Heinz Langer

Preface

In this volume we present a collection of research papers which mainly follow lectures given at the 'Colloquium on Operator Theory'. This conference was held at the Vienna University of Technology in March 2004 on the occasion of the retirement of Heinz Langer. The present volume of the series 'Operator Theory: Advances and Applications' is dedicated to him and his scientific work.

The book starts with an introductory part which provides some information about the colloquium itself. We have also included the laudatory speech given by Aad Dijksma and a list of the recent publications of Heinz Langer, which updates his biblibography given in OT-106. The main part of the book consists of fifteen original research papers which deal with various aspects of operator theory and indefinite inner product spaces. It concludes with a historical survey on the theory of positive definite functions.

It would not have been possible to bring together so many colleagues in Vienna without financial support provided by several organizations. We wish to thank the

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and everybody who has contributed to make this conference and this book possible. Our special thanks also go to the referees who did a lot of work and in some cases made valuable and essential suggestions that decisively improved the quality of the papers. Photos were provided by Dr.Mathias Beigelböck (conference photo) and ??? (photo of Heinz Langer).

As organizers of the 'Colloquium on Operator Theory' it was a great pleasure for us that so many colleagues participated in the conference; as editors of the present volume we are happy that a large part of them decided to contribute to these proceedings. We greatly acknowledge the interesting experience of this work.

Matthias Langer, Annemarie Luger, Harald Woracek
(the editors)

Vienna, July 2005

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Laudatory speech

By Aad Dijksma, Vienna, March 4, 2004

Dear Vice-Rector Kaiser, Dean Dorninger, and Professor Inge Troch, dear Heinz, dear colleagues, Ladies and Gentlemen.

Introduction

Heinz Langer is a world leading expert in spectral analysis and its applications, in particular in operator theory on spaces with an indefinite inner product. He has moved mathematical boundaries and opened new areas of research. He has the talent to focus on what is fundamental and to give directions to what is possible. By sharing his ideas he has stimulated many to explore unknown mathematical territory. Heinz is co-author of a book with M.G. Krein and I.S. Iokhvidov and he has published more than 170 papers with 45 co-authors from all over the world. He has directed the research of about 25 Ph.D. students. His results are still being applied and quoted in international journals in mathematics and theoretical physics. As one of his collaborators I can attest to the fact that Heinz is still very active.

When the organizers of this workshop invited me to give this laudatory speech I immediately said yes. I deem it an honor to pay tribute to Heinz. Not only because I admire his work, but also because I have learned a lot from him and still do and because I consider him a close friend. I feel privileged and pleased to speak on this occasion. First I will outline Heinz's biography and highlight his successful years at the Vienna University of Technology. Then I will try to clarify what I meant when I said that Heinz has moved mathematical boundaries and opened new areas of research by discussing some of the main themes in his work. Finally, I will speak about Heinz's connection with The Netherlands and especially with Groningen.

Biography

Heinz Langer was born in Dresden on August 8, 1935. He lived in Dresden for almost 55 years. He attended the Gymnasium there, studied mathematics at the Technical University of Dresden, where he became an assistant and where he obtained his Ph.D. in 1960 and his Habilitation in 1965. He was appointed professor in mathematics at his Alma Mater in 1966, at the age of 31. At that time there was officially no research group in analysis, let alone functional analysis, so Heinz joined the group in stochastics headed by his Ph.D. advisor Prof. P.H. Müller. He did research in and lectured on semigroups, one-dimensional Markov processes, and the spectral theory of Krein-Feller differential operators, but with Ph.D. students and colleagues from abroad he could work in his favorite topic: operator theory. Heinz declined a position at the prestigious Mathematical Institute of the

Academy of Sciences of the GDR, because he liked to teach and to work with Ph.D. and post-doctoral students.

At the beginning of his career Heinz spent two years abroad, first as a post-doc in Odessa in 1961/62 upon the invitation of M.G. Krein and later in 1966/67, shortly after his appointment as professor, on a fellowship of the National Research Council of Canada which was arranged by Professor I. Halperin in Toronto. The contact with Krein began with Heinz posting a handwritten manuscript in German, in the mailbox at the central station of Dresden on December 31, 1959. I will say more about the contents of the manuscript when I speak about the main themes in Heinz's work. The subsequent stay in Odessa and the many shorter visits after that had a tremendous influence on Heinz, his career in mathematics, and, I think, on his style of doing mathematics. When Heinz mentions Krein it is with great affection and respect, and I know that Krein thought of Heinz as one his most brilliant students and collaborators.

