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An interview with Paul Van Dooren

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Abstract

Interviews and dialogues have been a special way to transmit science since Socrates. They are maybe the only way to get the stories behind most discoveries. I was so positively impressed by the interview of Gene Golub by Nicholas J. Higham [1] that the idea of doing one with Paul Van Dooren obsessed me for a while. After a few attempts to arrange a meeting, I finally got an occasion during the Householder Symposium at Tahoe City. On June 15, 2011, when most participants were on an excursion (Paul did have a kind of cold), we sat in a corner of the Granhall of the Granlibakken Conference Center and we did the interview. This document provides an edited

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transcript of that dialogue. The bibliography contains some refernces in the interview.

YC: How did you do at school?

PVD: In elementary school, junior school and high school, I did very well, and I was good at mathematics.

YC: Where was the elementary school?

PVD: In Tienen in Belgium and the secondary school or high school as they say sometimes in English, was also in Tienen. I did well, especially in mathematics, even though I was not in the right orientation. I was not registered as a student of mathematics, but rather of Latin, Greek and so I had only 3 hours per week of mathematics, but that was one of the courses I liked most actually.

YC: That was until the age of 18, and then you moved to Leuven to attend the university?

PVD: I went to Leuven but I decided to enroll in engineering and for that I needed to do a special introductory year because my education in mathematics was not sufficient. This was one whole year of mathematics only, in order to prepare for the entrance exam. That year, I really started to like mathematics. I was 19.

YC: I remember that you have a funny story in your family, what was that again?

PVD: Oh yeah, you are talking about my grandfather and my wife's uncle. During the second World War, my wife's uncle was blowing up bridges in Belgium to stop the invasion, and it turned out that my grandfather had helped building these bridges before the war. We found out about this when our families met for the first time. That was a good way to start a good relationship. But, properly speaking, I did not know my grandfather well; he died when I was very young.

YC: Do you remember any professors from your period at Leuven?

PVD: I remember my professors very well. Most of them are still alive but not active anymore. I did my studies in Computer Science, and the one that was really teaching me applied mathematics was Robert Piessens. I did my Master Thesis with him. He retired a few years ago. Then there was Ludo Buyst. He was teaching linear algebra and started the first computer science department in Belgium. He is also retired. Buyst must be around 70 and Piessens around 65, I think.

YC: You mentioned that you did an engineering degree in computer science. How did you move to mathematics for the PhD?

PVD: Computer science in Leuven had two orientations. One was languages and operating systems; that was the most popular orientation. The second orientation was applied mathematics; we were only four students taking that option. We graduated in 1974 and were actually the first students graduating in computer science in Belgium. So four students did applied mathematics and the other fifteen or so did languages and operating systems.

YC: What was the subject of your Master thesis ?

PVD: Adaptive numerical quadrature in n dimensions.

YC: You still have copies of your Master thesis?

PVD: I think so, yes. It received an IBM award in informatics in Belgium. That method for numerical quadrature over a hypercube, is still used in the Numerical Algorithms Group (NAG) library (http://www.nag.co.uk/).

YC: Was Patrick Dewilde your only supervisor?

PVD: In the beginning, I was planning to do my PhD with Piessens, but he had too many students and he suggested that I would choose another supervisor. Patrick Dewilde was just appointed in Leuven as a professor. He was actually an electrical engineer but was teaching a course in numerical linear algebra, and I was doing the homeworks and exercises for that course. So I became his teaching assistant, and then I started to do my PhD with him as well. He gave me a very nice topic which is still not solved. It is the problem of finding prime factors of polynomial matrices. It is still not known what the solutions are. But it was a challenging problem and it raised a lot of related questions.

YC: How was your PhD period?

PVD: I had a very good time; PhD students had good interactions with the professors. I was actually sharing an office with Adhemar Bultheel who did also his PhD with Patrick Dewilde on rational approximations and we had very good discussions. The only problem was that Patrick went to another university after two years; so my advisor was gone abroad. I decided – well, Patrick arranged that – to go to the US for one year before ending my PhD. I first did a short trip to California and then visited Tom Kailath and Leonard Silverman. That is when I started to work on the generalized eigenstructure problem in linear system theory and that became the title of my thesis.

