International Conference on Variational Analysis and Nonsmooth Optimization

July 15 - July 16, 2021

dedicated to Christiane Tammer

Conference Booklet

Welcome message

It's a great pleasure to welcome you to the

"International Conference on Variational Analysis and Nonsmooth Optimization"

in honor of the 65th birthday of

Christiane Tammer (Martin Luther University Halle-Wittenberg).

The mission of the "International Conference on Variational Analysis and Nonsmooth Optimization", which will be held as an online conference during July 15 - July 16, 2021, is to bring together recognized experts as well as early-career researchers from countries across the globe to exchange the latest insights and present the recent scientific findings related to nonlinear and variational analysis, nonsmooth, vector, and set optimization, control theory, operations research, and related disciplines. A wealth of applications in economics, management science, engineering, mechanics, and behavioral sciences has led to the emergence of these theories. As a result of these important applications, these topics represent thriving research areas and branches of applied mathematics that continue to expand. This conference is primarily designed to explore new results, develop new ideas, and encourage participants' collaborations to generate new knowledge that can be applied to existing problems and future applications. The conference participants are invited to submit papers for a Special Issue of the international journal

"*Journal of Applied and Numerical Optimization (http://jano.biemdas.com)*".

Dear colleagues and friends, welcome and thank you for participating at the ICVANO 2021. It is a great pleasure for us to enjoy our online conference together with you.

Akhtar A. Khan
On behalf of the Organizing Committee

Christiane Tammer

Professor Tammer was born December 26, 1955 in Leipzig, in Saxonia. Already in the school, she was interested in mathematics and participated successfully in "Math Olympics" and special working groups for Mathematics. She started her undergraduate studies in process technology at the Technical University of Merseburg, but soon, she moved to studies in mathematics. In 1984 Christiane received her PhD degree, and in 1991 she finished her habilitation at the same university. Both of degrees she made under the supervision of Professor Alfred Göpfert whose professional competence had a great influence as on students as on collaborators.

In 1997 she got a visiting professorship at the University of Leipzig and one year later a visiting professorship at the Royal Military College of Canada, Kingston. From 1998 to 1999 Christiane Tammer got the Kovalewskaja-Visiting-Professorship at the University of Kaiserslautern. Since 1998 she has a chair as full Professor of Variational Methods.

Figure 1: Christiane Tammer

Therefore, it is not surprising that Christiane Tammer started relatively early with publishing her scientific results and presenting these at conferences. So, for instance, on the international conference in 1981 on the Isle of Hiddensee in the North of Germany (former GDR), where we met us first time. It was her first talk on an international platform which started very curious: an unknown person interrupted her, saying and repeating several times categorical "Aufhören, alles falsch (Stop, everything is wrong)". Of course, the chairman had fired this troublemaker. Later, we recognized that this person was a drunken fisherman from the isle. One must admire Christiane's courage that she continued and finished her talk with great success. Not only I have remembered this situation, also Professor Tyrrel Rockafellar, who was attending this conference in 1981, too.

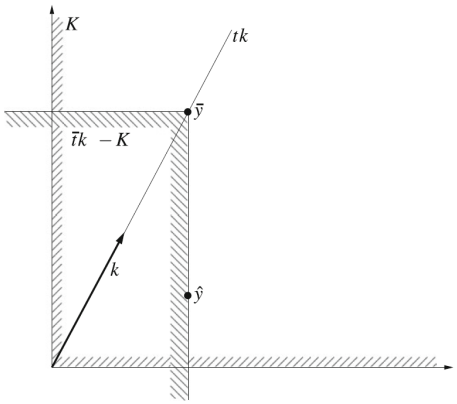

Figure 2: Gerstewitz functional

In 1983 Christiane Gerstewitz created and published separation theorems for nonconvex sets by means of nonlinear separating functionals, now well-known under the name "Gerstewitz functional", This functional is used by many mathematicians in convex analysis, optimization risk theory and robustness. Years later, having in the meantime a new family name, she was invited at the Northern Michigan University in Marquette to give there a lecture. Then, in the discussion a colleague asked Christiane for the novelty of her presented results because he already studied these in a paper by Gerstewitz. A clearing up could be given immediately with the result: a person with different family names can be one and the same person.

Of course, Professor Tammer's **research fields** increased continuously, and so we can study her results on topics on

- Minimal point theorems and variational principles
- Variational inequalities, regularization methods, inverse problems
- Generalized convexity
- Lagrange multiplier rules
- Duality theory
- Approximation theory
- Locational analysis
- Robustness
- Vector optimization, Set optimization.

The pleasure of discovering new results ought to be matched by the pleasure in studying the achievements of other mathematicians on other fields. Although this latter is often difficult by the overwhelming volume of mathematical output, Professor Tammer did it to the best of her knowledge and conscience.

Let me list the papers of Christiane Tammer ordered by the years of publication starting from 2012:

2012

Approximate solutions of vector optimization problem with variable ordering structure. (with Soleimani, Behnam) Numerical Analysis and Applied Mathematics (ICNAAM); Vol. B. AIP, 2363–2366, (2012).

Multicriteria approaches for a private equity fund. (with Tannert, Johannes) Numerical Analysis and Applied Mathematics (ICNAAM); Vol. B. AIP, 2367–2370, (2012).

Relations between strictly robust optimization problems and a nonlinear scalarization method. (with Köbis, Elisabeth) Numerical Analysis and Applied Mathematics (ICNAAM); Vol. B. AIP, 2371–2374, (2012).

Generalized Dubovitskii-Milyutin approach in set-valued optimization. (with Akhtar A. Khan) Vietnam journal of mathematics Vol. 402, No. 2/3, 285–304, (2012).

Lagrange necessary conditions for Pareto minimizers in Asplund spaces and applications. (with T.Q. Bao) Nonlinear analysis / Theory, methods and applications. Vol. 75, No.3, 1089–1103, (2012).

2013

Lagrange duality, stability and subdifferentials in vector optimization (with Hernández, Elvira; Löhne, Andreas; Rodriguez-Marin, Luis) Optimization, 3, 415–428, (2013).

Scalarization in geometric and functional vector optimization revisited. (with Durea, Marius; Strugariu, Radu) Journal of Optimization Theory and Applications Vol. 159, No. 3, 635–655, (2013).

A unified approach for different concepts of robustness and stochastic programming via non-linear scalarizing functionals. (with Klamroth, K.; Köbis, E.; Schöbel, A.) Optimization, Vol. 62, No. 5, 649–671, (2013).

2014

Concepts for Approximate Solutions of Vector Optimization Problems with Variable Order Structures (with B. Soleimani) Vietnam Journal of Mathematics, Vol. 42, No. 4, Special Issue: Some Selected Topics in Variational Analysis and Applications, 543–566, (2014).

The relationship between multi-objective robustness concepts and set-valued optimization. (with Ide, J., Köbis, E. Kuroiwa, D., Schöbel, A.) Fixed Point Theory and Applications, DOI: 10.1186/1687-1812-2014-83, (2014).

2015

Proximal Methods for the Elastography Inverse Problem of Tumor Identification Using an Equation Error Approach (with Mark S. Gockenbach, Baasansuren Jadamba, Akhtar A. Khan, Brian Winkler) Advances in Mechanics and Mathematics Vol. 33, 173–197, (2015).

Optimal exploitation of nonrenewable resources (with A. Kunow, S. Rosche, C. Weiser) J. Optim. Theory Appl. Vol. 167, No. 3, 928–948, (2015).

Regularization of quasi-variational inequalities (with C. Zălinescu, A. Khan) Optimization Vol. 64, No. 8, 1703–1724, (2015).

On set-valued optimization problems with variable ordering structure (with M. Durea, R. Strugariu) J. Global Optim. Vol. 61, No. 4, 745-767, (2015).

2016

Relationships between constrained and unconstrained multi-objective optimization and application in location theory (with Chr. Günther) Math. Methods Oper. Res. Vol. 84, No. 2, 359–387, (2016).

The Lipschitzianitiy of convex vector and set-valued functions (with V. A. Tuan, C. Zălinescu) TOP Vol. 24, 1, 273–299, (2016).

Duality related to approximate proper solutions of vector optimization problems (with C. Gutierrez, L. Huega, V. Novo) J. Global Optim. Vol. 64, No. 1, 117–139, (2016).

Optimality conditions for approximate solutions of vector optimization problems with variable ordering structures (with B. Soleimani) Bull. Iranian Math. Soc. Vol. 42, No. 7, 5–23, (2016).