In between the two trips abroad Heinz had married Elke and in May 1967 their daughter Henriette was born.

In the 1970's and 1980's Heinz spent several extended periods away from home in, for example, Jyväskylä, Stockholm, Uppsala, Linköping, Antwerp, Groningen, Amsterdam, and Regensburg. In all these places Heinz left his mark. He established some form of research co-operation, set up Ph.D. projects and made it possible for students and colleagues to come to Dresden. My account on Heinz's connection with Groningen later on serves as an example of his stimulating influence on other mathematicians. Heinz remained in Dresden until 1989. In October of that year, shortly before the fall of the Berlin wall, he and his family gave up hearth and home, left the GDR and went to Regensburg. Turbulent times followed. Thanks to Albert Schneider Heinz obtained a professorship for one year at the University of Dortmund. After that year, with the support of Reinhard Mennicken, Heinz became professor at the University of Regensburg. Finally, in August 1991, Heinz moved to Vienna where he began a new and successful period in his life and in his mathematical career.

Heinz was offered the prestigious chair 'Anwendungsorientierte Analysis' at the Vienna University of Technology, previously held by Professor Edmund Hlawka, but under a different name. The University could hardly have found a more worthy successor. For several years Heinz was chairman of the Institute. He was pragmatic and apparently did his job well because he was re-elected. In no time the Vienna University of Technology became an internationally renowned research centre of operator theory with young people doing challenging research. In Vienna Heinz guided 7 Ph.D. and 3 post-doctoral students. The centre attracted many visitors from all over the world for visits to do research and for workshops. During the past 12 years Heinz has organized 4 workshops, one in co-operation with the Schrödinger Institute and one in 2001 when the Vienna University of Technology awarded Professor Israel Gohberg from Israel an honorary doctorate. He obtained various long term research grants including funds for Ph.D. and post-doctoral projects. Heinz has clear and practical ideas and a keen sense on what to apply for and on how

to formulate it. Two of these grants were from the Austrian 'Fonds zur Förderung der Wissenschaftlichen Forschung (FWF),' the last of which was awarded very recently for a project on canonical systems. As to a third grant: Heinz is the leader of the Austrian-German team in a Research Training Network of the European Union, in which 10 universities from 9 different countries participate.

In recognition of his work Heinz was elected corresponding member of the Austrian Academy of Sciences.

Main themes in his work

Heinz's lifelong mathematical interest has been in the theory of operators, in particular operators on indefinite inner product spaces and its applications. This subject was suggested by Professor P.H. Müller, his thesis advisor. Heinz has initiated many new projects and made fundamental contributions to their development. His work draws the attention of several mathematicians and physicists. To illustrate this I elaborate on four of the main themes in his work:

1. From the Ph.D. period: the invariant subspace theorem.
2. From the Habilitation period: definitizable operators.
3. From the period 1975-1985: extension theory.
4. From the Vienna period: block operator matrices.

These main themes are interconnected and overlap in time. The division in periods is made only to facilitate the exposition.

THE INVARIANT SUBSPACE THEOREM

Now I come back to the handwritten German manuscript. For his Ph.D. thesis, so in the late fifties and early sixties, Heinz read the papers by L.S. Pontryagin, M.G. Krein, and I.S. Iokhvidov. Pontryagin in 1944 published his famous theorem that a self-adjoint operator A in a Π_κ space with a κ-dimensional negative subspace has a maximal invariant non-positive subspace and that the spectrum of A restricted to this subspace lies in the closed upper half-plane. In 1956 Krein gave a different proof of Pontryagin's theorem using a fixed point theorem but then for unitary operators. Iokhvidov used the Cayley transform to show that the theorems of Pontryagin and Krein are equivalent. Heinz generalized Pontryagin's theorem to self-adjoint operators on a Krein space. The sole assumption was a simple compact corner condition to have control over the operator when restricted to the possibly infinite dimensional negative subspace of the Krein space. It was a truly remarkable achievement. Heinz wrote it up by hand and in German and sent the manuscript to Krein on New Year's eve in 1959. It would later be the main result in Heinz's Ph.D. thesis. Iokhvidov in Odessa had tried to prove the same theorem before but he had not succeeded. So naturally Krein was very interested in Heinz's proof and he must have been impressed because in one of his Crimean lecture notes he refers to the generalized invariant subspace theorem as the Pontryagin-Langer theorem. In any case, Krein reacted by inviting Heinz to come to Odessa. The visit marked the beginning of a fruitful co-operation that lasted for more than 25 years, until