YC: You started with one topic and you finished with another one?

PVD: It was a kind of a shift of topics, but both are closely related

and I think it was a very good move.

YC: So that started your Californian period, right?

PVD: After my short visit, I first spent one year at the University of Southern California. I was actually still doing my PhD and I was working with Len Silverman at that time.

YC: You remember any names of colleagues, PhD students or professors, at the University of Southern California?

PVD: Michael Safonov was there, working on robust control. He was a young assistant professor who had made a major contribution in the area of robust control. Sun-Yuan Kung was another young assisant professor who was working in fast algorithms. Richard Bellman was also there at USC. And then we had famous vistors giving seminars such as Rudy Kalman, Tom Kailath and Bernard Levy. These were all very big or young promising names; all in systems theory, but none in numerical analysis.

YC: Then you went back to Belgium?

PVD: I did my PhD in Belgium. I was a teaching assistant in Leuven. After my thesis defense, I went back to California for another year, but now as a postdoc. Then I went to work with Gene Golub and Tom Kailath.

YC: How was your period with Golub and Kailath?

PVD: Tom was not often there. But it was a very interesting visit, especially since Kailath organized a very nice weekly seminar and had also lots of very good students. I started to work with George Verghese who is now a professor at the Massachusetts Institute of Technology. That was a very good collaboration also. And then I started to work with Gene of course. He was also travelling a lot at that time. But he had fantastic students. Nick Trefethen was there, Daniel Boley, Marsha Burger, Petter Björstad and Steven Nash. That was the period were they had a tremendous amount of busy talks in Stanford. The year I was there, Germund Dahlquist was visiting, Howard Rosenbrook passed by, Brian Anderson was there. Jim Wilkinson was a regular visitor in the summer. This was a beautiful location to spend some time and was ideal to learn to know people. Martin Gutknecht and later on Dario Bini, were both sharing an office with me for a while. This was really a fantastic year. This was 1980-1981.

YC: Then you went to Australia: what is the story of that visit?

PVD: At Stanford I had two offices : one with Tom Kailath's group and one with Gene Golub's group. With Tom Kailath's group I shared an office with Yves Genin. He arranged for me to be hired by the Philips Research Laboratory, where I stayed for about 11 years in the group of Yves

Genin. That was also a very good group; even though this was industry, we were doing rather fundamental research. During my Philips years, I went to Australia only for a short sabbatical stay of four months. That was in 1984 or 1985.

YC: Back to Australia, who was your host there?

PVD: Bob Bitmead, a colleague of Brian Anderson. They were both in the Systems Engineering Group. Another host was Richard Brent from the Center of Mathematical Analysis. I ended up working with Brent on some numerical issues for parallel algorithms, a hot topic at that time.

YC: If you would like to evaluate your time at Philips in a few words what can you say about it?

PVD: I was with the Philips Research Laboratories Brussels for 11 years with short breaks like the one trip to Australia. This was a fantastic period. I had the opportunity to do research with very good people at Philips and to interact with students from many universities. I was also teaching part time at Université Catholique de Louvain in Louvain-La-Neuve just for one course. But I had two PhD students in Leuven : Michel Verhaegen and Marc Moonen, and one in Eindhoven : Theo Beelen. Even though we were in industry we could supervise students, but we were not allowed to be officially their advisor. For that, you need to have an academic position, at least in Belgium.

YC: What were your duties at Philips?

PVD: In the beginning I was told that I would be in a group also solving specific problems originating from Philips Industry. But very quickly Genin realized that the work that I was doing was more important than the applications I was supposed to work on. So he gave me almost full freedom for my research. I was a bit surprised. Probably this was linked to the fact that I received the Householder prize in 1981.

YC: So you were able to choose the problems you wanted to work on ?

PVD: I had a lot of freedom indeed, which was very nice. And I was allowed to have PhD students at that time also. Yves Genin really took care of me.

YC: Do you remember the topics that you were considering at that time?

