit iterative algorithms for finding a zero, that solves a certain monotone variational inequality problem. As special cases, new generalized and contraction proximal point algorithms with a summable sequence of resolvent parameters are obtained. Two numerical examples are given for illustration and comparison.

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Random Attractors for Stochastic Differential Equations Driven by Fractional Brownian Motions

N. D. Cong¹, L. H. Duc², J. Jost³, and P. T. Hong⁴

Abstract: We develop the semigroup method to prove the existence of the global random attractor for stochastic differential equations driven by fractional Brownian motions.

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Octant-Based Stencil Selection for Meshless Finite Difference Methods in 3D

O. Davydov¹, D. T. Oanh² and N. M. Tuong³

Abstract: We introduce a meshless stencil selection algorithm in 3D for supporting the meshless finite difference method based on radial basis functions (RBF-FD) to solve the Dirichlet problem for the Poisson equation. Our numerical experiments show that the proposed method produces solutions that differ very little from the solutions by the finite element method with Courant’s piecewise linear basis functions, when the domain is discretized by the vertices of the respective tetrahedral triangulation.

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Duality for the Robust Sum of Functions

N. Dinh¹, M. A. Goberna², and M. Volle³

Abstract: In this report we associate with an infinite family of real extended functions defined on a locally convex space, a sum, called robust sum, which is always well-defined. We also associate with that family of functions a dual pair of problems formed by the unconstrained minimization of its robust sum and the so-called optimistic dual. For such a dual pair, we characterize weak duality, zero duality gap, and strong duality, and their corresponding stable versions, in terms of multifunctions associated with the given family of functions and a given approximation parameter $\varepsilon \geq 0$ which is related to the ε -subdifferential of the robust sum of the family. We also consider the particular case when all functions of the family are convex, assumption allowing to characterize the duality properties in terms of closedness conditions.

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Duality for Linear Infinite Programming Problems with Uncertainty

N. Dinh¹ and D. H. Long²

Abstract: In this paper, we are concerned with the *linear infinite programming problem* of the form

$$\begin{aligned} \text{(LIP)} \quad & \inf \langle c, x \rangle \\ \text{s.t. } & x \in X, \langle a(t), x \rangle \leq b(t), \forall t \in T, \end{aligned}$$

where X is a locally convex Hausdorff topological vector space, T is an arbitrary (possible infinite) index set, $c \in X^*$, $a: T \rightarrow X^*$ and $b: T \rightarrow \mathbb{R}$. When the parameters $a(t)$ and $b(t)$ are uncertain, and the couple $(a(t), b(t))$ belongs to an uncertainty set $\mathcal{U}_t \subset X^* \times \mathbb{R}$ for all $t \in T$, we have the *linear infinite programming* (LIP) with *input-parameter uncertainty* of which the *robust counterpart* is

$$\begin{aligned} \text{(RLIP)} \quad & \inf \langle c, x \rangle \\ \text{s.t. } & x \in X, \langle a(t), x \rangle \leq b(t), \forall (a(t), b(t)) \in \mathcal{U}_t, \forall t \in T. \end{aligned}$$

We propose several forms of dual problems for (RLIP) and establish necessary and sufficient conditions for robust strong duality of these pairs of primal-dual problems. We point out that in the absence of uncertainty, i.e., in the case where $\mathcal{U}_t$ is singleton for each $t \in T$, the results obtained still lead to new results on duality for robust linear infinite/semi-infinite problems.

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A New Approach to Solvability and Duality of Vector Optimization Problems using Characterizing Sets

N. Dinh¹, D. H. Long², and T. H. Mo³

Abstract:

In this report we study the *vector optimization problem* of the model

$$(P) \quad W \min \{F(x) : x \in C, G(x) \in -S\}, \quad (1)$$

where, X, Y, Z are locally convex Hausdorff topological vector spaces, K is a closed and convex cone in Y with nonempty interior, and S is a closed, convex cone in Z , $F: X \rightarrow Y^\bullet$, $G: X \rightarrow Z^\bullet$ are proper mappings, and $\emptyset \neq C \subset X$. The solvability and duality of the problem (P) are considered by using the *characterizing set*

$$\mathcal{H} := \bigcup_{x \in C \cap \text{dom} F \cap \text{dom} G} (G(x) + S) \times (F(x) + K).$$