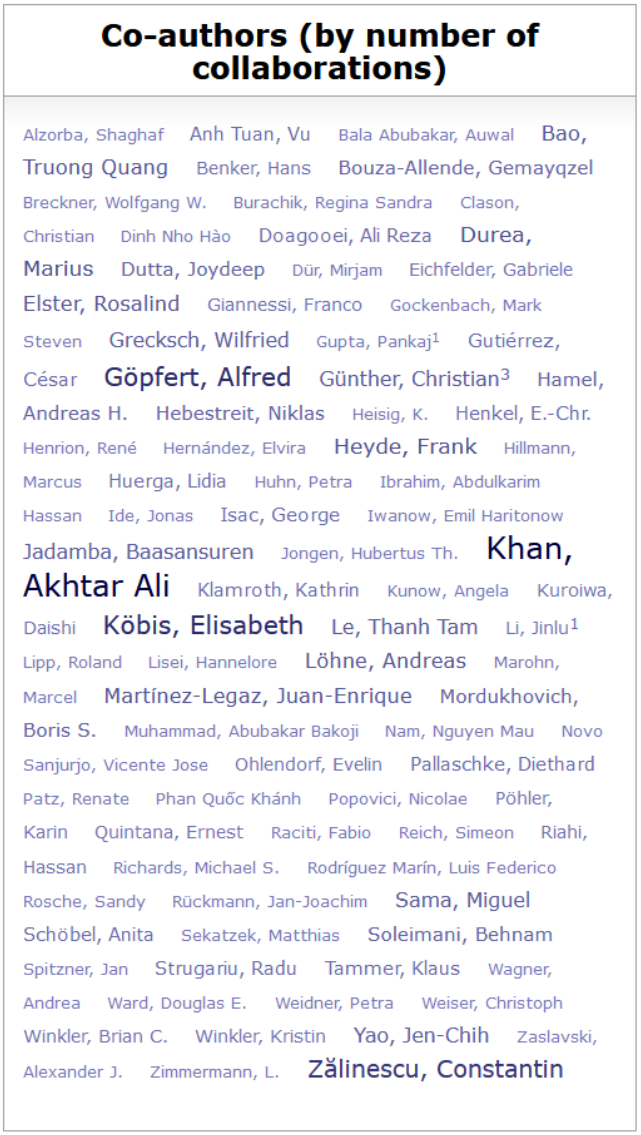

Figure 3: Co-authors of Christiane Tammer (Source MathSciNet)

2017

Optimality conditions for set-valued optimization problems based on set approach and applications in uncertain optimization (with E. Köbis and Yao, Jen-Chih), J. Nonlinear Convex Anal. Vol. 18, No. 6, 1001–1014, (2017).

Approximate solutions of set-valued optimization problems using set-criteria (with C. Gutierrez, L. Huerga, E. Köbis) Journal Applied Analysis and Optimization, Vol. 1, No. 3, 501–519, (2017).

A new scalarizing functional in set optimization with respect to variable domination structures (with E. Köbis, Th. Tam Le and Jen-Chih Yao) Journal Applied Analysis and Optimization, Vol. 1, No. 2, (2017) Robust Vector Optimization with a Variable Domination Structure (with E. Köbis) Carpathian J. Math., Vol. 33, No. 3, 343–351, (2017).

Subdifferentials of Nonlinear Scalarization Functions and Applications (with B. Q. Truong and M. Hillmann) Journal of Nonlinear and Convex Analysis, Vol. 18, No. 4, 589–605, (2017).

A new algorithm for solving planar multiobjective location problems involving the Manhattan norm (with S. Alzorba, Chr. Günther, N. Popovici) European Journal of Operational Research, Band 258, 1, S. 35–48, (2017).

A Vector-Valued Ekeland´s Variational Principle in Vector Optimization with Variable Ordering Structures (with B. Soleimani) J. Nonlinear Var. Anal. Vol. 1, No. 1, 89–110, (2017).

A unified approach to uncertain optimization (with K. Klamroth, E. Köbis and A. Schöbel) European Journal of Operational Research 260, 403–420 (2017).

Second-Order Optimality Conditions in Set-Valued Optimization with Variable Ordering Strkucture (with A. Khan and B. Soleimani) Pure and Applied Functional Analysis, Vol. 2, No. 2, (2017).

On convex modified output least-square for elliptic inverse problem: stability, regularization, applications, and numerics (with B. Jadamba, A. Khan and M. Sama) Optimization, Volume 66, (2017).

Generalized set order relations and their numerical treatment (with E. Köbis and D. Kuroiwa) Applied Analysis and Optimization, Vol. 1, No. 1, 45–65, (2017).

Nonlinear scalarizing functionals for computing minimal points under variable ordering structures (with G. Bouza) Applied Analysis and Optimization, Vol. 1, No. 1, 67–97, (2017).

Ekeland's Variational Principle for Vector Optimization with Variable Ordering Structure (with T. Q. Bao, G. Eichfelder and B. Soleimani) Journal of Convex Analysis Vol. 24, No. 2, 393–415, (2017).

On Some Methods to Derive Necessary and Sufficient Optimality Conditions in Vector Optimization (with Durea, M., Strugariu, R.) J Optim Theory Appl doi:10.1007/s10957-016-1059-y, (2017).

2018

Subdifferentials and SNC property of scalarization functionals with uniform level sets (with T.Q. Bao) J. Nonlinear Var. Anal. 2, No. 3, 355–378 (2018).

Necessary optimality conditions in generalized convex multi-objective optimization involving nonconvex constraints (with C. Günther, J.-C. Yao), Applied Analysis Optimization, Vol. 2, No. 3, 403–421 (2018).

Inverse Generalized Vector Variational Inequalities with Respect to Variable Domination Structures and Applications to Vector Approximation Problems (with R. Elster, N. Hebestreit, A. A. Khan), Applied Analysis Optimization, Vol. 2, No. 3, 341–372 (2018).

On generalized-convex constrained multi-objective optimization (with C. Günther), Pure and Applied Functional Analysis Vol. 3, No. 3, 429–461 (2018).

A Generalized Scalarization Method in Set Optimization with Respect to Variable Domination Structures (with Köbis, E. and Le, T. T.), Vietnam J. Math., Vol. 46, 95–125, (2018).

Set approach duality assertions for set-valued problems with the nonsolid ordering cone (with Ali Reza Doagooei), J. Nonlinear Convex Anal., Vol. 19, No. 3, 477–491 (2018).

The Lagrange multipliers for convex vector functions in Banach spaces (with Vu Anh Tuan and Thanh Tam Le), Revista Investigacion Operacional, Vol. 39,No. 3, 411–425 (2018).

Generalized cutting plane method by means of minimum type subdifferentials (with Ali Reza Doagooei), Applied Analysis and Optimization, Vol. 2, No. 1, 159–170, (2018).

2019

A Unified Characterization of Nonlinear Scalarizing Functionals in Optimization (with G. Bouza, Ernest Quintana), Vietnam J. Math., Volume 47, No 3, 683–713 (2019).

Contingent derivatives and regularization for noncoercive inverse problems (with Christian Clason, Akhtar A. Khan, Miguel Sama), Optimization, Vol. 68, No 7, 1337–1364 (2019).

Existence theorems and regularization methods for non-coercive vector variational and vector quasi-variational inequalities (with A. A. Khan, N. Hebestreit, E. Köbis), J. Nonlinear Convex Anal.Vol 20, No 3, 565–591 (2019).

Set optimization problems on ordered sets (with Jinlu Li), Appl. Set-Valued Anal. Optim., Vol. 1, No 1, 77–94 (2019).

Scalarization Functionals with Uniform Level Sets in Set Optimization (with T. Q. Bao), Journal of Optimization Theory and Applications 182:310–335 (2019).

Duality in vector optimization with domination structures (with T. Q. Bao, T. T. Le, V. A. Tuan), Appl. Set-Valued Anal. Optim.,Vol. 1 , No. 3, 319–335 Available online at http://asvao.biemdas.com https://doi.org/10.23952/asvao.1.2019.3.06 (2019).

Necessary conditions for solutions of set optimization problems with respect to variable domination structures (with E. Köbis, T. T. Le, J.-C. Yao), Pure and Applied Functional Analysis, Vol.4, No 2, 317–343 (2019).

Regularization methods for scalar and vector control problems (with B. Jadamba, A. A. Khan, M. Sama), In: Variational Analysis and Set Optimization, 269–295 (2019).

Convexity in the framework of variable domination structures and applications in optimization (with A. R. Doagooei, T.T. Le), J. Nonlinear Convex Anal., Volume 20, No 12, 2539–2556 (2019).

On nonlinear split ordered equilibrium problems (with Jinlu Li), J. Nonlinear Convex Anal., Volume 20, No 12, 2633–2652 (2019).

Inverse problems in variational inequalities by minimizing energy (with D. N. Hao, A. A. Khan, M. Sama), Pure and Applied Functional Analysis, Vol.4, No 2, 247–269 (2019).