PVD: If you look at the PhD subjects, for Theo Beelen it was the Kronecker canonical form, for Marc Moonen, it was adaptive algorithms for SVD computations, and with Michel Verhaegen it was the numerical analysis of the Kalman filtering problem.

YC: What was the link between these subjects and Philips?

PVD: Very little, but these were excellent topics at that time and I was allowed to work on those. Marc and Michel both became professors : one at KULeuven and one at TUDelft.

YC: Then you got a position in Urbana-Champaign?

PVD: That was because Philips Research Laboratories Brussels closed. It was a very good research lab, but when financial problems showed up in Philips this was one of the first labs to close. It was a prestige lab doing a very good work but not so crucial for Philips Industries. So it was decided to close it and everybody had to leave. That is when I went to Urbana-Champaign.

YC: How many persons where in that lab?

PVD: About 60 at the time we were closed.

YC: Do you remember some names from that lab?

PVD: Oh yeah, they were famous people there. Yves Genin, Philippe Delsarte, Yves Kamp, Marc Davio, Pierre-Jacques Courtois, Axel Van Lamsweerde, Benoit Macq, Michel Sintzoff, Jean-Jacques Quisquater; all those people became well-known professors in different universities in Belgium and around the world.

YC: How was your time at Urbana-Champaign?

PVD: That is where I had my first official PhD student of course. Urbana-Champaign is a top university with very good students. As PhD students, I had Mike Stewart (son of Pete Stewart), Eric Grimme whose thesis had an impact on model reduction, Jayaramanan Sreedhar who did periodic systems and Srikanth Thirumalai who did Toeplitz solvers. Colleagues were for example Mark Spong, Kyle Gallivan, Ahmed Sameh, and Tamer Basar, all big names in electrical or computer engineering. That was a very good department. But after 3 years I had the opportunity to take a position in Belgium and I decided to come back.

YC: Kyle Gallivan moved to Florida and you started your fructuous collaboration?

PVD: We had a NSF contract so I followed the contract and I am still going regularly to FSU in Tallahassee.

YC: Let us talk now about the SVD. When did you become interested in that decomposition?

PVD: That was quite early on. I was working on a paper by Golub and Wilkinson. This was the computation of the Jordan canonical form in a reliable way and in order to do that you have to compute the nullity of a matrix shifted by each eigenvalue λ_0. The nullity of $A - \lambda_0 I$ gives you the

number of eigenvectors related to λ_0 and that can be done with an SVD. So the interplay between the SVD and the eigenvalue problem was clearly visible in the paper of Golub and Wilkinson. I found a stable recursive procedure for extensions of this problem to the Kronecker form of a general pencil and that became known as the staircase algorithm. This was part of my PhD thesis. Then I visited Gene quite often even during the period at Philips. We started to work on various extensions, such as the periodic Schur form and the product SVD. These resulted from collaborations with Gene.

YC: You received the Householder prize in 1981; how was your feeling?

PVD: I was a bit surprized, I did not know about this prize. Golub and Wilkinson were impressed with the work I did and probably suggested my name. When I visited Stanford for the first time in 1977, Wilkinson was also there as special speaker for a conference and in his lecture he mentioned my recent results. That is also why I asked Wilkinson to become part of my PhD committee. And that also had an impact on the Householder prize (I think that Wilkinson was on the prize committee).

YC: Besides Dewilde and Wilkinson, who else was on your thesis committee ?

PVD: Robert Piessens and Anne Haegemans and I suppose other people from Leuven. There were six or seven members, I believe.

YC: How was the process of evaluating the PhD?

PVD: It was different from the current two stage defense in Leuven. Now you have a predefense behind closed doors, and a few weeks later a more formal public defense. I had a one stage defense : you submitted your thesis and defended it in public; the thesis committee then deliberated for about half an hour and then announced their decision.

YC: You received the SIAM Wilkinson prize in Numerical Analysis and Scientific Computing in 1989. What is this prize?

PVD: This was for the contributions to a particular area of scientific computing during the last 4 years. It is a quadrennial prize. Gene was on the committee and probably had an impact on the decision. I received the prize for my work on the interaction between linear algebra and systems and control theory. That topic was quite novel in those days. Alan Laub, Bruce Moore, myself and few others, were the pioneers of that area, in a sense.

