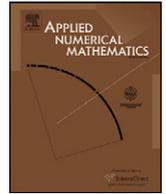




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Preface

Introduction

The “CONFERENCE IN NUMERICAL ANALYSIS (NumAn 2008) RECENT APPROACHES TO NUMERICAL ANALYSIS: THEORY, METHODS AND APPLICATIONS. Honoring Richard S. Varga on his 80th birthday” was held on September 1–5, 2008, in Kalamata, Greece. This Conference followed two earlier conferences of similar theme, one of which was in the same location (2007) (see <http://www.math.upatras.gr/numan2007/> and also [2]) and another that was held on June 3–4, 2005, in Ioannina, Greece.

At NumAn 2008 there were sixteen Plenary Speakers: Richard S. Varga (Kent State University), Claude Brezinski (University of Sciences and Technologies of Lille), Ronald Cools (Katholieke Universiteit Leuven), Michel Crouzeix (Université de Rennes), Vassilios A. Dougalis (University of Athens), Michael Eiermann (Technische Universität Bergakademie Freiberg), Elias Houstis (University of Thessaly), Volker Mehrmann (Technische Universität Berlin), Bernard Mourrain (INRIA Sophia Antipolis), Nicolas Papamichael (University of Cyprus), Panos M. Pardalos (University of Florida), Lothar Reichel (Kent State University), Youcef Saad (University of Minnesota), Hans J. Stetter (Technical University of Vienna), Daniel B. Szyld (Temple University), Paul Van Dooren (Catholic University of Louvain). The approximately 100 participants came from 21 countries: Austria, Belarus, Belgium, Canada, Cyprus, Czech Republic, France, Georgia, Greece, Israel, Italy, Lebanon, Poland, Portugal, Romania, Russia, Serbia, Spain, Switzerland, the United Kingdom and the United States of America.

The web page of the Conference is hosted at the University of Patras and is accessible on the Internet at <http://www.math.upatras.gr/numan2008/>.

The aims of the NumAn Conference Series are mainly to:

- bring together and bequeath scientific activities, directions and pursuits of scientists in Greece and abroad on subjects that pertain to the Conference,
- foster an exchange of views and ideas,
- study the theoretical background required for methods, algorithms and techniques used in applications,
- search directions of theoretical results towards applications, and
- highlight open problems and future directions of numerical analysis.

The members of the Conference Organizing Committee were G. Akrivis, E. Gallopoulos, A. Hadjidimos, I.S. Kotsireas, D. Noutsos and M.N. Vrahatis. The members of the Local Organizing Committee of the Conference were H.N. Vrahati, I.S. Kotsireas and M.N. Vrahatis.

Summary of conference activities

Monday September 1st, 2008

Opening ceremony: The president of the Organizing Committee of the Conference, Professor M.N. Vrahatis of the University of Patras addressed the attendants and declared, on behalf of the Organizing Committee, the opening of the conference. Afterwards, the attendants received the blessing of His Holiness, Metropolitan Bishop Chrysostomus III, who wished them to have a successful conference.

The keynote speakers and their corresponding lectures were as follows:

- (1) Richard S. Varga: *Three topics which I love: Geršgorin and his circles, Brualdi lemniscates, and Perron–Frobenius theory.*
- (2) Volker Mehrmann: *Sparse approximate solution of partial differential equations.*
- (3) Hans J. Stetter: *Numerical analysis meets commutative algebra.*
- (4) Panos M. Pardalos: *From local to global in numerical optimization.*

Amidst the aforementioned lectures, the following sessions were organized:

- (1) *Properties and criteria of special categories of matrices.*
- (2) *Methods of computation of special inverses, and other properties of matrices.*
- (3) *Pseudospectra of matrices and new methods of interpolation.*

On Monday's intermediate sessions, scientists from Belgium, Czech Republic, France, Serbia, Switzerland, U.S.A. and Greece, presented their work. All lectures highlighted the central role of Computational Linear Algebra in Numerical Analysis in modern science and technology.