the death of Krein in 1989, and resulted in 13 joint papers. But the story goes on: One of the first things they discovered was a beautiful and unexpected application of the invariant subspace theorem. With the help of this theorem they proved that a self-adjoint quadratic operator pencil has a root with some specified spectral properties. The two papers 'On some mathematical principles in the linear theory of damped oscillations', which deal with this factorization, led to new publications in spectral theory and applications to mechanics and physics. They are probably their most frequently cited joint papers.

DEFINITIZABLE OPERATORS

In 1962 Krein and Heinz proved that a self-adjoint operator in a Pontryagin space has a generalized spectral function. Krein showed that an integral operator with a positive kernel gives rise to a positive operator on a Krein space and that this operator also has a generalized spectral function. Heinz discovered that these are two examples of a special class of self-adjoint operators on a Krein space, namely the class of definitizable operators. The concept and the name are due to Heinz. A self-adjoint operator A is definitizable if it has a nonempty resolvent set and for some polynomial p, $p(A)$ is nonnegative. Like the compact corner condition in the Pontryagin-Langer theorem, definitizability is a way to keep control over the non-positivity of the inner product of the Krein space. In his Habilitation submitted in 1965 Heinz shows that a definitizable operator has a generalized spectral function and he applies his theory to quadratic operator pencils. It is no exaggeration when I say that this work is a genuine corner stone in the spectral theory of operators in spaces with an indefinite metric. Like its Hilbert space counterpart, the spectral function in a Krein space has a wide range of applications such as to quadratic pencils, just mentioned, Sturm-Liouville problems with indefinite weight, elliptic problems, and variational principles.

EXTENSION THEORY

The research of Heinz and Krein in the extension theory of symmetric operators in Pontryagin and Krein spaces began with generalizing Krein's theory of generalized resolvents, resolvent matrices, and entire operators to an indefinite setting with applications involving new classes of meromorphic functions with finitely many poles and canonical systems. It culminated in the 4 seminal "Über einige Fortsetzungsprobleme ...." papers published jointly with Krein in the period 1977-85. These papers are still quoted and applied today. In fact, they could be called trendsetters, because there is a growing interest in generalizing, where possible, positive definite results to an indefinite setting. Of the many examples I only mention the indefinite version of the de Branges theory of entire functions and canonical systems. The research in this area is carried out by the group around Heinz here at the Vienna University of Technology. The results are important and of a high quality. Heinz can be proud of the research team he leaves behind.

BLOCK OPERATOR MATRICES

This topic was taken up by Heinz jointly with Reinhard Mennicken in Regensburg and came to bloom in Vienna. 2×2 block operator matrices are common in the theory of operators on Krein spaces. But now the emphasis is different. The problem is to describe the spectral properties of an operator defined on a product of two Hilbert spaces and given as a 2×2 block operator matrix in terms of the properties of the operator entries of the matrix. Typical examples come from mathematical physics or system theory, where the entries are differential operators of different order and hence unbounded. One of the first problems is to define the domain of definition of the block operator matrix. Many papers have appeared since 1991. They concern, for example, the location of the essential spectrum, the solution of a Riccati equation, and block diagonalization. A new concept initiated and further developed jointly with others in the last 5 years is that of the quadratic numerical range. It is a new tool for localizing the spectrum of a block operator matrix.

