



# Operator Theory: Advances and Applications

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# Numerical Methods for Structured Matrices and Applications

The Georg Heinig Memorial Volume

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# Foreword

Georg Heing, a charming, erudite man, and a first rate mathematician died unexpectedly of a heart attack on May 10, 2005. Georg is survived by his wife Gerti, his daughter Susanne, and his son Peter.

We have lost one the leading experts in the field of structured matrices, a wonderful colleague, and a terrific friend.

Georg Heinig's results, approaches, and his scientific taste influenced our community of researchers working on structured matrices. In fact, the community's focus grew to reflect his interdisciplinary vision ranging from applications (e.g., in systems and control theory and signal processing) through fundamental mathematics (structured matrices, periodic Jacobi, Toeplitz, and Wiener-Hopf operators, classes of singular integral operators, resultants and Bezoutians for operator-valued polynomials and continual analogs thereof) to numerical analysis and fast algorithms. The broad spectrum of Georg Heinig's interests are represented in this collection.

Georg served as an Associate Editor of two top journals: *Integral Equations and Operator Theory* and *Linear Algebra and Its Applications*. This volume starts with two eulogies published earlier by IEOT and LAA. The first one, published in IEOT is by Albrecht Böttcher, Israel Gohberg (who was Georg's advisor during his Ph.D. studies), and Bernd Silbermann. The second one, published in LAA is by Karla Rost who collaborated with Georg during last three decades until day of his death. They have produced together more than 30 papers and a monograph.

We refer to these two eulogies for the details of Georg's career, and here we would like to emphasize only one point, namely the influence of his work in the area of structured matrices. Matrices with structure (e.g., Toeplitz matrices) are encountered in a surprising variety of areas in sciences and mathematics. There were many approaches to study Toeplitz structure and its generalizations, one of them was known under the name "displacement structure method." In their 1984 monograph *Algebraic Methods for Toeplitz-like Matrices and perators* G.Heinig and K.Rost demonstrated that this method (they called it the UV-reduction method) can be successfully used not only for Toeplitz structure and its derivatives, but also for many other patterns of structure, e.g., Hankel, Vandermonde, Cauchy matrices, Bezoutians and their generalizations. This breakthrough discovery facilitated a lot of interest in the community. Moreover, the new technique was immediately picked up and it was heavily used in the work of a number of research groups in Germany, USA, Israel, Leuven, Moscow, Hong Kong.

As Georg mentioned many times, about 20 years ago he was virtually alone delivering talks on structured matrices at such conferences as IWOTA and ILAS meetings. Nowadays special sessions and minisymposia on structured matrices are routinely included in programs of a number of conferences such as IWOTA, ILAS, SIAM annual meetings, SPIE, MTNS. Moreover, a number of conferences dedicated exclusively to structured matrices has been held (two AMS meetings in the USA, four conferences in Italy, three in Moscow, three in Hong Kong). Needless to say, Georg's results, ideas, his energy, and service to the community facilitated this development and strongly influenced the research efforts of structured matrices community.

We are happy to include in this volume a joint paper of Georg Heinig and Karla Rost on Bezoutians. This is a subject Georg worked on since the very beginning of his career, and to which he made a number of significant contributions. The paper blends an wonderful exposition of classical results with a survey recent development in the field.

It was a great honor and a privilege to edit this volume of papers dedicated in Georg's memory.

The Editors