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Long-Time Behavior of a Stochastic SIQR Model with Markov Switching

N. H. Du¹, N. T. Dieu², T. Q. Ky³, and V. H. Sam⁴

Abstract: In this talk, we consider a stochastic SIQR model with a perturbed disease transmission coefficient. We determine the threshold λ that is used to classify the extinction and permanence of the model. Concretely, $\lambda < 0$ implies that the disease-free equilibrium is globally asymptotic stable; that is, the disease will disappear and the entire population will become susceptible individuals. If $\lambda > 0$, the disease is strongly stochastically permanent.

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Golden Ratio Algorithms with New Stepsize Rules for Variational Inequalities

D. V. Hieu¹, Y. J. Cho², and Y-B. Xiao³

Abstract: In this paper, we introduce two golden ratio algorithms with new stepsize rules for solving pseudomonotone and Lipschitz variational inequalities in finite dimensional Hilbert spaces. The presented stepsize rules allow the resulting algorithms to work without the prior knowledge of the Lipschitz constant of operator. The first algorithm uses a sequence of stepsizes which is previously chosen, diminishing and non-summable. While the stepsizes in the second one are updated at each iteration and by a simple computation. A special point is that the sequence of stepsizes generated by the second algorithm is separated from zero. The convergence as well as the convergence rate of the proposed algorithms are established under some standard conditions. Also, we give several numerical results to show the behavior of the algorithms in comparisons with other algorithms.

Keywords: Variational inequality; Pseudomonotone operator; Lipschitz continuity; Projection method.

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The Topological Structure of the Solution Sets of Monotone Vector Variational inequalities

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Abstract: We show that if the weak Pareto solution set of a monotone vector variational inequality is disconnected, then each connected component of the set is unbounded. Similarly, this property holds for the proper Pareto solution set.

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Computing Boolean Elimination Ideal by All-solutions SAT and Interpolation

N. T. Hung¹

Abstract: Boolean Gröbner bases is the classical tool to compute Boolean elimination ideals. However, this method is inefficient in case we want to eliminate most of the variables from a big system of Boolean polynomials. We propose a more efficient approach to handle such cases. In this approach, we combine all-solutions SAT Solver and interpolation to compute a Boolean Gröbner basis of elimination ideals. This means that we do not compute a Gröbner basis of the given ideal but only a Gröbner basis of the ideal corresponding to the projection given by elimination of some variables. The given ideal is translated to the CNF formula. Then an all-solution SAT Solver is used to find a finite set of points, the projection of all solutions of the given ideal. Finally, an algorithm, e.g. Buchberger-Möller Algorithm, is used to associate the reduced Gröbner basis to this set of points. We also optimize the Buchberger-Möller Algorithm for lexicographical ordering and compare it with the algorithm from Brickenstein and Dryer, an alternative to the Buchberger-Möller Algorithm for Boolean polynomials.

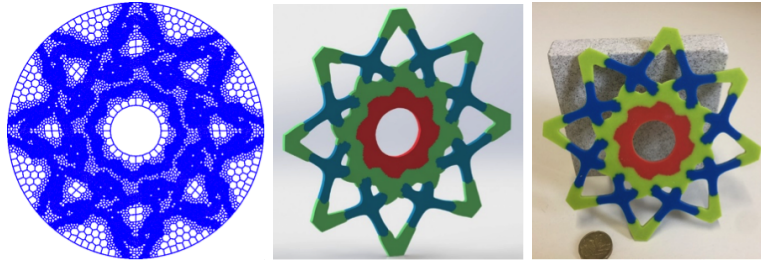
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Ba Vì, Hà Nội 18–20/4/2019