YC: Who nominated you for that prize?

PVD: I do not know, but probably Gene.

YC: At the October 2010 workshop organized in Louvain-la-Neuve for your 60th anniversary, Nick higham read Sven Hammarling's letter to you,

in which Sven mentioned a NATO workshop that you organized. Can you tell us about it?

PVD: That was a NATO ASI workshop held in Leuven, a special event that I organized in 1988. Actually Gene Golub suggested that we should have a workshop in Belgium on numerical linear algebra, signal processing and parallel algorithms.

YC: It was organized only once?

PVD: This was organized only once, but then afterwards there were other meetings on SVD and Total Least Squares applications. They were organized by Bart De Moor, Marc Moonen, Sabine Van Huffel and Joos Vandewalle. Leuven became a popular place for meetings.

YC: What was the form of that meeting?

PVD: It was a two week meeting on invitation only. There were about 90 to100 people. It was a very nice meeting. I still have pictures of that. Sven Hammarling and Gene Golub delivered me the Order of the Shiny Red Hat (which was a carnival hat) and a Charter which was signed by everybody. It was for fun, of course, but it was a nice attention. You will not find the Order of the Shiny Red Hat in my CV.

YC: Do you have any other special memories of Gene?

PVD: Yes, the seminar I gave at Serra House in Stanford, which was actually the first seminar I gave outside Belgium. This was during my first visit to Stanford and the first time I met Gene and Jim. At the beginning of each seminar, Gene had the habit of introducing also everybody in the audience to the speaker. When Gene started to introduce people, he said: this is Alston Householder, this is Tom Kailath, this is Brian Anderson, this is Germund Dalhquist, this is Jim Wilkinson, this is David Luenberger, this is Åke Björck and so on. So he introduced all these famous people and after that, he asked me: "are you scared?". I was indeed scared as hell, because this was an impressive set of names. Around the beginning of my talk I asked: "I will use a lot of SVDs; should I introduce what it is?". Everybody started to laugh, of course, and Gene said "These are the SVD World HeadQuarters". Nick Trefethen even desigend afterwards a "Serra House" T-shirt with the letters SVDHQ on the front, and on the back there was a little house and in it, the formula $fl(1) + \epsilon = 1$, which was Jim Wilkinson's definition of the machine epsilon. That is a nice memory but a scary moment.

YC: Let us talk about some of your publications now. One of the most cited paper of yours is the one with Nancy Nichols and Jerry Kautsky [2]. What was the story of that paper?

PVD: I was visiting Nancy in Reading (Philips gave me a lot of time to visit people). Nancy had applied for a special grant for having me over. We started to work on inverse eigenvalue problems and after a day or two of discussions, we had the basic ideas of a simple Jacobi-like iteration for doing robust pole placement. On the ISI Web of Knowledge this is cited more than 400 times, probably because we mentioned several alternative ideas, which we did not pursue. Many people started to work on these extensions.

YC: Another well cited paper is the one on the generalized eigenvalue method for Riccati equations [3]; what was the story behind that?

PVD: That was the introduction of the extended Hamiltonian. Also something that had an impact on the area. This was trying to solve Riccati equations not via the standard Hamiltonian matrix but using an extended generalized eigenvalue problem based on the original variational equations. The Hamiltonian approach, recommended by Alan Laub [4], is actually the Schur complement of this pencil approach. The extended Hamiltonian has better numerical properties. It is the recommended way to solve Riccati equations, nowadays.

YC: In your papers, you have treated many topics. What is the link between them?

PVD: Most of it is related to systems and control. I started with linear algebra with my advisor Patrick Dewilde. Then I workd on systems and control because I visited Len Silverman and Tom Kailath. When I went to Urbana-Champaign, I started to work on model reduction. Since I came back to Louvain-La-Neuve I started to work on graphs and networks. When you move to another place you have the tendency of refreshing your research area.These topics may look different, but in fact, they are all related to matrix theory. Matrices are everywhere.

YC: Who introduced you to model reduction?