The Netherland connection

Let me begin with how I came to meet Heinz. I wrote a letter to him with some results on differential operators with eigenvalue depending boundary conditions on February 25, 1980. Heinz responded on March 19, 1980 with detailed answers to my questions. Some years before, Rien Kaashoek had visited Heinz in Dresden and organized a return visit for Heinz to Amsterdam. This took place in October 1981 and Heinz used the opportunity to come to Groningen as well. This visit was an immediate success, we were on first name basis within a few minutes, and his visit to my house and family went as smooth as pie. With Henk de Snoo we started to work on classes of meromorphic functions which arose in extension theory of symmetric operators in spaces with an indefinite metric and applied the theory to self-adjoint boundary eigenvalue problems with eigenvalue depending boundary conditions. At one time Heinz predicted that what we were about to start would lead to many publications. Before I realized it, I asked "Oh, how many?" (I dislike vague remarks). Heinz actually paused to think and answered "About 10." I was impressed. How could he predict that many? But how right he was: Many papers have appeared since then. First jointly with Henk de Snoo, even more than 10, and later also with others. Since that first visit in 1981, we have met at numerous working visits, conferences, and workshops. When near the Mediterranean we would go out to swim. Out of all these contacts grew a friendship which I treasure very much. During his many visits to Groningen, Heinz generously shared many ideas with us and stimulated us to work on them by ourselves. They resulted in a master thesis and a Ph.D. thesis about extension theory and interpolation, some papers with postdoctoral students about extension theory and commutant lifting, and even a book about Schur functions, operator colligations, and reproducing kernel Pontryagin spaces which my co-authors D. Alpay, J. Rovnyak, and H.S.V. de Snoo and I dedicated to him in appreciation, admiration and amity.

Right now Heinz and I together with Daniel Alpay (from Israel), Tomas Azizov, and Yuri Shondin (both from Russia) and others are working on two projects.

One is about an indefinite version of the Schur algorithm. The other concerns singular perturbations of self-adjoint operators with applications to quantum physics and to, for example, the Bessel and Laguerre differential operators. I very much enjoy working with Heinz. His enthusiasm for the problem at hand is stimulating and I am impressed by the ease with which Heinz finds the right wording for a paper. Our style of working together depends on where we are. When in Vienna, we sit on a couch in Heinz's office, we have scratch paper on our knees, and our hands are blue from writing, so to speak. When in Groningen, we stand before a big green blackboard and our hands are white from the chalk.

Upon the invitation of Rien Kaashoek, Heinz regularly visited the Free University in Amsterdam. Heinz took part in the reading and examination committee for some of Rien's Ph.D. students. He also gave a series of lectures at the Thomas Stieltjes Institute. Heinz was an important participant in the INTAS-projects which Rien arranged. As to mathematics, Heinz's visits to the Free University resulted in joint works about solutions of the Riccati equation with André Ran and his students. Heinz was co-promotor for one of them. Heinz's relation with the Netherlands is not restricted to the Free University and the State University of Groningen only. At present Heinz is a member of the international evaluation committee to evaluate the output over the period 1996-2001 of the Mathematics Departments of all Dutch Universities. It is yet another indication that Heinz is recognized as an authority in mathematics with an international reputation.

Concluding remark

I have said a lot and inadvertently I may have omitted things I should have said, but I should finish. Allow me to make one last remark: Some years ago at some place Heinz and I had to fill in some forms and we discovered that at the space where we had to write down our profession we had entered different things. I had written "Professor" and Heinz had filled in "Mathematician." Heinz may have retired as a professor but I hope and wish that he will not retire as a mathematician for many years to come, for mathematics and for the sake of all of us, I am sure.

Speech of Heinz Langer

By Heinz Langer, Vienna, March 4, 2004

Magnifizenz, Spectabilis, Inge and Aad, Ladies and Gentlemen!

I feel very honoured by all these nice words, thank you very much indeed. And I am deeply touched by the fact that so many friends and colleagues have come to this conference, although at the beginning it was intended to be just a small meeting. My thanks go to the organizers, Institutsvorstand Inge Troch, Harald Woracek, Annemarie Luger, Matthias Langer, and Fritz Vogl, who have put a lot of efforts in bringing us together for these days.

Many things have been said about the 45 years of my life as a mathematician. All this may look very smooth from outside, but in fact I am not somebody who likes to make long-term plans for the future. Looking back, I see two special features which have determined my life.

The first one is that I often made decisions which at the time were rather unpopular and not understandable for others.

Let me give three examples. At the time of my diploma at the end of the 1950's, under the strong influence of Bourbaki, abstract linear topological spaces and, in particular, locally convex spaces were very much in fashion. However, I chose a more classical topic, namely operator theory in Hilbert spaces which at that time by some colleagues was considered a bit outdated, but from today's viewpoint it turned out to be a very good decision. And I am very grateful to my teacher P. H. Müller that he proposed to me to study indefinite inner product spaces.