Topology Optimization Based on Polyhedrons and Additive Manufacturing

N. X. Hung¹

Abstract: Polyhedrons (polygons in 2D) occur extensively in nature. Finite element analysis based on such mesh structures is found in the literature. It leads to better computational efficiency and higher flexibility in mesh design for arbitrary geometries. In addition, adaptive polyhedrons/polygons finite element analysis is of interest in several applications. In recent years, topology optimization is a powerful tool for obtaining the best modeling layouts in the conceptual design stage. The key idea is how to redistribute the material on a discretized domain with a given set of loads and the prescribed volume fraction. Polygonal and polyhedral elements can be replaced for traditional elements in these problems because of their strong points. They improve the optimization layout by reducing the checkerboard-pattern issues due to their element properties. Poly-discretization manifests a more natural connection than regular elements in structures. The approximation of the basis function over polygons can be also inherited from the conventional finite element method. Moreover, topology optimization can be integrated in manufacturing process using 3D printer as a hot trend in the era of industry 4.0. The following figure illustrates a real application of this study through the integration of applied mathematical modeling, topology optimization, and additive manufacturing.



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A Variation of Constant Formula for Caputo Fractional Stochastic Differential Equations

P. T. Huong¹

Abstract: We establish and prove a variation of constant formula for Caputo fractional stochastic differential equations whose coefficients satisfy a standard Lipschitz condition. The main ingredient in the proof is to use Ito's representation theorem and the known variation of constant formula for deterministic Caputo fractional differential equations. This is a joint work with Doan Thai Son and Pham The Anh.

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Solution Existence Theorems for Finite Horizon Optimal Economic Growth Problems

V. T. Huong¹

Abstract: The solution existence of finite horizon optimal economic growth problems is studied by invoking Filippov's Existence Theorem for optimal control problems with state constraints of the Bolza type from the monograph of L. Cesari [*Optimization Theory and Applications*, Springer-Verlag, New York, 1983]. Our results are obtained not only for general problems in which the constancy of the saving rate is not assumed as in most neoclassical growth models but also for typical ones with the production function and the utility function being either the AK function or the Cobb–Douglas one. An open question about the regularity of the global solutions of finite horizon optimal economic growth problems is formulated in this paper.

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Multi-dimensional Fractional Bessel Type Processes and Its Numerical Approximation

V. T. Huong¹ and N. H. Long²

Abstract: We consider a multi-dimensional version of fractional Bessel processes $Y = (Y_1, \dots, Y_d)$ given by a fractional stochastic differential equation with a singular drift coefficient. We prove that the equation has a unique solution which is positive in the sense that $Y_i(t) > 0$ for all $i = 1, \dots, d$. We propose an Euler approximation scheme for the equation, show that it is also positive, and study its rate of convergence in path-wise sense.

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The Stationary Point Set Map of General Parametric Optimization Problems

D. T. K. Huyen¹, J.-C. Yao², and N. D. Yen³

Abstract: In the present paper, we show how the so-called *linear independence constraint qualification* (LICQ) can be combined with some conditions put on the first-order and second-order derivatives of objective function and constraint functions to ensure the Robinson stability and the Lipschitz-like property of the stationary point set map of a general C^2 -smooth parametric constrained optimization problem. So, a part of the results in two papers of the authors [J. Optim. Theory Appl. 180 (2019), 91–116; 117–139], which were obtained for a problem with just one inequality constraint, now has an adequate extension for problems having finitely many equality and inequality constraints. The proofs of our results are mainly based on an estimate of B. S. Mordukhovich and R. T. Rockafellar [SIAM J. Optim. 22 (2012), 953–986; Theorem 3.1] for a second-order partial subdifferential of a composite function.

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The Inverse Fermat-Weber Problem under Chebyshev Norm and Hamming Distance

T. T. Le¹ and **K. T. Nguyen**¹

Abstract: The Fermat-Weber problem is a location problem which aims to find the new optimal facility position on the plane such that the total weighted distances from the existing customers to that facility is minimized. Inverse optimization problem is to modify parameters in the minimum way of cost so as to make the prespecified facilities optimal with respect to new parameters. In the known inverse optimization problems, the objective cost function may be measured by either norms or distances. We consider in this paper a model of the inverse Fermat-Weber problem on plane under Chebyshev norm or bottleneck Hamming distance. Polynomial time algorithms are proposed to tackle these models based on a greedy type approach.