Inverse Problems for Vector Variational and Vector Quasi-Variational Inequalities (with A. A. Khan, N. Hebestreit), Appl. Set-Valued Anal. Optim., Vol.1, No 3, 307–317 (2019). Available online at http://asvao.biemdas.com https://doi.org/10.23952/asvao.1.2019.3.05

2020

The Fermat Rule for Set Optimization Problems with Lipschitzian Set-Valued Mappings (with Gemayqzel Bouza, Ernest Quintana, V. A. Tuan), J.Nonlinear Convex Anal., Vol. 21, No 5, 1137-1174 (2020).

Generalized Solutions of Quasi-Variational-Like Problems (with T. Q. Bao, N. Hebestreit), Vietnam Journal of Mathematics (2020) 48:509-526

A scalarization scheme for binary relations with applications to set-valued and robust optimization (with C. Gutiérrez, L. Huerga, E. Köbis), Journal of Global Optimization, https://doi.org/10.1007/s10898-020-00931-x (2020).

A modified Descent Dai-Yuan Conjugate Gradient Method for Constrained Nonlinear Monotone Operator Equations (with Auwal Bala Abubakar, Abdulkarim Hassan Ibrahim, Abubakar Bakoji Muhammad), Applied Analysis Optimization, Vol. 4, No 1, (2020).

Characterization of Efficient Points of Acceptance Sets (with M. Marohn), Applied Analysis Optimization, Vol. 4, No 1, (2020).

Three Optimization Formulations for an Inverse Problem in Saddle Point Problems with Applications to Elasticity Imaging of Locating Tumor in Incompressible Medium (with O. Babaniyi, B. Jadamba, A. A. Khan, M. Richards, M. Sama), J.Nonlinear Var. Anal., Vol. 4, No 2 (2020). Available online at http://jnva.biemdas.com, https://doi.org/10.23952/jnva.4.2020.2.10

Analyzing the role of the Inf-Sup condition for parameter identification in saddle point problems with application in elasticity imaging (with B. Jadamba, A. A. Khan, M. Richards, M. Sama), Optimization, https://doi.org/10.1080/02331934.2020.1789128 (2020).

Set Optimization Problems on Ordered Topological Vector Spaces (with Jinlu Li), Pure and Applied Functional Analysis Vol. 5, No 3, 621–651 (2020).

Contingent Derivatives of the Set-Valued Solution Map of a Non-coercive Saddle Point Problem. A Cross-Fertilization Between Variational Analysis and Inverse Problems (with B. Jadamba, A. A. Khan, M. Sama), J. Nonlinear Var. Anal. Vol. 4, No 1, (2020). Available online at http://jnva.biemdas.com, https://doi.org/10.23952/jnva.4.2020.1.xxx

A Fixed Point Approach with a New Solution Concept for Set- valued Optimization Problems (with Chaoli Yao, Shengjie Li), accepted Proceedings NACA (2020).

A Hybrid Conjugate Gradient Algorithm With Spectral Parameters for Solving Monotone Operator Equations With Convex Constraints and Application (with Abubakar Bakoji Muhammad, Auwal Bala Abubakar), accepted Proceedings NACA (2020)

2021

A Convex Optimization Framework for the Inverse Problem of Identifying a Random Parameter in a Stochastic Partial Differential Equation (with B. Jadamba, A. A. Khan, M. Sama, H.-J. Starkloff), SIAM/ASA Journal on Uncertainty Quantification, Vol. 9, No 2, 922–952 (2021)

On the Intrinsic Core of Convex Cones in Real Linear Spaces (with Bahareh Khazayel, Ali Farajzadeh, Christian Günther), SIAM J. Optim., 31(2), 1276–1298 (2021).

Characterizations for the Strong Abadie Constraint Qualification and Applications to Calmness of Convex Multifunctions (with Zhou Wei, Jen-Chih Yao), Journal of Optimization Theory and Applications, DOI: 10.1007/s10957-020-01808-5 (2021).

A scalarization scheme for binary relations with applications to set-valued and robust optimization (with C. Gutiérrez, L. Huerga, E. Köbis), Journal of Global Optimization, 79, 233-256 (2021).

A Steepest Descent Method for Set Optimization Problems with Set-Valued Mappings of Finite Cardinality (with G. Bouza, Ernest Quintana), Journal of Optimization Theory and Applications, accepted (2021).

On Clarkes Subdifferential of Marginal Functions (with G. Bouza, Ernest Quintana), Applied Set-Valued Analysis and Optimization, accepted (2021).

Inverse Problem of Estimating the Stochastic Flexural Rigidity in Fourth-order Models (with W. Grecksch, B. Jadamba, A. A. Khan, M. Sama), Pure and Applied Functional Analysis, accepted (2021).

From my point of view we would carry coals to Newcastle when we believe that Christiane Tammer didn't publish before 2012, and it would be a nice task to complete this list, respectively.

Another important field of her mathematical activities is her co-working as author of the following **books**:

Tammer, Chr., Weidner, P.: Scalarization and Separation by Translation Invariant Functions. Springer Nature Switzerland, 2020.

Göpfert, A., Riedrich, T., Tammer, Chr.: Approximation und Nichtlineare Optimierung in Praxisaufgaben. Springer Verlag, Wiesbaden, 2017.

Khan, A.A., Tammer, Chr., Zălinescu, C.: Set-valued Optimization - An Introduction with Applications. Springer, Berlin Heidelberg 2015.

Göpfert, A., Riedrich, T., Tammer, Chr.: Angewandte Funktionalanalysis. Vieweg+Teubner Verlag, Wiesbaden, 2009.

Göpfert, A., Riahi, H., Tammer, Chr., Zălinescu, C.: Variational Methods in Partially Ordered Spaces. Springer, New York, 2003.

Some of these monographs will be published as revised second edition in 2021.

According to the old proverb - actions speak louder than words - Professor Tammer's scientific activities were also concentrated on her HDR candidates she had supervised to completion - 14 PhD students who all defended their title "Dr.rer.nat" with great success, and 8 of her current PhD students are still working on their thesis.

Let me say brief and to the point: all of her activities as **member of**

the Scientific Committee of the Working Group on Generalized Convexity (2018)
the EUROPT Managing Board (2018)
the Editorial Board of the journals

Mathematical Inverse Problems
Journal of Optimization Theory and Applications
Minimax Theory and its Applications
Investigacion Operacional
Applied Analysis and Optimization
Journal of Nonlinear and Variational Analysis
Vietnam Journal of Mathematics

or as **Editor-in-Chief** of the journal "Optimization" and **Co-Editor-in-Chief** of the journal "Applied Set-Valued Analysis and Optimization" were and are very time-consuming.

Professor Tammer spent a lot of time as for teaching students as for identifying new, promising areas of research and for applying the results in industry, business and government.

For all these let us say: Thank you very, very much.

Rosalind Elster

Alfred Göpfert
Martin Luther University Halle-Wittenberg, Germany

Laudatio for Christiane Tammer dedicated to her 65th birthday

In the research work of mathematics (and not only there) it is important that we "see" something, that after reading, after a stimulating lecture, after remarks of an expert or maybe even after looking at a drawing we feel a hunch, an inkling, maybe even have an idea or vision what we could make out of a fact taken note of. I have seen many times in the past decades how jubilarian Christiane successfully seized such opportunities, combined them with her extensive and well-sorted knowledge of functional analysis and optimization, and then, often with colleagues and students and these scattered all over the world, obtained results.

When she was working in the eighties on the **separation** of two sets A, B in a topological vector space X, she came one day in a joyful mood and said that she suspected to be able to describe (under conditions) the separation **by shifting** one of the sets along a ray k emanating from the zero point in X. At first this was only a vision, but soon it turned out that with the shift a set of epigraphic type is formed, so that by infimum formation **a functional** can be formed which under conditions leads both to theorems about **nonconvex separation** and is suitable for **scalarization** in vector optimization and set-valued optimization. Through contributions of various authors, properties of the functional (as being f. i. convex, lsc., proper, monotone, finite-valued) have become more and more precise. Only recently, in a joint work with C. Zălinescu, she succeeded in showing **Lipschitz properties** of the functional, so that it is also suitable for obtaining optimality conditions. The honoree was also able to use the functional in proofs on extremality principles in the sense of Mordukhovich. B. S. Mordukhovich writes about her in page 100 of his 2018 monograph, "We also mention here important results on the so-called nonlinear separation that were initiated by Gerstewitz (Tammer) who was motivated by developing new scalarization techniques in vector optimization. Her idea was greatly elaborated and applied in many subsequent works"...Picked out from her extensive research work, perhaps a remark on **preferences**, i. e. order structures in general spaces, the basis of solution definitions. There are interesting applications of the functional especially w. r. to preferences concerning different concepts of **robustness**, I refer to her work with K. Klamroth, E. Köbis, A. Schöbel from 2017. Speaking on robustness there is a joint paper with E. Köbis of 2017 where both authors deal with robustness for uncertain vector optimization problems leading these problems to **set-valued optimization** problems with **a variable domination structure**, that means they look for cones C depending on the feasible points. Her research activities also include highly applied problems, and I refer here only to her results on **location optimization**.