PVD: I listened to a talk given by somebody of the AWE group. I think it was Rohrer who came to give a seminar in Urbana-Champaign on using Padé approximations for this problem. I knew that Padé approximations could be done via the Lanczos algorithm [5]. At the same time Freund started to work on this as well [6]. I started to work on Krylov methods for multi-point Padé approximations around that time.

YC: For you what is your preferred paper?

PVD: One paper that I was surprised it did not catch much attention is the one with Gene Golub and Knut Solna on the product SVD [7]. On the other hand, the periodic Schur paper with Golub and Bojanczyk was a

conference paper [8] and it is quite well cited. We never extracted a journal paper out of it, which is kind of strange.

YC: What about the opposite: a paper that attracted a lot of attention but for you it was not really great?

PVD: The paper with Nichols and Kautsky [2] is very well cited but not deep. The results are good but its success is due to the fact that we presented several alternative methods without giving the optimal solution. Other people improved on it, like Andre Tits and several Chinese authors.

YC: I would like to ask you questions about some of your collaborators. From the graph of your collaborations using Microsoft Academic Search, the top of the list is Kyle Gallivan?

PVD: I worked a lot with him. This started in Urbana-Champaign. Over the years, we had several NSF grants together, and I visited him almost every summer during more than 10 years. We still visit each other now. Next week, I will see him in Belgium.

YC: What about Yves Genin?

PVD: Yves was my group leader at Philips Research. We talked to each other a lot but did not publish together that much. He is the one who gave me a lot of freedom in my research performed at Philips. I am very grateful to him for that.

YC: What about Andreas Varga?

PVD: I think we met at a conference. I do not remember which year exactly, but it must be around 1982 or 1983. We both got involved in the development of SLICOT, a software library for systems and control, now available via MATLAB. Andras contributed a lot to SLICOT and was critical about all software contributions : he had the reputation of being very accurate and precise, which is good when you try to put together a software library. SLICOT was initiated by the Working Group on Software (WGS). When Sven Hammarling, Volker Mehrmann, Adreas Varga, Sabine Van Huffel and Vasile Sima got involved, we obtained funding from the EU and everything started to roll.

YC: What about Bart de Moor?

PVD: I knew him from Leuven, but got to know him better in Stanford. The Stanford connection started with Patrick Dewilde : he was at Berkeley but visited Stanford quite often. He introduced me to Tom Kailath and Gene Golub. Both of them got interested in the students graduating from Leuven. After that, Bart de Moor, Sabine Van Huffel and Marc Moonen, all visited Stanford for some time.

YC: What about Yurii Nesterov?

PVD: He is a great guy. I met him as a colleague in Louvain-La-Neuve. When he got a permanent position, I started to work with him and and we had several joint PhD students. We have done some very good work together. He is a fantastic colleague !

YC: What was your best period of research?

PVD: In terms of environment, the one year in Stanford was fantastic. But I think in Louvain-La-Neuve, we developed a very good group now, as well. Colleagues I have now at Louvain-La-Neuve are just marvellous people to work with.

YC: Your Erdos number is 4, what do you think about this?

PVD: Strange : I am a coauthor of Gene Golub and of Vincent Blondel who both have Erdos number 2, I thought. But, I do not think that this is important. I am not working in an area that Erdos was interested in. I prefer to say that my Golub number or my Wilkinson number is 1.

YC: Your first PhD student was Michael Verhaegen in 1985?

PVD: He is not officially my PhD student of course because I was not allowed to have students those days but Joos Vandewalle allowed me to supervise his thesis.

YC: Who proposed the topic?

PVD: He came to talk to me. I think that his official advisor, Joos Vandewalle, suggested it. It started of very quickly : the topic was the error analysis of the Kalman filter. We did many other things but that was the main contribution. Michael wanted to have a thesis on aircraft state estimation and Kalman filtering was popular in those days. But it was not clear how to analyze error propagation in those filters. That was exactly the main contribution of Michel's thesis, which is still being cited for that.

YC: Who was your first official PhD student?