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QuickhullDisk: A Faster Convex Hull Algorithm for Disks

N. K. Linh¹, C.-Y. Song², J.-H. Ryu², P. T. An³, N.-D. Hoang⁴,
and D.-S. Kim²

Abstract: Convex hull is one of the most fundamental problems in geometry and its construction has been extensively studied. There are many prior works on the convex hull of points. However, the convex hull problem for disks has not been sufficiently addressed despite important applications. In this talk, we present our simple and fast algorithm, **QuickhullDisk**, for constructing the convex hull of a finite set of disks in the plane by generalizing the powerful quickhull algorithm for points. **QuickhullDisk** takes $O(n \log n)$ time on average and $O(mn)$ time in the worst case where m represents the number of extreme disks which contribute to the boundary of the convex hull of n disks. Experimental result shows that the proposed **QuickhullDisk** algorithm runs significantly faster than the $O(n \log n)$ time incremental algorithm, proposed by Devillers and Golin in 1995, particularly for big data. **QuickhullDisk** is approximately 2.6 times faster than the incremental algorithm for random disks and is 1.2 times faster even for the disk sets where all disks are extreme.

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On Convergence of Continuous Half-explicit Runge-Kutta Methods for a Class of Delay Differential-Algebraic Equations

V. H. Linh¹ and N. D. Truong²

Abstract: Real-life processes that involve simultaneously time-delay effect and constraints are usually described by delay DAEs. Solving delay DAEs is more complicated than solving non-delay ones since we should focus on both the timedelay and DAE aspects. Recently, we have revisited linear multistep methods and Runge-Kutta methods for a class of nonlinear DAEs (without delay) and shown the advantages of appropriately modified discretizations. In this talk, we extend the use of half-explicit Runge-Kutta methods to a class of similar structured strangeness-free DAEs with constant delay. Approximation of solutions at delayed time is obtained by continuous extensions of discrete solution, i.e. continuous output formulas. Convergence analysis for continuous Runge-Kutta methods is presented. It is shown that, similarly to the non-delay case, order reduction that may happen even with non-delay DAEs is avoided if we discretize an appropriately reformulated DDAE instead of the original one. Difficulties arising in implementation are discussed as well. Finally, numerical experiments are given for illustration.

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Ba Vì, Hà Nội 18–20/4/2019

A New Type of Error Bounds: Necessary and Sufficient Conditions

V. S. T. Long¹

Abstract: In this talk we propose and study a new type of local error bounds for convex inequalities systems in terms of minimal time functions, called generalized local error bound with respect to F (an unbounded subset of Euclidean space), which includes the known notion in the literature. Several necessary and sufficient conditions for the existence of this type of error bounds are established. We also state and prove a generalized-invariant-point result and use it to derive a characterization of generalized local error bounds in the case of F being a bounded set and $0 \in \text{int}F$. Discussions and examples are provided to explain advantages of the obtained results.

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Nguyên lý biến phân: Lịch sử và ứng dụng

H. V. Ngai

Tóm tắt: Nguyên lý biến phân là một công cụ nền tảng của Giải tích Toán học, có nhiều ứng dụng phong phú trong các lĩnh vực toán học khác nhau, đặc biệt trong Phép tính biến phân, Tối ưu và Điều khiển. Báo cáo nhằm trình bày một cách tổng quan có thể, sự phát triển của Nguyên lý biến phân, từ cổ điển đến hiện đại, và giới thiệu chọn lọc một số ứng dụng của Nguyên lý biến phân trong lĩnh vực Giải tích biến phân và Tối ưu.

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The 2-Maxian Problem on Trees with Distance Constraint

K. T. Nguyen¹

Abstract: This paper concerns the 2-maxian problem on trees with constraint on the distance of two new facilities, say $d(x_1, x_2) \leq \mathcal{U}$ with $\{x_1, x_2\}$ being the set of new facilities and $\mathcal{U}$ being the given upper bound of their distance. We show that the optimal objective is obtained if the constraint holds with equality. By this result, we further digest some characteristics of the optimal solution, which help to develop a linear time algorithm to solve the problem. Two special cases of the problem, namely the 1-maxian problem (Ting, 1984) with $\mathcal{U} = 0$ and the 2-maxian problem (Burkard et al., 2007) with $\mathcal{U} \geq \text{diam}(T)$, $\text{diam}(T) := \max_{u,v \in V} d(u, v)$, on the tree $T = (V, E)$, are also discussed.