Another example is my stay in Odessa at the beginning of the sixties. Krein had invited me to spend a year with him within an existing exchange programme between the GDR and the Soviet Union. Officially the German-Soviet friendship was a big issue, but many people were feeling differently, and not all of my friends could understand why I wanted to follow this invitation. But I insisted: even after my first application in 1960 had been rejected for political reasons, I tried again and succeeded one year later in 1961. In fact, this year in Odessa was one of the most important turning points of my life. I was deeply impressed by Krein's personality, and his school of Functional Analysis in Odessa did not only influence me strongly as a mathematician, but was also the origin of true friendships which last until today. And I am very happy that some of these friends are here.

The third example is my decision not to return to the GDR in October 1989 and to give up a secure position for a rather uncertain future.

But, of course, the price for this security was very high, and this brings me to the second special feature, which I mentioned before: during a great part of my life I had to find ways to cope with the boundary conditions imposed by the political system of the GDR. So it was not always possible to do what you wanted and when you wanted it. For example,

- I was not allowed to study physics (which was maybe not the worst thing in the end),
- I was allowed to go to Odessa only one year later,
- contacts to colleagues in the West were very restricted, and permissions to travel abroad were often denied or delayed, like my first trip to Canada: I got the invitation from Israel Halperin to Toronto for 1965. This was not so long after the Berlin wall had been built, and so this first invitation was not even considered seriously by the authorities. However, Israel Halperin was very insistent and renewed the invitation for the next year, then even by a letter to the minister. And he succeeded.

This was somehow a typical situation, and I am very grateful also to other colleagues who made it possible for me to visit them in the West by not giving up after a first or even a second failure: Ilppo Simo Louhivaara who at the time was rector in Jyväskylä, Rudi Hirschfeld in Antwerp who visited the GDR with an official delegation from Belgium and on this occasion established contacts with me, Göran Borg, who was the rector of the Royal Institute of Technology in Stockholm, and Björn Textorius, Åke Pleijel in Uppsala, Hrvoje Kraljevic and the late Branko Najman in Zagreb, Rien Kaashoek and Israel Gohberg in Amsterdam, and finally Reinhard Mennicken in Regensburg. All these contacts to colleagues from abroad were very important for me, also because they allowed me to continue to work in operator theory while in Dresden I held a professorship in probability theory.

And even in the most critical situation, when I arrived in West Germany in October 1989 and did not have a job, colleagues from there, in particular, Reinhard Mennicken and Albert Schneider from Dortmund helped me to keep my period of unemployment to 3 weeks.

Now you may wonder how it came to this happy end in Austria. Well, I don't know myself, and this is one of the big miracles in my life. Certainly, it had nothing to do with the fact that Austria had been present for me already since my childhood like a fairy tale. I am still keeping an Edelweiss in Meyers Ostalpen from my father which he found in 1926 at the Karlingerboden near Kaprun, and in our living room we had a painting called "Im Stubaital". After the Second world war it was basically impossible to visit Austria from East Germany, and my first visit in 1955 via West Germany was illegal from the point of view of GDR and kind of adventurous. Hitchhiking with a friend from Munich to Salzburg, but in separate cars, we had agreed to meet at a bridge over the Salzach mentioned in my Baedeker from the 1920's. I arrived first, but the bridge had disappeared .... Only 35 years later, in 1990, I could return to Austria, when I applied for the Chair previously held by Edmund Hlawka.

That I finally got this position was for me like a dream came through. In the past almost 13 years here at the University of Technology in Vienna I had the freedom to follow my own scientific interests, to build up a research group in operator theory, and to cooperate with colleagues from all over the world. I am very grateful to the University and the former Institute of Analysis and Technical

Mathematics for giving me this opportunity and supporting me in many ways. It has always been a pleasure to work in the friendly atmosphere here. And I also enjoyed teaching several generations of students of electrical engineering and mathematics.

You may now have got the impression that I am just another example of a Saxonian as described by Franz Grillparzer in his "Loblied auf Österreich" where it reads

S'ist möglich, daß in Sachsen und beim Rhein
Es Leute gibt, die mehr in Büchern lasen

than people in Austria, I should add. However, I really enjoy living in Vienna with all its theaters and museums, opera houses and concert halls, cafés and vineyards, and nearby mountains and valleys. And, being attentive, you can even find a number of close cultural ties between Vienna and Dresden, like the Albertina or Gottfried Semper's architecture.