PVD: Yvan Hachez was my first student at UCL. But my first official student is Nicolas Mastonardi, who was co-supervised at the KULeuven by me and Sabine Van Huffel. The students from my Philips and Urbana-Champaign periods where not my official students. The four ones from Urbana-Champaign had to choose another advisor when I left the university, which I found rather strange.

YC: How did SLICOT start?

PVD: This was at a Benelux meeting, probably in 1981. I gave a presentation on software in systems and control, and somebody in the room (maybe Jan Willems) suggested that we should make the software available.

We created the Benelux Working Group on Software (WGS) and I was the first chairman. The idea was to make all software in systems and control available to others, and to document and standardize it. I think Sabine Van Huffel became a member of the group and it was her idea to apply for EU money. We extended the group to a European NICONET group and finally obtained support from the EU. The new members included Sven Hammerling, Andras Varga and Volker Mehrmann. At Philips, I was allowed to get a software developer, Michel Vanbegin, involved.

YC: I know that SLICOT went really well, so how were you approached by MathWorks to get SLICOT?

PVD: It took years to write and to standardize the codes. There were a lot of discussions about what language to use and how to distribute it. Ssomebody then suggested that we should write an interface for MATLAB and that Mathworks should distribute it rather than us. That was a very good decision because otherwise SLICOT would not be used that much. You did some work on it during your PhD and you used it also a lot. I do not care that SLICOT is not visible, as long as the software is used via the MATLAB Control Toolbox.

YC: How did you think about combining numerical analysis with systems and control?

PVD: It was really my advisors idea who put me on that track. Patrick Dewilde gave me a few papers to read about realizations and transfer functions. It was the beginning of numerical linear algebra being applied to systems and control but it became quickly a hot topic. Each linear algebra conference has now an important component in the area of systems and control. Linear algebra people are working on Lyapunov and Riccati equations, Hamiltonian systems, model reduction and so on. It became a hot topic.

YC: What about the open problems in this area?

PVD: The area is evolving now. Robust control, nearness problems and model reduction became hot topics recently and these are not simple numerical problems. We heard several talks on such topics today at the Householder symposium. Hybrid systems also seems very challenging. You started to work in this area and you know better than me that there is hardly any numerical work in that area.

YC: What do you think about the use of GPU?

PVD: I think it is a very important area but I am not familiar enough with it to be able to contribute to it. It is amazing to see the performance that some people manage to obtain from these architectures.

YC: During this symposium and many other linear algebra events, we have heard people talking about trying to produce algorithms using less communications. What do you think about this topic?

PVD: This is very important for large scale problems. But, again, this is not really my area. I study algorithms without focusing too much on implementation aspects.

YC: What is your definition of large scale?

PVD: To me, large scale depends on the machines we have at our disposal. I consider a problem to be large scale if present computers cannot handle them appropriately without doing something special. Large scale therefore evolves with time. Ten years ago, dense matrix problems were considered large scale above a few hundreds, nowadays it is several thousands or even millions.

YC: In model reduction, what do you think about combining Krylov subspace ideas with SVD based methods?

PVD: It is often a good idea to combine different approaches. In your thesis, you did propose such combinations. For large scale problems, you will have to do something special and Krylov methods will probably be the preferred method. You can combine this with gramians if you can approximate them, which is again a large scale issue. It is a bit misleading to say that these are two different types of approaches since both will require sparse or structured matrices techniques.

YC: Are you happy with what you did in research? What is your self-evaluation?

PVD: I was lucky enough to be able to open up the interaction between numerical linear algebra and linear systems theory. I am not known as a pure numerical analyst and I am also not known as a pure systems and control person. I work more on the interaction between the two. My focus was always on how to solve numerically problems that originate from an engineering application involving systems and control. Nowadays I am shifting towards the interaction between numerical analysis and application to graph and network problems.

YC: Can you tell us more about this last subject?

PVD: Vincent Blondel and I started to work on the problem of graph similarity, and we derived a matrix iteration defining a matrix whose entries could be used as a similarity measure between the nodes of two graphs. It was based on work performed with two students and a postdoc and it was eventually published in SIAM Review [9]. This was the starting point of a

new activity in our department for which we managed to get a comfortable grant from the university. This team has grown to about a dozen people, and includes Yurii Nesterov and Pierre-Antoine Absil.