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Thuật toán chọn tâm dựa trên khoảng cách cho phương pháp không lưới RBF-FD giải phương trình đạo hàm riêng trong không gian 3 chiều

Đ. T. Oanh¹, H. X. Phú² và N. M. Tường³

Tóm tắt: Trong báo cáo này, chúng tôi giới thiệu một thuật toán chọn bộ tâm Ξ_ζ hỗ trợ cho phương pháp không lưới RBF-FD giải phương trình đạo hàm riêng trong không gian 3 chiều, trong đó $\Xi_\zeta := \{\zeta, \xi_1, \xi_2, \dots, \xi_k\}$. Thuật toán bao gồm hai công đoạn. Trong công đoạn 1, chọn bộ tâm ban đầu Ξ_{init} sao cho khoảng cách từ các tâm này đến ζ không quá xa và mỗi Octant chỉ chứa một số lượng tâm tối đa nào đó, trong đó mỗi Octant là một trong 8 phần bằng nhau của hệ tọa độ 3 chiều. Trong công đoạn 2, đầu tiên đặt $\Xi_\zeta := \{\zeta\}$, tiếp theo lần lượt xét các tâm $\xi_i \in \Xi_{\text{init}} \setminus \{\zeta\}$ theo thứ tự tăng dần của khoảng cách từ ξ_i đến ζ , nếu $\text{dist}(\xi_i, \Xi_\zeta \setminus \{\zeta\}) \geq d$ thì $\Xi_\zeta := \Xi_\zeta \cup \{\xi_i\}$, trong đó $d > 0$ và $\text{dist}(\xi_i, \Xi_\zeta \setminus \{\zeta\})$ là khoảng cách gần nhất từ ξ_i đến $\Xi_\zeta \setminus \{\zeta\}$.

Thử nghiệm của chúng tôi trên một số bài toán mẫu cho thấy lời giải của phương pháp RBF-FD với thuật toán chọn tâm dựa trên khoảng cách cho lời giải chính xác hơn nhiều so với phương pháp FEM.

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Ba Vì, Hà Nội 18–20/4/2019

Noise Induces Phenomena

D. T. Son¹

Abstract: In the first part of the talk, we present and explain why noise can induce synchronization in low dimensional systems including circle maps and planar ordinary differential equations. Finally, we also provide some numerical computations showing that noise also can induce chaos for planar ordinary differential equations.

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On Robust Stability of Switched Linear Systems

N. K. Son¹ and L. V. Ngoc²

Abstract: In this report, we study the robust stability of continuous-time switched linear systems under the assumption that the matrices of the associated linear subsystems are subjected to affine perturbations. The notion of structured stability radius of a switched linear system which is asymptotically exponentially stable w.r.t. arbitrary switchings is introduced. Some lower bounds and upper bounds for estimating this radius are established, by using the system's common quadratic Lyapunov functions and via an approach based on solutions comparison principle. Several examples are provided to illustrate our approach.

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Structural Convexity and Ravines of Quadratic Functions

N. N. Tam¹

Abstract: Belousov and Andronov [*Solvability and Stability for Problems of Polynomial Programming* (in Russian), Publishing House of the Moscow University, Moscow, 1993; p. 4] have observed that the notions of *structural convexity* and *ravine* of a polynomial function, which were introduced by themselves, are useful for studying stability and solvability of convex polynomial mathematical programming problems, as well as for the investigation of the distribution of integer points in convex sets. The results given in Chap. 3–5 of the monograph justify their observations. Here we establish some facts about structural convexity and ravines of quadratic functions. Among other things, we obtain a verifiable criterion for structural convexity of a quadratic function and show that such a function has no ravine.

This talk is based on a joint research work of C.F. Wen, J.-C. Yao, N.D. Yen, and the speaker.