A professor at a venerable university has even more obligations than research, I mention **lectures**, which are consistently well attended at her place; I mention **contact** with students, I know she is easily accessible; there are offices, she is vice dean; there is the German Association of Universities, she was **chairperson** in the state of Saxony-Anhalt for years and had thus "incidentally" all kinds of influence on university legislation in the state; furthermore she was (is) often **co-author** of books, also with me, and it was (and is) always a successful and very pleasant collaboration. She acquires so-called third-party funding, directs projects and now especially there is the Journal Optimization and she is **Editor in Chief** and finally, she has her **doctoral** and **post-doctoral** students; I wonder how she manages it all and so effectively? As an answer I come back to my thesis mentioned at the beginning: she "sees" connections and thinks quickly (and likes to do her job).

Annette Henn
Merseburg University of Applied Sciences, Germany

An anecdote as example for your understanding of collaboration - dear Christiane Tammer

We know us via our common colleague and friend, Renate Patz. In the early years of the 21th century she acts as the mentor in my doctorate procedere. In this context I needed assistance and you gave relevant advice in mathematical modelling of criterias in decision support structures. ... I could conclude my PhD thesis in 2004 and now I'm holding the professorship in Entrepreneurship at the University of Applied Sciences in Merseburg.

Deeply IMPRINTED in my MEMORY is a special impression, standing as a sign of your understanding of collaboration. We were invited to "Leibniz-Sozietät der Wissenschaften zu Berlin". For me as a young researcher a great opportunity.

But after all this years I connect another and very personal note with this experience: Since our common journey to Berlin I know two very nice and typical places! At first the restaurant "Zum Nußbaum", where we had lunch. At the second the "Reinhards". On our way home we had to wait for the train on the former central station "Bahnhof Zoo". It must has been a long time for waiting and it was cold. Therefore you decided, we need a cup of coffee to warm up. With conclusive arguments you maneuvered us to the famous coffee house at the corner Ku'Damm. We spent a very inspirating afternoon with insights into many aspects of sciences and life. Always when I'm in Berlin, I remember in this day.

Thank you and best wishes for all! Your Annette Henn (Summer 2021).

Elisabeth Köbis

Norwegian University of Science and Technology, Norway

Laudatio for Christiane Tammer dedicated to her 65th birthday

It is a great pleasure for me to write this laudation on Christiane Tammer, an outstanding scientist, mentor, and friend. I met Christiane for the first time in April 2007, when I attended her lecture on linear optimization. Not only did she spark my interest in mathematics in general and optimization in particular, she soon became my mentor and person I looked up to and consulted for guidance in any matters of science and life.

Christiane has provided 22 PhD students with her excellent counseling, leading them to each succeed in their own way. Some of her protegees thrived in academia, while others' paths led them to find their way in industry. One of the unifying characteristics they all have in common is that they all have benefited from Christiane's thorough, personal advising, which laid the foundation of their professional life.

I find it outstanding how Christiane manages to fulfill her many roles with such great success, involvement, and humanity. As Editor-in-Chief of the journal *Optimization*, she constantly is engaged with upholding and enhancing the quality and outreach of the journal. This is not only visible in the increasing impact factor of the journal, but also in the contentment and gratitude of authors, editors, and reviewers. Her many activities in Editorial Boards of various journals also need to be mentioned, among others, at the *Journal of Nonlinear and Variational Analysis, Journal of Applied and Numerical Optimization, Journal of Optimization Theory and Applications, Mathematical Inverse Problems, Minimax Theory and its Applications, Investigación Operacional, Applied Analysis and Optimization, and Vietnam Journal of Mathematics*. She also serves as one of the Editors-in-Chief at Applied Set-Valued Analysis and Optimization. It is important to mention here that she especially takes great effort in supporting newly founded journals on their way to become successful and established in the optimization community.

Her research work is highly appraised world-wide. She co-authored five monographs, which present fundamental results together with various of her many contributions in a lucid style.

As Professor at the Martin-Luther-University in Halle-Wittenberg, she has been or currently is, amongst others, vice dean for research, member of the examination committee, chairperson of the PhD panel, member of the panel of the *Stiftung Mathematik / Theoretische Physik*, organizing the monthly colloquium of the institute, organizing the correspondence circle (a project for high-school students interested in mathematics), and acting as liaison lecturer with the Rosa Luxemburg Stiftung. As chairperson of the regional association Saxony-Anhalt of the German Association of University Professors and Lecturers, Christiane, again with great dedication, represented the professional interests of university teachers in opposition to state and society. It is incredible how she manages all her commitments with the same, strong and ever growing involvement and energy.

She has been a mentor not only for her students, but also for young researchers from around the world that she met, for example, at conferences or via colleagues. Always open and helpful to anyone, it is no surprise that she is well-liked among researchers worldwide. Anyone working with her will testify what a delight she brings to any collaboration.

Christiane, together with her colleagues from Freiberg, annually organizes a workshop on set and vector optimization in the historic setting of the university library in Wittenberg, which presents a pleasant opportunity for the younger researchers to present their results and discuss them in a friendly surrounding.

Christiane's lectures, both at the university as well as research lectures at conferences and workshops, are always a delight to listen to and give much inspiration.

Most importantly, Christiane is known as a kind-hearted, generous person with a dedication for humanity. I am very thankful to her for all that she has taught me in the last 14 years, and I am looking forward the next ones. It is an absolute pleasure for me to celebrate this colloquium dedicated to her 65th birthday with Christiane and her friends.

Figure 4: Elisabeth Köbis, Christiane Tammer and Thanh Tam Le at a conference in Hokkaido, Japan

Renate Patz
Merseburg University of Applied Sciences, Germany

A life for mathematics and for a better human society

Laudatio for Christiane Tammer dedicated to her 65th birthday

It is a great pleasure for me to praise Christiane Tammer as an outstanding and amazing woman. There are the two sides of the same coin: Her life for the science and especially for mathematics and on the other side her human side, her personal qualities, her life towards a better way of working and living together.

She is known worldwide for her excellent work on the field of mathematical optimization. It is also truly important to her to contribute with the help of research in optimization to solve real problems. We experienced this when we had been worked in the 1990s at the University of Applied Sciences Merseburg on a number of projects on the field of urban and regional planning. It has to be said that it was a very special situation in East Germany at that time, resulting from the reunion of the two German states, the merging of different societies. There had been fundamental changes in all structures of society, changes in the economy, policy, education, science, in the life and work of the people. The former Technical University of Leuna-Merseburg - where Christiane studied and received her doctoral degree - was shut down in 1993. On the same campus a new university was founded in 1992, the University of Applied Sciences Merseburg in accordance with the West German higher education system. Closeness of application and a close connection to the regional economy are characteristic of these universities. The ambition of the University of Applied Sciences Merseburg was from the beginning that it should be a university with a special focus on applied research.

In the early 1990s I worked in the project group Technology Assessment. We investigated different change processes during this special time. With a project for investigating the acceptance of changes of green and open spaces of the city of Halle my activities began at the University of Applied Scíences Merseburg. There were many questions how to manage processes in the urban development in the new context. In particular, one of the problems in urban planning was the traffic problem, due to the extremely high increase of motorized individual traffic in an extremely short time period. Missing of parking lots was part of the traffic problem. One question was: It is better to reduce green areas for parking lots or to look for a suitable location for a new car park?

Christiane noted, that this is a typical example of a location problem and she suggested the multicriteria approach to describe the change and decision process as a multicriteria optimization problem. This makes it possible to consider different alternatives resulting from different criteria and weights. The corresponding algorithms developed by Christiane are used successfully to solve location problems and further problems in planning practices. It was possible to propose a way to support town planners in making decisions. The project initiator and planners recognised, that the multicriteria approach is practical way to qualify the discussion process with all involved actors with their special, usually competing interests to find the best solution. At the same time, this was also a learning process, a challenge for understanding between planners and mathematicians. For example, to transform a planning problem into a mathematical model or, on the other side, to consider real-world conditions of the concrete town in the mathematical model. Christiane was ever a good and understanding partner. Stimulated by Christiane the solution procedure was later combined with Geographical Information Systems (GIS), which were developed in cooperation with the company SCC GmbH Merseburg. With this it was possible to visualize the solutions in the map.