Tuesday September 2nd, 2008

The keynote speakers and their corresponding lectures were as follows:

- (1) Claude Brezinski: *Estimations of the norm of the error in linear systems, with an application to regularization.*
- (2) Nicolas Papamichael: *A class of orthonormalization methods for numerical conformal mapping.*
- (3) Daniel B. Szyld: *Modern Krylov subspace methods for parabolic control problems.*
- (4) Michael Eiermann: *Krylov subspace methods for matrix functions – recent advances and open problems.*

Amidst the aforementioned lectures, the following sessions were organized:

- (1) *Computational convex analysis and integral equations.*
- (2) *Computations with matrix functions and applications to equations.*
- (3) *Numerical solution of differential equations and applications.*

On Tuesday's intermediate sessions, scientists from universities and industrial research centers of France, Germany, Spain, Cyprus, Lebanon, Portugal, Czech Republic, Romania, U.S.A. and Greece, presented their work.

Wednesday September 3rd, 2008

The keynote speakers and their corresponding lectures were as follows:

- (1) Elias Houstis: *Problem solving environments (PSEs) in computational science & engineering education and training.*
- (2) Paul van Dooren: *Graph matching with type constraints.*

Subsequently, a session on the subject of *Applications of numerical analysis in problems of physics and medicine* took place.

On Wednesday's session, scientists from Belgium, Germany, Israel and Greece, presented their work.

In the afternoon, the participants visited the city of Ancient Messini and afterwards, a reception was held by the Mayor of Ithomi Mr. Konstantinos Georgakopoulos and the Vice Mayor Mr. Evaggelos Kapsias. It was an excellent opportunity for the distinguished participants to enjoy the Messinian hospitality and the great beauty and historical heritage of the area as well as an exceptional tour by the resident archaeologists.

Thursday September 4th, 2008

The keynote speakers and their corresponding lectures were as follows:

- (1) Michel Crouzeix: *Some estimates in a non-self-adjoint context.*
- (2) Vassilios A. Dougalis: *Nonlinear dispersive wave propagation in two space dimensions: the Boussinesq system.*
- (3) Lothar Reichel: *Multilevel methods for ill-posed problems.*
- (4) Ronald Cools: *An introduction to the world of lattice rules for multivariate integration.*

Amidst the aforementioned lectures, the following sessions were organized:

- (1) *Numerical methods for the solution of special categories of differential equations.*
- (2) *Iterative methods for the solution of large sparse systems and applications.*
- (3) *Methods of prestabilization of large sparse systems and applications.*

On Thursday's intermediate sessions, scientists from Canada, Georgia, Greece, Russia and the U.S.A. presented their work. This session was remarkable because it showed that Mathematics and endeavors such as the NumAn Conference help promote peace by bringing closer people with common intellectual curiosities. The setting was particularly inspiring: "Greece inspires you to look at the fundamentals" said with great acumen speaker Vladimir Druskin.

At 9:00 p.m. a classical music concert was performed by Ms. Irene Lalioti-Vrahati (piano), Ms. Dimitra Tsigka (soprano) and Mr. Orestis Zaphiropoulos (cello) in compositions by N. Skalkotas, M. Ravel, G. Konstantinides, K. Giannides and M. Hatzidakis. Subsequently, the conference banquet took place, in which, apart from the participants, local officials joined the festivities honoring Professor Varga.

Friday September 5th, 2008

The keynote speakers and their corresponding lectures were as follows:

- (1) Yousef Saad: *Efficient linear algebra methods in data mining.*
- (2) Bernard Mourrain: *Solving polynomial equations with approximate coefficients.*

Subsequently, a session on the subject of *Combinatorial algorithms and applications* took place. During that session, scientists from French, Canadian and Greek universities presented their work.