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An IP-based Approach for Solving Picross Puzzles

L. X. Thanh¹, N. T. Nga¹, and L. T. Nga²

Abstract: Picross is a well-known type of picture logic puzzles. In its typical format, a Picross puzzle is given by a rectangle grid consisting of square cells. Each cell of the grid must be colored (by black) or left blank (white). On the left of each row and on the top of each column of the grid, some clues that are nonnegative integers are given. These numbers form a kind of discrete tomography in the sense that each number measures how many consecutive black cells in the corresponding row or column. Players reveal a hidden picture in the grid after completing coloring the cells according to the clues.

In this talk we present an integer programming formulation for the problem of solving Picross puzzles. The efficiency of this IP-based approach will be shown by numerical experiments on various instances of Picross puzzles.

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Robust Controllability of Linear Systems: An Overview

D. D. Thuan¹

Abstract: In this talk, we summarize results about the robust controllability of linear systems with unconstrained and constrained controls under assumption that the system matrices are subjected to structured perturbations. Firstly, we present notions and characterizations for controllability of linear systems, descriptor systems, delay systems and neutral systems. Secondly, the structured controllability radii are defined for these systems. Based on theory of the multi-valued linear operators, the convex processes and the structured distance to the nearest systems without properties P , some general formulas for controllability radii are established with respect to structured perturbations of the system matrices. Finally, some computable formulas and numerical algorithms for calculating controllability radii are studied. Examples are given to illustrate the obtained results and some open problems are introduced.

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Output Regulation and Non-weighted $\mathcal{L}_2$ -gain of Linear Impulsive Systems: Lyapunov Function Approach

L. Q. Thuan¹, S. Yuan², L. Zhang³ and S. Baldi³

Abstract: In this paper, we deal with the issue of output regulation for an important class of hybrid linear systems called linear impulsive systems. The contribution of this work is twofold: first, we address an asynchronous scenario in which the exosystem and the plant to be regulated are asynchronously subject to impulses; second, we guarantee non-weighted $\mathcal{L}_2$ -gain via an appropriately designed time-varying Lyapunov function. The criteria for stability and non-weighted $\mathcal{L}_2$ -gain for the closed-loop systems are established in term of linear matrix inequalities and linear matrix equations. Finally, a numerical example is provided to show the effectiveness of the proposed method.

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**Convergence, Non-negativity and Stability
of a New Tamed Euler-Maruyama Scheme
for Stochastic Differential Equations
with Hölder Continuous Diffusion Coefficient**

K. T. Thuy¹, L. D. Trong², N. H. Long³, and N. T. Thuy⁴

Abstract: We propose and analyze a new tamed Euler-Maruyama approximation scheme for stochastic differential equations with Hölder continuous diffusion. This new scheme preserves the stability and non-negativity of the exact solution.

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Convergence of a Hybrid Viscosity Approximation Method for Finding Zeros of m -accretive Operators

N. T. T. Thuy¹, P. T. Hieu², and J. J. Strodiot³

Abstract: For finding a zero of an m -accretive operator in a real Banach space, we consider an implicit hybrid viscosity approximation method and show that its explicit variant converges strongly to a zero under weaker assumptions than the ones used recently in *Ceng, L.C., Ansari, Q.H., Schaible, S., Yao, J.C.: Hybrid viscosity approximation methods for zeros of m -accretive operators in Banach spaces. Numer. Func. Anal. Opt. **35**(2), 142–165 (2012)*.

First we examine the case of spaces which are uniformly smooth or reflexive and strictly convex with a uniformly Gâteaux differentiable norm. Afterwards, we improve our convergence results when the space is uniformly convex. Furthermore, we show that the strong convergence of some modified Halpern and Krasnosel'skii–Mann type methods can also be deduced from our results. Finally, a simple numerical example is also given to illustrate the convergence analysis of the considered method.

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Explicit Criteria for Exponential Stability of Nonlinear Neutral Functional Differential Equations

C. T. Tinh¹

Abstract: In this talk, we present some explicit criteria for exponential stability of nonlinear time-varying functional differential equations of neutral type. The stability conditions obtained are quite simple, easy to use. Furthermore, they have some potential applications, for example, they can be applied to study behavior of solutions of neutral delay logistic equations and exponential stability of equilibria of various classes of neural networks of neutral type.