Further applications have been examined. Such an example was resulting from the rehabilitation and recultivation of nearly all former open-cast mines. One of the largest and well known (because of the fossil finds) is the Geiseltal not far away from city of Halle. Like most of the Central Germany's open-cast mines the Geiseltal open-cast mine was closed in the 1990s. The aim of redevelopment of former coal-mining areas was to create a solid and high-grade varied usable landscape. This means that there are created completely new landscapes by humans. A number of interests for the use of future land need to be taken into account. Where should be locations and areas for housing, working, leisure, nature etc. so that recultivation leads to an optimal development in the sense of a sustainable development of the region? Which facilities of former mining should maintain and for which purposes they could be used? Is a former machinery hall of a disused briquette factory in the Geiseltal a suitable location for a new cultural and tourist centre? This is exactly the aim of a non-profit association, to converse a former building of mining to an industrial monument. The study as a multicriteria location problem showed under what conditions this location is good. For the association it was a confirmation that it is worth fighting with commitment to preserve things which were left to us by past generations and times and that there are people like Christiane who are on the point of helping.

The collaboration with Christiane has been a very good experience for my later activity as coordinator of research and knowledge transfer at the young University of Applied Sciences Merseburg. These are experiences to know what is relevant for the management of successful research and development, how young researchers are to be promoted etc. As one of the first ones Annette Henn has concluded in 2004 successfully a cooperative doctorate procedure in the Economic Sciences Department. She investigated the management of land use under aspects of nature protection, social concerns and economic efficiency. She received important informations from Christiane for the mathematical modelling and investigation of decision-making processes containing a number of criteria and in cases of differing interests. Another good example of the influence of Christiane is that she knows how important it is in science to make the results public. She offers us the opportunity to present our results and experiences of the application of location optimization and methods of decision support on national and international conferences.

Well, that is all a long time ago, but linked with sustainable effects and many wonderful memories. Christiane is an extraordinary and amazing woman. She paved the way for many people and projects through her profundly and untiring work in science. She stands for deep knowledge and high degree of various interests, passion on art and culture, nature and gardening, sports activities such as swimming, skiing, hiking or biking. During the lengthy time - since the 1970s we know each other – it has developed a close friendship. I have seen how important to her are work and mathematics just like family and friends, how good and loving she was to her parents and to her son. She is also known for her respect, steady helpfulness, compassion, especially for those people who are disadvantaged.

Christiane is herself the proof of the fact that mathematics is not just an abstract or vague theory but rather is of great practical benefit, and how much mathematicians can achieve for humans being. Her understanding and support for voluntary work is encouragement for their doing. On this way these initiatives get acknowledgement and appreciation by important persons like Christiane. Our society needs urgently more motivated persons of integrity like Christiane.

Dear Christiane, thank you so much for all, for your dedication and friendship. I wish you all the best for upcoming time, health, optimism, energy, always a good life.

Many thanks also to the organizers of the ICVANO conference, it is a wonderful occasion to praise Christiane.

Renate Patz

July 2021

Franco Giannessi
Department of Mathematics, University of Pisa, Pisa, Italy

Some Remarks on Bad Convex Functions

Dedicated to Professor Christiane Tammer on the occasion of her 65th birthday

Abstract: This note deals shortly with some questions about a class of convex functions, which have a special behaviour and which have been named bad.

1. A Question

Let $f : \mathbb{R}^n \to \mathbb{R}$, with $n \geq 2$, be a convex function, and set:

$$x(t) = (t, 0 \ldots, 0), \quad \text{with } t \in \mathbb{R}. \tag{1}$$

Assume that, $\forall t > 0$, the gradient $\bigtriangledown f(x(t))$ exists. The question consists in asking whether there exist functions f, such that the following

$$\lim_{t \downarrow 0} \bigtriangledown f(x(t)) \tag{2}$$

does not exist. The question appeared in [1]. Ennio De Giorgi was the first to answer in the affirmative, constructing a function f, without demonstration (see [2] for historical details); it, together with another function f, was given a few later by Tyrrell Rockafellar; both facts have been published in [3]. Independently of them and of each other, other mathematicians have discovered further functions f, naming them *bad convex functions*; see, e.g., [4].
Several questions are still open. When dealing with numerical methods, perhaps, to have to deal with a bad convex function might be unpleasant. Therefore, a condition for a convex function to be bad would be desirable. Beginning with the convex hull of those already discovered, it might be useful to estimate the measure of the set of bad convex functions.
What happens if $x(t)$ is a curve, having the origin as endpoint, but being not necessarily a ray? Do such functions, with $x(t)$ a ray or not, exist, if we pose ourselves in infinite dimensional spaces?

2. A Further Question

Let $f : \mathbb{R}^n \to \mathbb{R}$, with $n \geq 2$, be as above and consider again (1). Let H denote the Hessian. Now assume that, $\forall t > 0$, both $\bigtriangledown f(x(t))$ and $\mathrm{Hf}(x(t))$ exist. May a function f exist, such that both limits (2) and

$$\lim_{t \downarrow 0} \mathrm{Hf}(x(t)) \tag{3}$$

do not exist? The question extends naturally to higher orders. Restricting ourselves to analytic functions, the case of infinite orders might be treatable. All the questions of the previous section can be considered here too. Recently [5], Dariusz Zagrodny has made very interesting insights and observed that answers to the above questions might help with other pending questions, known in the literature; e.g., Klee's problems: the convexity of Chebyshev sets and farthest point conjecture; Borwein's question on the Alexandrov Theorem in infinite dimensions.

References

[1] F. Giannessi, A Problem in Convex Functions, JOTA, Vol.59, No.5, 1988, p.525.

[2] M. Théra, "Every mathematician can do a true theorem. Only a genius can make an important mistake" (interview). JOTA Special Issue on "Optimization, Variational Analysis and Applications". To appear.

[3] R.T. Rockafellar, On a Special Class of Convex Functions, JOTA, Vol.70, No.3, 1991, pp.619–621.

[4] D. Zagrodny, An example of Bad Convex Function, JOTA, Vo.70, No.3, 1991, pp.631–637.

[5] D. Zagrodny, "The strong convergence of subgradients of convex functions along directions, perspectives and open problems", JOTA, Vol. 178, No. 2, 2018

General information

Organizing Committee

Rosalind Elster (Halle, Germany)
Christian Günther (Martin Luther University Halle-Wittenberg, Germany)
Akhtar A. Khan (Rochester Institute of Technology, USA)
Elisabeth Köbis (Norwegian University of Science and Technology, Norway)
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If you have any questions please do not hesitate to contact us:

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Event information

Information for participants

Information about this event will be posted here:

`https://wiki.math.ntnu.no/icvano2021/start`.

The conference will take place online via zoom, and the link will be sent to all the participants.

Information for speakers

All speakers will have 30 minutes per talk. Please note that the lecture times as given in the program already include some minutes for discussion. Session chairs will make sure that speakers do not exceed their allocated time.

1st ICVANO day: Thursday, July 15, 2021

Time (CEST)	Activity information
08:45 - 09:00	Opening
09:00 - 09:45	**Laudations**
09:45 - 10:00	Short break
	Session 1 (Chair: Juan Enrique Martínez Legaz)
10:00 - 10:30	**Juan Enrique Martínez Legaz**: *Closed convex sets with an open or closed Gauss range*
10:35 - 11:05	**Marius Durea**: *Some issues on stability of Pareto efficiency*
11:10 - 11:40	**Xiaoqi Yang**: *Lipschitz-like property relative to a set and the generalized Mordukhovich criterion*
11:40 - 12:40	Break
	Session 2 (Chair: Johannes Jahn)
12:40 - 13:10	**Johannes Jahn**: *Lagrange theory of discrete-continuous optimization*
13:15 - 13:45	**Gemayqzel Bouza Allende**: *A steepest descent-like method for solving variable order vector optimization problems*
13:50 - 14:20	**Kathrin Klamroth**: *Finding Optimal Locations Under Uncertainties: A Multi-Objective Perspective*
14:20 - 14:45	Coffee break
	Session 3 (Chair: Wilfried Grecksch)
14:45 - 15:15	**Wilfried Grecksch**: *An Optimal Control Problem for a Nonlinear Stochastic Schrödinger Equation*
15:20 - 15:50	**Miguel Sama**: *A Convex Optimization Framework for the Inverse Problem of Identifying a Random Parameter in a Stochastic Partial Differential Equation*
15:55 - 16:25	**Hannelore Lisei**: *ε-Optimal Solutions for a Class of Stochastic Control Problems Involving Schrödinger Equations*
16:30 - 17:00	**Marcel Marohn**: *Recent results on risk measures and acceptance sets*
17:00 -	Closing