I was happy when I received the Austrian citizenship 13 years ago. Indeed, I do now share the passionate love of the Austrians for this beautiful country and its rich culture. And I have at least tried to adopt the Austrian mentality which in his "Loblied" Grillparzer describes as follows:

Allein, was not tut und was Gott gefällt,
Der klare Blick, der off'ne, richt'ge Sinn,
Da tritt der Österreicher hin vor jeden,
denkt sich sein Teil und läßt die andern reden!

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Programme of the
'Colloquium on Operator Theory'

| Thursday, 4 March	
Thursday, 4 March	

9'15	Opening:
	     H. KAISER (Vice-Rector of the Vienna University of Technology)
	     D. DORNINGER (Dean of the Faculty for Mathematics and Geoinformation)
	     I. TROCH (Head of the Institute for Analysis and Scientific Computing)
	 Laudatory speech: A. DIJKSMA
	 HEINZ LANGER

10'30	I. GOHBERG: Continuous analogue of orthogonal polynomials
Coffee break	
Chair: A. Luger	
11'30	C. TRETTER: Spectral theory of block operator matrices and applications in mathematical physics
12'15	V. ADAMYAN: Matrix continuous analogues of orthogonal trigonometric polynomials
12'45	Organizational remarks, conference photo
Lunch break	
Chair: R. Mennicken	
14'30	P. LANCASTER: An inverse quadratic eigenvalue problem
15'00	H. DE SNOO: Singular Sturm–Liouville problems nonlinear in the eigenvalue parameter
15'30	M. KALTENBÄCK: Indefinite canonical systems and the inverse spectral theorem
Coffee break	
Chair: A. Fleige	
16'30	F. SZAFRANIEC: q-disease in operator theory: some cases
17'00	B. TEXTORIUS: Directing mappings in Krein spaces
17'30	H. WINKLER: Isometric isomorphisms between strings and canonical systems

Friday, 5 March

Chair: B. Kirstein	
9'00	A. DIJKSMA: The algorithm of Issai Schur in an indefinite setting
9'45	K.-H. FÖRSTER: On matrix and operator polynomials with nonnegative coefficients

Coffee break

Chair: O. Staffans	
11'00	A. RAN: Some remarks on LQ-optimal control: asymptotics and the inverse problem
11'30	A. GHEONDEA: The indefinite Caratheodory problem
12'00	D. ALPAY: Rational functions and backward shift operators in the hyperholomorphic case

Coffee break

Chair: B. Textorius	
13'00	M. BROWN: Inverse resonance problems for the Sturm–Liouville problem and for the Jacobi matrix
13'30	P. BINDING: Oscillation of indefinite Sturm–Liouville eigenfunctions
14'00	M. MÖLLER: The spectrum of the multiplication operator associated with a family of operators in a Banach space

Afternoon in Vienna

Conference dinner

Saturday, 6 March, morning		
Chair: M. Langer		
9'00	P. KURASOV: Pontryagin type models for soliton potentials: inverse scattering method for operator extensions	
		Chair: H. de Snoo
9'30	D. VOLOK: De Branges–Rovnyak spaces and Schur functions: the hyperholomorphic case	S. HASSI: Boundary relations and Weyl families of symmetric operators
10'00	X. MARY: Subdualities and associated (reproducing) kernels	A. BATKAI: Polynomial stability of operator semigroups
10'30	Y. SHONDIN: Pontryagin space boundary value problems for a singular differential expression	V. STRAUSS: On J-symmetric operators with square similar to a bounded symmetric operator
Coffee break		
Chair: A. Ran		
11'30	B. ĆURGUS: Indefinite Sturm–Liouville problems with eigenparameter dependent boundary conditions	
		Chair: P. Binding
12'00	C. TRUNK: Spectral points of type π for closed operators in Krein spaces	D. POPOVICI: Moment theorems for commuting multi-operators
12'30	J. BEHRNDT: Finite-dimensional perturbations of locally definitizable selfadjoint operators in Krein spaces	H. LUNDMARK: Direct and inverse spectral problem for a non-selfadjoint third order generalization of the discrete string equation
Lunch break		

	Saturday, 6 March, afternoon

	Chair: C. Tretter	
14'30	V. Pivovarchik: Shifted Hermite–Biehler functions	

		Chair: C. Trunk
15'00	G. Wanjala: The Schur transform at the boundary point $z = 1$	A. Lasarow: Some basic facts on orthogonal rational matrix-valued functions on the unit circle
15'30	L. Kérchy: Canonical factorization of vectors with respect to an operator	L. Mikayelyan: Orthogonal polynomials on the unit circle with respect to a rational weight function