YC: For you, what are the remaining challenges in model reduction of large scale systems ?

PVD: Oh, plenty. Definitely the nonlinear problems in model reduction are very challenging and we heard several talks here going in different directions. It is not clear yet what is the preferred method, which means that there are still interesting issues to be resolved. Also the MIMO case, the structured problems like polynomials and interconnected systems and of course switched and parametric systems. For the linear case, on the other hand, one could say that a consensus has been reached about what are the good approaches.

YC: If you look at your research, what would you change?

PVD: When working on popular topics you are facing a lot of competition and you often see others obtain results you could have found as well. But that is a healthy competition and it keeps us active. I do not feel bad about the choices I made.

YC: What about people you did not meet?

PVD: I never met Rutishauser, Givens or Lanczos. This is a pity because they were still alive when I started in this business. I should have travelled more...

YC: Any special comment about your students?

PVD: I always had a very good interaction with my PhD students. At least this is what I am thinking. I am not sure if they all agree with this. I am still in contact with many of them, even some of those who went to industry, like Antoine Vandendorpe and Yvan Hachez.

YC: What do you think about mathematics nowadays? Should we focus on solving some problems coming from industry and real life, or should we focus more on fundamental research?

PVD: A tendency that I am a bit scared about, is that numerical analysis becomes a service community to engineering applications. The good side of that is that it enriches the problems to be considered by numerical analysts. But the bad side is that a numerical analyst then becomes a second class citizen. And I think that numerical analysis deserves to remain a research area on its own. So we should honour the fact that people want to do numerical analysis without considering applications.

YC: What do you think about using software in doing mathematics

and especially in numerical analysis? Should we encourage that?

PVD: Yes, but we should encourage to develop software even more than using it. Learning to write and implement efficiently algorithms, is something very important. Then you start to realize that it is not all about simple formulas and that error propagation and performance analysis are so important. So students who do numerical analysis should be aware of that.

YC: What about the availability of the software?

PVD: I like the idea that widely used software like LAPACK would be free. Some government labs pay good people to write good software. But this is not always the case. Sometimes good software is commercial. I am willing to pay for it if it is worth the price. But to ask students to pay it is another story. For instance MATLAB is getting expensive but most universities make it available for their students.

YC: Have you been involved in any other software development than SLICOT?

PVD: Not really. But my first publication was a numerical integration routine and an improved version of that was used by NAG. The software was published in the Journal of Computational and Applied Mathematics. We did publish mathematical software in FORTRAN66 in those days. I also published some software in ACM TOMS which went into SLICOT afterwards. I never contributed to LAPACK but I think some of my routines for the scaling of generalized eigenvalue problems have been considered for LAPACK and that some of my SLICOT routines were adapted for LAPACK by Vasile Sima.

YC: What is your preferred coding language?

PVD: I will have to say MATLAB, because of its simplicity and its power. I use it just to analyze properties of algorithms. I am not trying to write commercial level codes and for that reason MATLAB is just the right tool for me.

YC: Let us move to your memories about conferences. Now we are at a Householder conference; when was your first one?

PVD: That was in Oxford in 1981. That is when I got the Householder prize. Actually Gene invited me to attend the previous one at Asilomar in 1977 but then I did not go because I thought I had nothing new to talk about. I was convinced that I should never talk about the same topic twice, which is stupid of course. In Oxford, I knew very few people. I met for the first time people like Kahan, Parlett, Stewart, Moler, Davies, Varga, and many other well-known people. I also met Sven Hammarling there, who was a close

collaborator of Jim Wilkinson. The meeting was very well organized and I had a great time.

YC: What was your first conference?

PVD: The first conference I attended was a regional one in Belgium. Thirst first talk I gave abroad was at Stanford in 1977. My first big international conference was the IEEE Conference in Decision and Control in 1979 in San Diego. I was then at the University of Southern California and I had to present four conference talks. I remember very well that we were driving from Los Angeles to San Diego and I have forgotten my slides in Los Angeles. So we had to drive back at night and got a speeding ticket because of that. But my presentation the next morning went well anyway.

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