2nd ICVANO day: Friday, July 16, 2021

Time (CEST)	Activity information
09:00 - 09:15	Welcome
	Session 4 (Chair: Alexander Kruger)
09:15 - 09:45	**Alexander Kruger**: *Error bounds revisited*
09:50 - 10:20	**Radu Strugariu**: *On directional regularity with respect to fixed sets*
10:25 - 10:55	**César Gutiérrez**: *Existence conditions for weak efficient solutions in vector optimization*
10:55 - 11:20	Coffee break
	Session 5 (Chair: Constantin Zălinescu)
11:20 - 11:50	**Constantin Zălinescu**: *On relatively solid convex cones in real linear spaces*
11:55 - 12:25	**Bahareh Khazayel**: *Vector optimization w.r.t. relatively solid convex cones in real linear spaces*
12:30 - 13:00	**Nicolae Popovici**: *A new concept of semistrict quasiconvexity for vector functions*
13:00 - 14:00	Break
	Session 6 (Chair: Boris Mordukhovich)
14:00 - 14:30	**Boris Mordukhovich**: *Varational Analysis in Numerical Optimization*
14:35 - 15:05	**Andreas Löhne**: *Approximate vertex enumeration*
15:10 - 15:40	**Joydeep Dutta**: *The Proximal Gradient Method for Convex Multiobjective Optimization Problem using Bregman distance*
15:40 - 16:00	Coffee break
	Session 7 (Chair: Bao Truong)
16:00 - 16:30	**Bao Truong**: *Ekeland variational principles in vector optimization with domination set*
16:35 - 17:05	**Pradeep Kumar Sharma**: *Some Properties of Generalized Oriented Distance Function and their Applications on Set-valued Saddle-point Problems*
17:10 - 17:40	**Ernest Quintana**: *Solving Nonconvex Set Optimization Problems with a Vectorization Scheme*
17:40 -	Closing

Abstracts of the speakers

Thursday, July 15, 2021

Juan Enrique Martínez Legaz (Thu, 10:00 - 10:30)

Autonomous University of Barcelona, Spain

▷ **Closed convex sets with an open or closed Gauss range**

In this joint work with Cornel Pintea, we characterize the closed convex subsets of the Euclidean space that have open or closed Gauss ranges. We pay special attention to epigraphs of lower semicontinuous convex functions.

Marius Durea (Thu, 10:35 - 11:05)

Alexandru Ioan Cuza University of Iasi, Romania

▷ **Some issues on stability of Pareto efficiency**

We present some situations when the limit of Pareto minima of a sequence of perturbations of a set-valued map F is a critical point of F. The concept of criticality is understood in the Fermat generalized sense, by means of Mordukhovich coderivative. On the one hand, we consider perturbations of enlargement type and on the other hand, we present the case of Lipschitz-like perturbations.

Xiaoqi Yang (Thu, 11:10 - 11:40)

Hong Kong Polytechnic University, Hong Kong/China

▷ **Lipschitz-like property relative to a set and the generalized Mordukhovich criterion**

In this paper we will establish some necessary condition and sufficient condition respectively for a set-valued mapping to have the Lipschitz-like property relative to a closed set by employing regular normal cone and limiting normal cone of a restricted graph of the set-valued mapping. We will obtain a complete characterization for a set-valued mapping to have the Lipschitz-property relative to a closed and convex set by virtue of the projection of the coderivative onto a tangent cone. Furthermore, by introducing a projectional coderivative of set-valued mappings, we establish a verifiable generalized Mordukhovich criterion for the Lipschitz-like property relative to a closed and convex set. We will study the representation of the graphical modulus of a set-valued mapping relative to a closed and convex set by using the outer norm of the corresponding projectional coderivative value. For an extended real-valued function, we will apply the obtained results to investigate its Lipschitz continuity relative to a closed and convex set and the Lipschitz-like property of a level-set mapping relative to a half line.

This is a joint work with Meng K.W., Li M.H. and Yao W.F.

Johannes Jahn (Thu, 12:40 - 13:10)

University of Erlangen-Nürnberg, Germany

▷ **Lagrange theory of discrete-continuous optimization**

In this talk a new Lagrange theory of discrete-continuous conic optimization is presented in an infinite dimensional setting. Optimization problems with discrete and continuous variables are much more complicated than standard problems of continuous optimization. The following questions are answered for these discrete-continuous optimization problems: How to define a Lagrange functional, how Karush-Kuhn-Tucker conditions look like, and which duality results can be obtained? This approach is based on a new kind of separation theorems for discrete sets, which are also given in this talk. The presented theory is published in [2] and the presentation follows the lines of Chapter 8 in [1].

[1] J. Jahn: Introduction to the Theory of Nonlinear Optimization (4th edition, Springer, Cham, 2020).

[2] J. Jahn and M. Knossalla: Lagrange theory of discrete-continuous nonlinear optimization, J. Nonlinear Var. Anal. 2 (2018) 317–342.

Gemayqzel Bouza Allende (Thu, 13:15 - 13:45)

University of Havana, Cuba

▷ **A steepest descent-like method for solving variable order vector optimization problems**

In some applications, the comparison between two elements may depend on the point, leading to the so called variable order structure. Optimality concepts has been extended to this more general framework and scalarizing functions have been an important tool for characterizing the solutions of this optimization problem.
In this paper, we propose a steepest descent-like method for solving smooth unconstrained vector optimization problem under a variable ordering structure. At each step, descent directions are computed using scalarizations. We will discuss the convergence of the approach for computing minimizers and non dominated solutions for approaches defined by different scalarizations. Examples comparing the numerical behavior of the approaches defined by scalarizations as those studied in [1], [2], [3].

This contribution is gathers together part of the joint work with Christiane Tammer.

[1] C. Gerth and P. Weidner. Nonconvex separation theorems and some applications in vector optimization. J. Optim. Theory Appl., 67(2):297–320, 1990.

[2] L. M. Graña Drummond and B. F. Svaiter. A steepest descent method for vector optimization. J. Comput. Appl. Math., 175(2):395–414, 2005.

[3] J.-B. Hiriart-Urruty. New concepts in nondifferentiable programming. Bull. Soc. Math. France Mem., (60):57–85, 1979. Analyse non convexe (Proc. Colloq., Pau, 1977).

Kathrin Klamroth (Thu, 13:50 - 14:20)

University of Wuppertal, Germany

▷ **Finding Optimal Locations Under Uncertainties: A Multi-Objective Perspective**

Location decisions are typically long-term decisions that involve relatively high installation costs. Knowledge about future developments, for example, of demands and of the environmental conditions, are thus highly important in this context. We consider location problems under different scenarios w.r.t. demands and weights, and w.r.t. potential candidate sites and the feasible region for new locations.
The trade-off between the cost of a solution on one hand and its robustness with respect to the uncertain data on the other hand is analyzed, which naturally motivates a multiple objective formulation of the problem. A two-stage stochastic programming model is obtained as a scalarization of the multiple objective model, and the relations to associated single-objective location problems are discussed. From a more general perspective, we discuss *deterministic multi-objective* counterparts for *uncertain single objective* optimization problems with finite scenario sets and show how classical concepts from robust optimization and stochastic programming can be interlinked through this approach.

This talk is based on recent joint works with Markus Kaiser, Elisabeth Köbis, Anita Schöbel and Christiane Tammer.

Wilfried Grecksch (Thu, 14:45 - 15:15)

Martin Luther University Halle-Wittenberg, Germany

▷ **An Optimal Control Problem for a Nonlinear Stochastic Schrödinger Equation**

An optimal control problem for a nonlinear stochastic Schrödinger equation is considered, where the noise process is a linear multiplicative fractional Brownian motion with Hurst index $1/2 < h < 1$. The noise structure is chosen so that a transformation into a pathwise integral equation and a stochastic process can be used. An optimality condition of maximum principle type is proven by using of the theory of stochastic Itô Volterra backward integral equations and variational techniques.

This talk is based on a joint work [1] with Hannelore Lisei.

[1] W. Grecksch, H. Lisei: Stochastic Schrödinger Equations, in: W. Grecksch, H. Lisei (Editors): Infinite Dimensional and Finite Dimensional Equations and Applications in Physics. World Scientific Publishing Co. Pte. Ltd. 2020, 115-160.

Miguel Sama (Thu, 15:20 - 15:50)

National Distance Education University Madrid, Spain

▷ **A Convex Optimization Framework for the Inverse Problem of Identifying a Random Parameter in a Stochastic Partial Differential Equation**

This talk is based in the recent paper with Prof. Tammer [Jadamba, J., Khan, A.A., Sama, M., Starkloff, H-J., Tammer, C. (2021). *A Convex Optimization Framework for the Inverse Problem of Identifying a Random Parameter in a Stochastic Partial Differential Equation.* SIAM/ASA Journal on Uncertainty Quantification. 9(2):922–952]. The primary objective of the talk is to study the inverse problem of identifying a stochastic parameter in partial differential equations with random data.

In the framework of stochastic Sobolev spaces, we consider two optimization based methods: a standard output least-squares (OLS) objective functional and a new energy-norm based modified output least-squares (ELS) objective functional. We study existence, stability and differentiabilty results for the considered optimization problems. Futhermore we obtain a computational framework by using the stochastic Galerkin discretization scheme and derive explicit discrete formulas for the considered objective functionals and their gradient. Finally, we present a numerical example showing the feasibility of the proposed framework.