Coffee break

Chair: H. Woracek	
16'30	Z. Sasvári: The extension problem for positive definite functions. A historical survey
17'15	M. Kaashoek: Metric constrained interpolation problems and control theory

Closing

Participants of the
'Colloquium on Operator Theory'
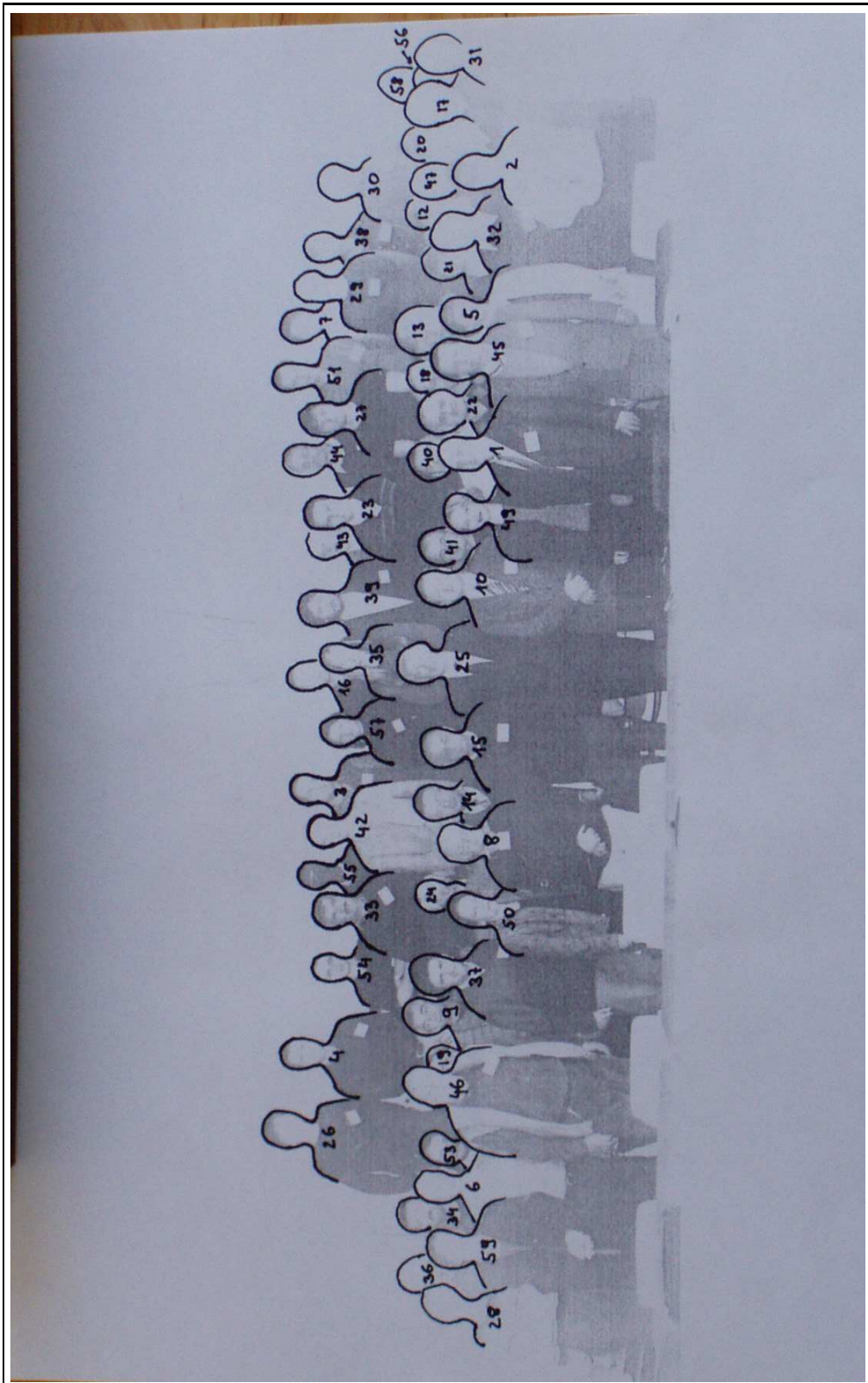
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