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Sample-based Clustering for Big Data using Coresets

L. H. Trang¹, P. V. Ngoan¹, and N. V. Duc¹

Abstract: The concept of coresets was proposed for geometric approximation of a given set of points (Agarwal et al., Geometric approximation via coresets, *Combinatorial and Computational Geometry*, pp. 1–30, 2005). Given a set T and $\varepsilon > 0$, let μ be a *monotonic function* defined on T , i.e., for $S \subseteq T$, $\mu(S) \leq \mu(T)$. Then, S is an ε -coreset of T with respect to μ , if $(1 - \varepsilon)\mu(T) \leq \mu(S)$. This talk presents the use of the coreset for sampling a dataset for clustering purpose and a related problem called visual assessment of cluster tendency (VAT), and then introduces an improved sampling technique for big data clustering. Numerical examples are given to illustrate why it can be properly used as a sample set of a big dataset. Some initial results on VAT and clustering problems are shown. Finally, potential applications are also discussed.

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Semi-implicit Milstein Approximation Scheme for Non-colliding Particle Systems

L. D. Trong¹ and **N. H. Long**¹

Abstract: We introduce a semi-implicit Milstein approximation scheme for some class of non-colliding particle systems modeled by systems of stochastic differential equations with non-constant diffusion coefficients. We show that the scheme converges at a rate of order 1 in the mean-square sense.

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Some Amended Parametric and Non-parametric Estimations and their Applications in a Flood Forecasting Ensemble Model

L. H. Tuan¹ and T. A. Dung²

Abstract: In this talk, some modified parametric and non-parametric algorithms are investigated. Each method has some advantages. Two of them are combined in a altered semi-parametric regression model. This proposed model is used to modelize flood water-level and to predict the short-term inundation of Mekong Delta, Vietnam. In the process of model building, several justified linear regression models are explored for the parametric component. We use a lost function, a squared error function or a cost function to solve step-wise multiple linear regression, partial least squares solution and multi-recursive regression method. They are utilized to capture flood's linear characteristics. The non-parametric estimations are studied by two justified algorithms. Some modified non-linear regression models based on artificial neural network are also able to obtain flood's non-linear characteristics. The model's error, consistency of those estimations and convergence are studied. Then the principle component analysis technique (PCA) is utilized to set up the final model. The potential and effect of the proposed ensemble model can be evaluated and confirmed via obtained empirical results. The proposed estimations can be used as a reliable and sensible/reliable alternative flood forecasting tool to improve prediction quality and accuracy further.

Key words: parametric, non-parametric, estimations, regression, ensemble model, artificial neural network, estimation, smooth function, flood, inundation, water-level, prediction, forecasting, principle component analysis, kernel, splines.

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Ba Vì, Hà Nội 18–20/4/2019

An Algorithm to Solve the Standard two Variables Linear Programming Problem with any Number of Constraints

N. A. Tuan¹ and N. V. Nhan²

Abstract: In this report, we present a standard two variables linear programming problem with any number of constraints and an algorithm to solve this problem. We demonstrate that the algorithm can solve the above problem after two iterations.

We illustrate the geometric meaning of the algorithm and give some examples.

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On the Mangasarian-Fromovitz Constraint Qualification and Optimality Conditions in Nonsmooth Semi-Infinite Multiobjective Programming

N. M. Tung¹

Abstract: In this talk, we consider Karush-Kuhn-Tucker multiplier rules in nonsmooth semi-infinite multiobjective problems with mixed constraints. A version of the Mangasarian-Fromovitz constraint qualification is proposed, in terms of the Michel-Penot directional derivative and the Studniarski derivative of order p which is just the order of the directional Hölder metric subregularity included also in this proposed qualification version. Using this qualification together with the Pshenichnyi-Levitin-Valadire property, we establish Karush-Kuhn-Tucker optimality conditions for Borwein-proper and firm solutions. We also compare our qualification version with other usually-employed constraint qualifications.