The last session of the conference was a 50 minute long Panel Discussion coordinated by Professor Efstratios Gallopoulos. All participants available that day attended and many of them spoke. It was quite a mix of distinguished numerical analysts, most numerical linear algebra experts, belonging to a variety of departments, such as Mathematics, Computer Science, Computer Engineering and Informatics, Mathematical Engineering etc. based in Asia, Europe and North America. The lively discussion that took place in the course of this session was primarily about teaching and the evolution of the field itself and its relation to other sciences. The entire discussion can be found online at the Conference website.

We next provide our summary and comments on this session. So, we take this opportunity to thank the participants and especially the speakers that contributed with their remarks: Richard Varga, Ronald Cools, Paul Van Dooren, Efstratios Gallopoulos, Volker Mehrmann, Nabil Nassif, Nicolas Papamichael, Lothar Reichel, Yousef Saad, Hans Stetter and Nikos Stylianopoulos.

After some motivational remarks by the coordinator, our honored guest, Professor Richard Varga, posed the first question, pursuing a topic raised by Professor Elias Houstis during his invited talk. Is it possible to structure Numerical Analysis courses around collaborating student teams? Several participants observed that this is an excellent idea and that several courses use tutorials and project assignments where students work in synergy which also has some nice social effects. As some noted, however, project assignments cannot be used as substitutes for theory. Moreover, tutorials and projects are “labor intensive” and their fair evaluation and grading is a challenge for the instructor. Another question that was posed was: How do you enhance the “student learning experience” to make numerical analysis more interesting? Typically, non-computer science (engineering) students are already convinced about the importance of computing to solve their problems, therefore, they do not doubt that numerical analysis is an important topic. Several participants, however, observed that it is hard today to motivate students in Mathematics and Computer Science to pursue this field. Some participants described their instructional experiences and some others observed how hard it is to attract students from Mathematics (where students typically prefer Pure Mathematics) and Computer Science (where Numerical Analysis is regarded as “something else”). Would departments, like Mathematical Engineering, be more hospitable? This discussion brought to mind George Forsythe’s dictum “in the past many numerical analysts have progressed from being queer people in mathematics departments to being queer people in computer science departments” [1]. It was also noted that the field must be more concerned with real applications and finding ways to immerse students at an early stage. There was a consensus on this but also a warning was voiced that Mathematics is changing from a problem solving science to an esoteric science. There is a great risk if Numerical Mathematics follows this path and if researchers deal only with convergence issues. As one participant put it, it is worth pursuing significant engineering and scientific problems even though this might imply a little less theorem proving and probably less fun. He also reminded the audience that if the field did not open up, it ran the risk of suffering the fate of “human computers”. On the other hand, it was also argued that the importance of Analysis should not be forgotten; as someone said, when hard analysis is not needed, engineers solve the problems on their own. Some comments of George Forsythe on this topic are worth re-reading (see [3]).

Some participants also pointed out that one cannot do everything and that there is always the risk for an individual researcher (but also for the most capable researchers viewed collectively) to spread oneself too thin. Everyone agreed that numerical analysts must talk more to engineers. Several interesting remarks were made regarding this important issue. Some noted the great communication difficulty that exists as different (engineering and scientific) disciplines tend to use different vocabularies to mean pretty much the same thing (in terms of Text Mining, synonymy and polysemy abound!). It was also agreed that the Numerical Analyst must demand to see and understand the global picture rather than just the local problem, as it often happens when scientists and engineers try to communicate their numerical problem. Otherwise, they might “miss the forest for the trees” and be misled into proposing irrelevant solutions. Needless to say that this underlines the need for Numerical Analysts who are trained to converse with scientists and engineers.

