Celebrating 10 Years of Mathematical Synergy

NUS National University of Singapore | IMS Institute for Mathematical Sciences

A commemorative booklet for the
IMS 10th anniversary celebration on 24 June 2010

Contents

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A Shared Vision Realized

CHONG Chi Tat | Chairman of Management Board

When the Mathematical Sciences Research Institute (MSRI) was established in Berkeley in 1982, many of us in Singapore were inspired. We thought that an institute of similar nature in Asia would play more than a useful role in the development of mathematical sciences in this part of the world. In 1990 I spent a semester at MSRI and that experience reinforced this belief. It is now clear that this vision of a mathematical institute modeled after the MSRI, serving as a key engine in the progress of mathematical sciences, was shared by many in the international community, as witnessed by the establishment of mathematical institutes in North America, Europe, Australia and China within the past thirty years, all variations of the same model. In terms of order of appearance, IMS is a late comer. With support from the Ministry of Education and the National University of Singapore, one can confidently say that IMS has contributed in many ways to the development of science in Singapore and beyond, as had been envisaged, in its first ten years of existence. The Institute is now a major port of call for mathematical scientists; its programs attract the participation of many who are among the best in the profession; its summer schools are attended by students from major graduate schools; its publications, including the newsletter *Imprints*, are widely circulated and read, and commented on. The Management Board extends its heartiest congratulations to Louis Chen, Director of IMS, and his team for a job well done. This tenth anniversary is a good occasion to reflect on the past: what have been achieved and what opportunities were missed, and to plan for the next ten years, which I think will be as exciting and challenging as the first ten.

Fostering Mathematics in Singapore

Roger HOWE | Chairman of Scientific Advisory Board

The IMS under Louis Chen's direction can be proud of its first 10 years. Among its many activities, some have been recorded in its Lecture Note Series, published by World Scientific, 19 volumes so far. It is interesting to examine the contents of these volumes as examples of the dynamics of progress in mathematics, and also to see how IMS programs have amplified local research activities.

Some mathematical advances take the shape of big breakthroughs that bring new understanding and new applications nearly overnight. These striking events can be purely theoretical, or can result from the application of known theory in a new way, or both together. Progress can come also in long, rolling developments that start with an idea that solves or helps with a particular problem, then keeps getting used and reused in new contexts over a period of years, until a major theme is recognized. Probably the most common form of mathematical progress comes in slow gestational work that examines examples and tries to codify, systematize, link or generalize pieces of theory or information based on existing structures. Some of this work cleans up, clarifies and/or extends aspects of the big breakthroughs. Other parts help to establish or add another step to what later gets identified as an important long term trend. However, at a given time, much of this work may seem to be internally motivated, unconnected to anything else, and proceeding in no clear direction; but I believe that it prepares the ground on which the dramatic breakthroughs are built. The breakthroughs get the attention, but many of them could not happen without the quiet work of uncertain significance.

Among the IMS Lecture Notes volumes, one can distinguish examples that illustrate all the types of activity described above. The latest Lecture Notes, volume #19, records a homegrown breakthrough, on braids. Knot theory was one of the early subjects of topology, and its problems and techniques have received renewed attention with the recent focus on low dimensional topology. Braids have provided a valuable approach to knot theory, but recent discoveries at NUS have linked braids with another seminal topic in topology, the homotopy groups of spheres.

The volume #10, on Gabor and Wavelet Frames can be seen as a systematizing or consolidating activity for the great 1980s breakthrough in harmonic analysis, the theory of wavelets. Wavelets have become an essential part of the toolkit of signal processors, including being incorporated in the JPEG standards. Wavelets have been a central topic of research of several members of the NUS Department of Mathematics, and Lecture Notes #10 is one product of the IMS programs related to image processing, including application of wavelets.

Several Lecture Notes record the bringing to Singapore the latest results of long, rolling developments that have led to major progress, and can be expected to continue to do so. These volumes would include #7 on Markov Chain Monte Carlo, #18 on Random Matrix Theory and its Applications, and #4 and #5 on Stein's Method in probability theory. Both Markov Chain Monte Carlo and random matrices emerged out of efforts to solve difficult physical problems, and have branched out in fascinating ways. Lately MCMC has been applied to biology and to finance. Random matrices have been found to be relevant to data analysis and wireless communication.