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On Approximate Karush–Kuhn–Tucker Conditions for Locally Lipschitz Multiobjective Optimization Problems

N. V. Tuyen¹, J. C. Yao², and C. F. Wen³

Abstract: In this talk, we introduce a kind of approximate Karush–Kuhn–Tucker (AKKT) condition for locally Lipschitz multiobjective optimization problems. We show that, without any constraint qualification, the AKKT condition is a necessary for a local weak efficient solution of the considered problem. For convex problems, we prove that the AKKT condition is a necessary and sufficient optimality condition for a global weak efficient solution. Furthermore, we prove that, under some suitable additional conditions, an AKKT condition is also a KKT one.

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Palais-Smale Values and Stability of Global Hölderian Error Bounds for Polynomial Functions

H. H. Vui¹ and H. P. Dung²

Abstract: Let f be a polynomial function of n variables. In this talk, we study stability of global Hölderian error bound for a sublevel set $[f \leq t]$ under a perturbation of t . Namely, we investigate the following questions:

1. Suppose that $[f \leq t]$ has a global Hölderian error bound, when does there exist an open interval $I(t) \subset \mathbb{R}, t \in I(t)$, such that for any $t' \in I(t)$, $[f \leq t']$ has also a global Hölderian error bound?
2. Suppose that $[f \leq t]$ does not have global Hölderian error bound, when does there exist an open interval $I(t) \subset \mathbb{R}, t \in I(t)$, such that for any $t' \in I(t)$, $[f \leq t']$ does also not have global Hölderian error bound?
3. Are there other types of stability which are different from types in questions 1 and 2?

To answer these questions, we compute the set $H(f)$ of all values $t \in \mathbb{R}$ such that $[f \leq t]$ has a global Hölderian error bound and study the relationship between $H(f)$ and the set of Palais-Smale values of f . Our main results are the following:

- The list of all possible types of stability is given;
- For an arbitrary $t \in \mathbb{R}$, we can determine the type of stability of global Hölderian error bound for $[f \leq t]$.

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Kể chuyện về cuộc đời và sự nghiệp khoa học của Viện sĩ Lev Semyonovich Pontryagin

N. D. Yên¹

Tóm tắt: Với những hiểu biết hạn hẹp của mình, tôi muốn kể một câu chuyện về cuộc đời và sự nghiệp khoa học của Viện sĩ Lev Semyonovich Pontryagin (sinh ngày 3/9/1908, mất ngày 3/5/1988), một nhà toán học lớn của Liên Xô, người đã từng giữ chức vụ Phó Chủ tịch Liên đoàn Toán học thế giới. Tôi sẽ trình bày một số thông tin về cuộc đời của Lev Pontryagin, các nghiên cứu của ông trong toán học lý thuyết và trong toán học ứng dụng, và kể một vài giai thoại về nghị lực và tài năng của ông. Tài liệu tham khảo chính của báo cáo này là trang Wikipedia https://en.wikipedia.org/wiki/Lev_Pontryagin, bài tiểu sử nhà toán học <http://www-history.mcs.st-andrews.ac.uk/Biographies/Pontryagin.html> do J. J. O'Connor và E. F. Robertson viết, và cuốn Tiểu sử tự thuật hơn hai trăm trang của Lev Pontryagin (<http://ega-math.narod.ru/LSP/book.htm>, tiếng Nga).

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Ma trận đối dương và ứng dụng

L. H. Yến¹ và V. N. Phát¹

Tóm tắt: Ma trận đối xứng A cỡ $n \times n$ được gọi là đối dương(copositive) nếu $x^T Ax \geq 0$ với mọi $x \in \mathbb{R}_+^n$. Tập các ma trận đối dương không chỉ chứa các ma trận nửa xác định dương mà nó còn xuất hiện trong nhiều ứng dụng thực tế. Trong báo cáo này, chúng tôi giới thiệu lớp các ma trận đối dương và các tính chất cũng như những câu hỏi mở liên quan. Sau đó, chúng tôi trình bày một ứng dụng của ma trận đối dương trong việc nghiên cứu sự ổn định của hệ phương trình vi phân tuyến tính suy biến dạng polytopic.

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