The discussion then moved to the topic of Problem Solving Environments and their role in the field. Everyone agreed that MATLAB and similar environments are essential in teaching and research. The point was made that such environments not only serve to verify that algorithms work but also to demonstrate the theory and possibly trigger new ideas. According to the ancient Greek maxim, however, “everything in moderation”. Specifically, it was pointed out that there is a danger when students (and researchers) solely use such tools because it becomes hard for them to appreciate the intricacies involved in producing correct and fast running codes on today’s high performance computing systems (where various types of parallel and GPU programming might be necessary). There was consensus that the best course is to be able to program in multiple environments, for instance MATLAB and C. One participant reminded the audience how difficult the task of professional level coding has become, indeed, a subject by itself, that might not be within the reach of every numerical analyst. There was also the suggestion that there must be a greater effort from the community to build “free” MATLAB-like environments. Another interesting question was whether anyone had ideas on how to structure numerical analysis courses based on

software that enables collaboration, wiki's for example. This was an interesting “software” followup to the topic raised by Professor Richard Varga at the start of the session. One participant described his experience at his institution (though by no means unique) with a forum for the class created on a content management system platform that is used by instructors to make announcements, students to pose questions and registered users to post follow ups on either. The lively discussions in these fora indicate that they can be a very useful tool. There was also a word of warning: everyone must be informed early on about the “rules of participation”, or else students might expect that the instructor is available on stand by and on a twenty-four-hour basis to answer queries. It was also observed that currently there is a lack of textbooks in Numerical Analysis that could lure students from Computer Science in the field. Fortunately, recent topics that are “attention getters” such as Google's PageRank, Data Mining and Computer Graphics contain plenty of Numerical Analysis material to motivate students.

The allotted time for the Discussion Panel went by very fast. The questions that were raised and the agreements (and disagreements) that ensued clearly highlighted how tough some of these (non-numerical) problems are! In fact, some of them have been occupying luminaries of the field since the early days of numerical analysis and computer science. On the other hand, as Professor Volker Mehrmann observed, today there is high demand for good Numerical Analysts in most areas of Science and Engineering and “to make things even more interesting” the scale and nature of the most challenging problems are such that traditional techniques or slight modifications thereof do not suffice and might demand radical departures. Great news for everyone, especially the students and other young participants.

The Panel signaled the end of the NumAn 2008. Warm thanks were extended from everyone present as the organizers promised to see that NumAn continues in the future.

Acknowledgements

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The hard work and assistance of Michael G. Epitropakis, Vassilis Galanis and Manos Oikonomakis, students at the Mathematics Department, and Aris G. Vrahatis, student at the Computer Engineering and Informatics Department, all of the University of Patras, proved to be invaluable in many critical aspects of local organization and in the compilation of this volume.

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The Guest Editors are also delighted to thank Professor Daniel Szyld for his (unsolicited) “participant's view” of the Conference, published as [4].

Last but not least, the Guest Editors would like to express their most sincere thanks to Professor Robert Beauwens, IMACS President and Editor-in-Chief of *Applied Numerical Mathematics (APNUM) Journal*, who accepted our proposal to host in a Special Issue of the APNUM Journal selected papers presented at the NUMAN 2008 Conference, and to Ms. France Pinon, IMACS Administration. Without their patience and continuous encouragement and assistance, especially when all of us, along with the corresponding authors and reviewers, were trying to get familiar with and use the EES (Elsevier Electronic System), this Special Issue would not be possible. Many thanks go also to the Elsevier B.V. Publishers.

The Guest Editors
 Georgios Akrivis
 Efstratios Gallopoulos
 Apostolos Hadjidimos
 Ilias S. Kotsireas
 Dimitrios Noutsos
 Michael N. Vrahatis

References

- [1] G. Forsythe, What to do till the computer scientist comes, *Amer. Math. Monthly* 75 (1968) 454–462.
- [2] E. Gallopoulos, A. Hadjidimos, I.S. Kotsireas, D. Noutsos, M.N. Vrahatis (Eds.), Preface, *J. Comput. Appl. Math.* 227 (1) (May 2009) 1–4.
- [3] D.E. Knuth, George Forsythe and the development of computer science, *Commun. ACM* 15 (August 1972) 721–726.
- [4] D. Szyld, A conference celebrating Richard Varga's eightieth birthday, *IMAGE – The Bulletin of ILAS* 41 (Fall 2008) 6.