Hannelore Lisei (Thu, 15:55 - 16:25)

Babeş-Bolyai University Cluj-Napoca, Romania

▷ **ε-Optimal Solutions for a Class of Stochastic Control Problems Involving Schrödinger Equations**

We study ε-optimal solutions of a nonconvex control problem associated to a Schrödinger equation driven by a cylindrical Wiener process. The existence of ε-optimal solutions is investigated by using two methods: a finite dimensional approximation and a linearization method.

Marcel Marohn (Thu, 16:30 - 17:00)

Martin Luther University Halle-Wittenberg, Germany

▷ **Recent results on risk measures and acceptance sets**

Risk measures with respect to acceptance sets have been studied in financial mathematics for a long time (see Artzner et al. [1])). Financial institutions face many different risks like market risk or credit risk. Consequently, there are many different ways of measuring and, thus, managing risk. Moreover, there is an one-to-one-correspondence between monetary risk measures and acceptance sets, see [1] and [4]. Portfolio optimization is one of the oldest financial mathematical problems. The modern portfolio theory traces back to Markowitz from 1952 (see [6]), where returns are measured by the expected value and risk is measured by standard deviation. Since then many extensions like CAPM have arisen. For instance, general risk measures instead of standard deviation are considered in the literature.

In recent years extended regulatory preconditions like Basel III have much more influence on measuring and managing risk then ever before. One origin can be found in the massive failures of banks and misbehavior of financial institutions in dealing with risk, which have been revealed during the financial crisis 2007 and afterwards. Thinking of the risk-return-trade-off, there result also restrictions in generating returns by more restrictions in risk-taking through intense regulatory influence. Thus, it is more important than ever for institutions to find optimal portfolios.

Our studies are motivated by Baes et al. in [2] and Farkas et al. in [3]. Let $\mathcal{X}$ be a space of capital positions, $\emptyset \neq \mathcal{A} \subseteq \mathcal{X}$ be an acceptance set representing the regulatory preconditions, $\mathcal{M} \subseteq \mathcal{X}$ be a subspace of $\mathcal{X}$ describing the payoffs which result through possible investments into given eligible assets and $\pi\colon \mathcal{M} \to \mathbb{R}$ be a pricing functional on $\mathcal{M}$. The optimization problem from interest is to "reach acceptability" under minimal costs, i.e., for a given initial position $X \in \mathcal{X}$, we minimize

$$\mathcal{X} \mapsto \rho_{\mathcal{A},\mathcal{M},\pi}(X) := \{\pi(Z) \mid Z \in \mathcal{M}, X + Z \in \mathcal{A}\}. \tag{4}$$

The resulting solution set is

$$\mathcal{E}(X) := \{Z \in \mathcal{M} \mid X + Z \in \mathcal{A}, \pi(Z) = \rho_{\mathcal{A},\mathcal{M},\pi}(X)\}. \tag{5}$$

In this talk, we state some properties of the risk measure in (4) and the solution set in (5), which are results from our papers [7] and [8]. For example, $\rho_{\mathcal{A},\mathcal{M},\pi}$ can be reduced to a nonlinear translation invariant functional $\varphi_{\mathcal{A},K} : \mathcal{X} \to \mathbb{R} \cup \{-\infty\} \cup \{+\infty\}$ from type

$$\varphi_{\mathcal{A},K}(X) := \inf\{t \in \mathbb{R} \mid X \in tK + \mathcal{A}\} \tag{6}$$

with $K \in \mathcal{X}\backslash\{0\}$ such that $\mathcal{A} - \mathbb{R}_+ K \subseteq \mathcal{A}$. Functionals like (6) are used by Gerstewitz in [5] as scalarization functional of vector optimization problems or for deriving separation theorems. It is well known that scalarization and separation of sets are important topics in a wide field of research, including multiobjective optimization, optimization under uncertainty, financial mathematics and risk theory. At the end of the presentation, we state some remarks about efficient points of the acceptance set $\mathcal{A}$.

[1] P. Artzner, F. Delbaen, J.-M. Eber, and D. Heath, *Coherent Measures of Risk*, Mathematical Finance, 9 (1999), pp. 203–228.

[2] M. Baes, P. Koch-Medina, and C. Munari, *Existence, uniqueness, and stability of optimal payoffs of eligible assets*, Mathematical Finance, 30 (2020), pp. 128–166.

[3] W. Farkas, P. Koch-Medina, and C. Munari, *Measuring risk with multiple eligible assets*, Mathematics and Financial Economics, 9 (2015), pp. 3–27.

[4] H. Föllmer and A. Schied, *Stochastic finance: An introduction in discrete time*, vol. 27 of De Gruyter studies in mathematics, de Gruyter, Berlin, 3. rev. and extended ed. ed., 2011.

[5] C. Gerstewitz, *Beiträge zur Dualitätstheorie der nichtlinearen Vektoroptimierung [Contributions to duality theory in nonlinear vector optimization]: PhD Thesis*, 1984.

[6] H. Markowitz, *Portfolio Selection*, The Journal of Finance, 7 (1952), p. 77.

[7] M. Marohn and C. Tammer, *Efficient Points of Acceptance Sets*, Applied Analysis and Optimization, 4 (2020), pp. 79–114.

[8] M. Marohn and C. Tammer, *A new view on risk measures associated with acceptance sets*, Applied Set-Valued Analysis and Optimization, 3 (2021 (upcoming)).

Friday, July 16, 2021

Alexander Kruger (Fr, 09:15 - 09:45)

Federation University Australia, Australia

▷ **Error bounds revisited**

We propose a unifying general framework of quantitative primal and dual sufficient error bound conditions covering linear and nonlinear, local and global settings. We expose the roles of the assumptions involved in the error bound assertions, in particular, on the underlying space: general metric, Banach or Asplund. Employing special collections of slope operators, we introduce a succinct form of sufficient error bound conditions, which allows one to combine in a single statement several different assertions: nonlocal and local primal space conditions in complete metric spaces, and subdifferential conditions in Banach and Asplund spaces. In the nonlinear setting, we cover both the conventional and the 'alternative' error bound conditions. It is a joint work with Nguyen Duy Cuong (Federation University).

The talk is based on the paper:

[1] N. D. Cuong and A. Y. Kruger, Error bounds revisited, arXiv: 2012.03941 (2020).

Radu Strugariu (Fr, 09:50 - 10:20)

Gheorghe Asachi Technical University Iasi, Romania

▷ **On directional regularity with respect to fixed sets**

In this talk we present directional regularities and subregularities of mappings with respect to fixed sets. We establish a result concerning the preservation of global directional regularity at composition, and on this base we deduce a directional variant of Lim's lemma. Finally, some applications to the study of directional regularity of the solutions of differential inclusions are given.

César Gutiérrez (Fr, 10:25 - 10:55)

IMUVA (Mathematics Research Institute - University of Valladolid), Spain

▷ **Existence conditions for weak efficient solutions in vector optimization**

The talk focuses on the existence of weak efficient solutions of a vector optimization problem. Specifically, coercive and noncoercive existence results as well as a Weierstrass-type theorem are stated. They are obtained by a scalarization approach based on the well-known Gerstewitz's functional, some closedness, boundedness and compactness properties of colevel sets of the objective function and a simple regularization in the noncoercive case.

This talk is based on a joint work with Rubén López.

Constantin Zălinescu (Fr, 11:20 - 11:50)

Alexandru Ioan Cuza University Iasi, Romania

▷ **On relatively solid convex cones in real linear spaces**

Having a convex cone K in an infinite-dimensional real linear space X, Adan and Novo stated (see-https://doi.org/10.1023/B:JOTA.0000037602.13941.ed) that the relative algebraic interior of K is nonempty if and only if the relative algebraic interior of the positive dual cone of K is nonempty. Khazayel et al. observed (see http://www.optimization-online.org/DB_HTML/2019/08/7349.html) that the preceding equivalence seems to be not valid. It is our aim to show that the direct implication is not true even if K is closed with respect to the finest locally convex topology on X, and that the converse is true if the algebraic interior of the positive dual cone of K is nonempty.

Bahareh Khazayel (Fr, 11:55 - 12:25)

Martin Luther University Halle-Wittenberg, Germany

▷ **Vector optimization w.r.t. relatively solid convex cones in real linear spaces**

In vector optimization, it is of increasing interest to study problems where the image space (a real linear space) is preordered by a not necessarily solid (and not necessarily pointed) convex cone. It is well-known that there are many examples where the ordering cone of the image space has an empty (topological / algebraic) interior, for instance in optimal control, approximation theory, duality theory. Our aim is to consider Pareto-type solution concepts for such vector optimization problems based on the intrinsic core notion (a well-known generalized interiority notion). We propose a new Henig-type proper efficiency concept based on generalized dilating cones which are relatively solid (i.e, their intrinsic cores are nonempty). Using linear functionals from the dual cone of the ordering cone, we are able to characterize the sets of (weakly, properly) efficient solutions under certain generalized convexity assumptions.

