

# Laudation for the Johann Bernoulli lecture 1995-1996

## “Aspects of Scientific Computing”

delivered by Gene H. Golub

Arthur E.P. Veldman<sup>1</sup>

*Department of Mathematics*

*University of Groningen*

*PO Box 800, 9700 AV Groningen*

*email: veldman@math.rug.nl*

“The field of computing is on the verge of a new revolution”. With this quote from Nobel laureate Carlo Rubbia [1] I started my inaugural lecture in this same beautiful auditorium about five years ago [2]. Today the same quotation is appropriate to announce the Johann Bernoulli lecture.

Rubbia was pointing at the impressive development that has taken place in computer simulation, or scientific computing as it is mostly called. Reality can now be simulated with a high degree of reliability. In a wide range of scientific and engineering applications simulation is increasingly replacing traditional experiments, in particular in situations where experimenting is too time consuming, too expensive, too dangerous or simply impossible. You may think for example of weather forecasting, combustion or automotive and drug design.

Usually this revolution is associated with the impressive progress that we have seen in the performance of computers. It is much less known that the mathematical techniques with which problems are solved on a computer have shown a progress that is at least as spectacular. I am talking numerical mathematics now, and therefore I am very proud to introduce to you one of the architects of numerical mathematics: professor Gene Golub.

To start with, Gene Golub is one of the happy few that remain young more easily than most of us: just over one month ago he became sixteen. If your numerics is swift enough, you will have computed by now that he was born on the 29th of February in the year 1932. Born in Chicago, his scientific education started at the local university but soon he moved to the University of Illinois at Urbana-Champaign. Here he graduated in Mathematics and Mathematical Statistics, and received his doctorate in 1959.

Soon after that he moved to California, where – after a short industrial intermezzo – in 1962 he first set foot in the Computer Science Division of Stanford University as a visiting scientist. After a short two year stay at the Courant Institute in New York, in 1966 he permanently settled in Stanford; at least formally... He is constantly on the move and he has contacts all over the world. His agenda for the coming months (available on internet) shows a tight travelling schedule, which exhausts me already by only looking at it. Gene, you must have found a medicine against jet lag.

At the same time this reflects his broad scientific interests and his attitude towards cooperation. His list of publications tells the same story. He has published at this moment exactly 100 journal papers, of which 92 are co-authored; his last single-authored paper dates from 1974! Many of these papers are written with the ‘next generation’. Furthermore he supervised 22 PhD theses. His support of young people shows clearly that he recognizes how important the nurturing process is.

His first journal publication - co-authored of course, but not with his PhD supervisor - was with Richard Varga [3]. This cooperation saved his PhD. Gene’s thesis supervisor (Taub) had

---

<sup>1</sup>The contributions by Eugen Botta and Freddy Wubs in preparing the laudation are gratefully acknowledged.

asked Varga for an outside opinion on Gene's work, and he learned that Varga had done similar work. He then threatened Gene that he would not accept his thesis if Varga would have published his results first: 'A PhD is supposed to be an original piece of research.' But what his supervisor did not know was that one day earlier Varga and Golub had agreed already to make it a joint publication: Gene's first one of many more to come!

Gene's main interests are Numerical Analysis, Mathematical Programming and Statistical Computing. He is noted for his work in numerical linear algebra and its applications. His interests in that area culminate in his book 'Matrix Computations' with Charles Van Loan, that has become a standard work in this field [4]. Besides editing a number of volumes, he recently produced two further books on scientific computing (with James Ortega) [5, 6].

Some further keywords of his research (with apologies for the 'slang'): least-square algorithms for statistical problems, iterative solution methods for solving elliptic partial differential equations (SOR, cyclic reduction, preconditioned conjugate gradients) and eigenvalue problems.

Golub was actively involved in setting up an electronic digest for the community of numerical analysts (NA-Net) about ten years ago. Up to now NA-Net plays a very important role in communicating between numericists. On his last birthday a special birthday song was published on NA-Net (melody: When I'm sixty-four)

Now that you're older, with greying hair,  
Years from when we met,  
You are still sending us papers to read,  
Birthday greetings, papers to edit.  
If you had switched to work in AI,  
Would you be so keen?  
Yes you still need us, yes we still need you,  
Now that you're sixteen.

The outstanding quality of his work and his broad interest are reflected by the many awards and distinctions professor Golub received over the years. I have counted around 10 honorary doctorates and various honorary memberships. Amongst others, he is a member of the National Academy of Science and the National Academy of Engineering. He is a foreign member of the Swedish Academy of Engineering Sciences, and received the B. Bolzano Gold Medal for merit in the field of Mathematical Sciences from the Czech Academy of Sciences. Further, he is an honorary member of the International Statistical Institute, reflecting once again his broadness. Golub served as President of SIAM (Society of Industrial and Applied Mathematics, 1985-1987), and there even is a prize named after him: the Golub Prize in the SIAM Nordic Section.

Between the lines, Golub is very concerned with all of us who have to prepare laudations. He has made a very detailed CV available on the internet<sup>2</sup>. Thank you Gene for this; it helped us a lot! This also gives me the opportunity to acknowledge the contributions of my numerical colleagues Eugen Botta and Freddy Wubs in preparing this laudation.

Turning back to Stanford, since 1988 professor Golub is director of the Scientific Computing and Computational Mathematics program. This is a multi-disciplinary graduate and PhD educational program from a number of departments in the Stanford School of Engineering. The participants range from computer science and mathematics on the one side, and applied and engineering sciences on the other side. Interaction between these disciplines prevails. In the program attention is paid to all ingredients of scientific computing: i.e. knowledge of the (usually) physical application, knowledge of numerical mathematics and mathematical analysis, and knowledge of computer science.

---

<sup>2</sup><http://sccm.stanford.edu/faculty/nf-golub.html>

As I stated about ten minutes ago, the progress made in numerical mathematics has contributed heavily to the impact that scientific computing is making in modern society. Therefore, now I would like to ask professor Golub to share with us the history of and the secrets behind this numerical ‘revolution’.

## References

- [1] C. RUBBIA, *et al.* *Report of the EEC Working Group on High-Performance Computing*. Commission of the European Communities, Geneva, November 1990.
- [2] A.E.P. VELDMAN *Een stroom van getallen* (in Dutch), Oratie, Rijksuniversiteit Groningen, 7 mei 1991.
- [3] G.H. GOLUB AND R.S. VARGA Chebyshev semi-iterative methods, successive overrelaxation iterative methods, and second-order Richardson iterative methods, Parts I and II. *Numerische Mathematik* 3 (1961) 147-168.
- [4] G.H. GOLUB AND C. VAN LOAN *Matrix Computations*, Johns Hopkins University Press, 3rd edition (1996).
- [5] G.H. GOLUB AND J.M. ORTEGA *Scientific Computing and Differential Equations. An Introduction to Numerical Methods*. Academic Press (1992).
- [6] G.H. GOLUB AND J.M. ORTEGA *Scientific Computing. An Introduction with Parallel Computing*. Academic Press (1993).