This talk is based on joint works with Ali Farajzadeh, Christian Günther and Christiane Tammer.

Nicolae Popovici (Fr, 12:30 - 13:00)

Babeş-Bolyai University Cluj-Napoca, Romania

▷ **A new concept of semistrict quasiconvexity for vector functions**

We present a new concept of semistrict quasiconvexity for vector functions defined on a nonempty convex set from some real linear space X taking values in a real topological linear space Y, partially ordered by a proper solid convex cone C. The so-called semistrict C-quasiconvexity recovers the classical concept of semistrict quasiconvexity of scalar functions when $Y = \mathbb{R}$ and $C = \mathbb{R}_+$. Moreover, similarly to the scalar case, whenever C is closed, a vector function is both semistrictly C-quasiconvex and C-quasiconvex if and only if it is explicitly C-quasiconvex. We characterize the semistrictly/explicitly C-quasiconvex functions by means of linear transformations and the nonlinear scalarization functions introduced by Christiane Tammer.

This talk is based on a joint work with Christian Günther.

Boris Mordukhovich (Fr, 14:00 - 14:30)

Wayne State University, USA

▷ **Varational Analysis in Numerical Optimization**

In this lecture we discuss recent applications of advanced variational analysis and generalized differentiation to the design, justification of numerical algorithms of nonsmooth optimization with applications to practical modeling. Our main attention is paid to developing generalized Newton-type algorithms to solve nonsmooth optimization problems and subgradient systems that are based mainly on constructions and results of second-order variational analysis. Solvability of these algorithms is proved in rather broad settings, and then verifiable conditions for their local and global superlinear convergence are obtained. We consider in more detail problems convex composite optimization for which a generalized damped Newton algorithm exhibiting global superlinear convergence is designed. The efficiency of the designed algorithm is demonstrated by solving a class of Lasso problems that are well-recognized in applications to machine learning and statistics. For this class of nonsmooth optimization problems, we conduct numerical experiments and compare the obtained results with those achieved by using other first-order and second-order methods.

This talk is based on recent joint works with P. D. Khanh (HCMUE, Vietnam), V. T. Phat (WSU), M. E. Sarabi (Miami Univ., USA), and D. B. Tran (WSU).

Andreas Löhne (Fr, 14:35 - 15:05)

Friedrich Schiller University Jena, Germany

▷ **Approximate vertex enumeration**

Convex polytopes are not necessarily finite sets but they can be finitely represented. Thus they play an important role for various types of set computations, for instance in set optimization. Most of the computational techniques for polytopes rely in some sense on vertex enumeration, which means to compute the vertices of a polytope which is given by (finitely many) linear inequalities. The inverse problem, which is equivalent by polarity, is called convex hull problem. In practice it is quite common to implement vertex enumeration and convex hull methods by using floating point arithmetic. However, in most situations there is no proof of correctness of the methods when inexact arithmetic is used. In particular, there is no correct floating point algorithm known for polytopes of dimension larger than 3.
We demonstrate by examples that inexact computations can produces results which are far away from the correct ones. We present an approximate vertex enumeration method, which is shown to be correct for polytopes of dimension 2 and 3. We discuss why a generalization to any higher dimension is, if possible, not trivial.

Joydeep Dutta (Fr, 15:10 - 15:40)

Indian Institute of Technology Kanpur, India

▷ **The Proximal Gradient Method for Convex Multiobjective Optimization Problem using Bregman distance**

In this talk we focus on a multiobjective optimization problem which is unconstrained consisting of convex objective functions. The key idea is to develop a descent algorithm for solving this problem paralleling what is done in single objective optimization. The direction is descent here is computed using a step which is motivated by the proximal gradient algorithm for scalar convex optimization. One of the major changes that our work has from the existing literature is the use of Bregman distance rather than the Euclidean one. This not only provides more flexibility in applications but also provides a theoretical challenge specially in proving the convergence of the descent algorithm which we have attempted to address in this work. We shall provide a presentation of our approach and the main results including the convergence theorem and also present numerical examples based on Bregman distances induced by different types of strict convex functions.

This talk is based on a joint work with Dr. M. A. T. Ansary.

Bao Q. Truong (Fr, 16:00 - 16:30)

Northern Michigan University, USA

▷ **Ekeland variational principles in vector optimization with domination set**

This talk presents vectorial versions of Ekeland variational principle in vector optimization with domination set and domination structure. They are derived by using the scalarization approach used in Tammer C. A generalization of Ekeland's variational principle. Optimization 5(1992)129-141. Several results in the literature are improved since they are stated by weaker assumptions. Illustrated examples are presented.

Pradeep Kumar Sharma (Fr, 16:35 - 17:05)

University of Delhi, India

▷ **Some Properties of Generalized Oriented Distance Function and their Applications on Set-valued Saddle-point Problems**

In this talk, we present several interesting basic properties of generalized oriented distance function with respect to co-radiant sets or free disposal sets, which are more general than a cone and play an important role to study quasi-minimal solutions of set optimization problems. In particular, we deal with some special properties, namely, translation property, subadditivity, and monotonicity, by using co-radiant sets. Moreover, we investigate several kinds of monotonicity properties by means of nonconvex free disposal sets. As an application, we present an existence theorem for cone saddle-point for set-valued maps. Several examples will be given to verify the validity and effectiveness of the derived results.

Ernest Quintana (Fr, 17:10 - 17:40)

Technical University Ilmenau, Germany

▷ **Solving Nonconvex Set Optimization Problems with a Vectorization Scheme**

In this talk, we consider a solution approach for set optimization problems with respect to the lower set less relation. In the first part of the talk, we derive a parametric family of vector optimization problems whose solution sets approximate, in a specific sense, that of the set-valued problem with arbitrary accuracy. In the second part, we examine particular classes of set-valued mappings for which the corresponding set optimization problem is equivalent to a vector optimization problem in the previously generated family. Further applications of these results are also discussed.

List of participants (44 participants, 22 speakers)

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▷ A steepest descent-like method for solving variable order vector optimization problems (July 15, 13:15 - 13:45)

DUREA, Marius

Alexandru Ioan Cuza University of Iasi, Romania
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▷ On directional regularity of mappings and applications to optimization (July 15, 10:35 - 11:05)

DUTTA, Joydeep

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▷ The Proximal Gradient Method for Convex Multiobjective Optimization Problem using Bregman distance (July 16, 15:10 - 15:40)

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▷ An Optimal Control Problem for a Nonlinear Stochastic Schrödinger Equation (July 15, 14:45 - 15:15)

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▷ Existence conditions for weak efficient solutions in vector optimization (July 16, 10:25 - 10:55)

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▷ Lagrange theory of discrete-continuous optimization (July 15, 12:40 - 13:10)

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▷ Vector optimization w.r.t. relatively solid convex cones in real linear spaces (July 16, 11:55 - 12:25)

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▷ Finding Optimal Locations: Continuous and Discrete Models, and Personal Preferences (July 15, 13:50 - 14:20)

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▷ Error bounds revisited (July 15, 09:15 - 09:45)

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▷ ε-Optimal Solutions for a Class of Stochastic Control Problems Involving Schrödinger Equations (July 15, 15:55 - 16:25)

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▷ Approximate vertex enumeration (July 16, 14:35 - 15:05)

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▷ Recent results on risk measures and acceptance sets (July 15, 16:30 - 17:00)

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▷ Closed convex sets with an open or closed Gauss range (July 15, 10:00 - 10:30)

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▷ Varational Analysis in Numerical Optimization (July 16, 14:00 - 14:30)

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▷ A new concept of semistrict quasiconvexity for vector functions (July 16, 12:30 - 13:00)

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▷ Solving Nonconvex Set Optimization Problems with a Vectorization Scheme (July 16, 17:10 - 17:40)

SAMA, Miguel

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▷ A Convex Optimization Framework for the Inverse Problem of Identifying a Random Parameter in a Stochastic Partial Differential Equation (July 15, 15:20 - 15:50)

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▷ Some Properties of Generalized Oriented Distance Function and their Applications on Set-valued Saddle-point Problems (July 16, 16:35 - 17:05)

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▷ On directional regularity with respect to fixed sets (July 16, 09:50 - 10:20)

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▷ Ekeland variational principles in vector optimization with domination set (July 16, 16:00 - 16:30)

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▷ Lipschitz-like property relative to a set and the generalized Mordukhovich criterion (July 15, 11:10 - 11:40)

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▷ On relatively solid convex cones in real linear spaces (July 16, 11:20 - 11:50)

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