Stein's Method presents an analogous development which is closer to home, in that developing it has been a significant aspect of Louis Chen's own research. Stein's method has expanded from a novel way to characterize random variables that are normally distributed, to a flexible technique applicable to many questions in probability.

These very abbreviated examples can perhaps suggest how IMS programs have helped foster mathematics in Singapore, both by highlighting local developments, and bringing results of worldwide activity to local scientists. In doing this, IMS has demonstrated its value as a national resource for Singapore.

Interview with the Director

Interview of Louis CHEN by Y.K. LEONG

As part of its 10th anniversary celebrations in June 2010, the Institute for Mathematical Sciences (IMS) of the National University of Singapore is publishing a commemoration booklet that will put on record some of its achievements and will also include interviews with the Director and with the past and present Deputy Directors. The interview with Louis Chen, who has been the Director of IMS since its establishment in 2000, was conducted by Y.K. Leong in three sessions, each lasting about one and a half hours, on three days in February and March 2010.

The following is an edited and vetted version of the interview in which the Director tells a story of collective perseverance in pursuit of a common dream. He opens up a window into a world of international scientific endeavor in which a fledgling institute attempts to gain recognition in the face of many odds. And, of course, the interview would be incomplete if it sheds no light on his induction into an area of mathematical research that turns out to have important applications to other disciplines some 15 years after his unplanned and serendipitous entrance into a rather specialized area in probability.

IMS: The First Ten Years

Y.K. Leong: Let us begin the interview in reversed chronological order, starting from the present. You have been the Director of IMS since its establishment in 2000. For IMS to reach its present international status within a short span of 10 years it is undoubtedly an achievement. Would you have thought that this was possible when you became the Director? What are the factors that made this possible?

Louis Chen: It is very nice of you to say that it was undoubtedly an achievement. When I first became the Director, I was not really thinking what achievement I could make. It was something given to me. I have seen what institutes were like elsewhere and I wanted to be like them. It was more or less what I wanted to do, and I tried to do my best. As to what factors made this possible, I think the time was right. But one has to see things historically and see how it [IMS] evolved. 1991 was the first time we submitted a proposal and we knew why we didn't succeed. We tried again in 1996 and we also didn't succeed. In 1998, the time was right.

L: When was the idea of establishing IMS first mooted? What was decisive in turning a dream into reality?

C: By 1991, two NSF [US National Science Foundation]-funded institutes MSRI (Mathematical Sciences Research Institute) and IMA (Institute for Mathematics and its Applications) had been set up for ten years, we thought that Singapore should have a similar institute. So a group of us got together, and led by Peng Tsu Ann, who was then Head of the Department of Mathematics, submitted a proposal. I forgot exactly who was in the group. Chong Chi Tat was there, and Jon Berrick was asked to help make a first draft. Before this, Tsu Ann wrote to S.S. Chern, who came back with a very enthusiastic letter to support us. We attached Chern's letter with our proposal, which was submitted to the University through the Dean (Bernard Tan). I believe the Dean supported us, but probably the time was not right and it was not successful. Then in 1996, the Dean asked us to submit again. This time many more people became involved. Peng Tsu Ann was still the Head and he played the key role. We beefed up the proposal. Of course, we got the support of the University (Lim Pin) and we were asked to write to NSTB (National Science and Technology Board) to apply for funding. But we failed again.

Then in 1998, Lee Soo Ying became the Dean and he wanted to revive the proposal. So he talked to us, and Chow Shui Nee was around at that time and he wanted to chair the Committee. It consisted of Chow Shui Nee as chair, Tan Eng Chye, Ling San, Jon Berrick, Judy Jesudason and myself. Judy was asked to do the new draft. We all discussed together and members of the Department were asked to give their views. Again it was a departmental project. This time, things were different because Chi Tat was the Deputy Vice Chancellor and in charge of research. Shui Nee was the Dean of Research and Graduate Studies. We submitted a proposal to the Ministry of Education (MOE) to apply for academic research funding and I gave a presentation at the Academic Research Fund Committee meeting. The University, in order to support us, also committed a sum of money as startup funding. Chi Tat was on the Academic Research Fund Committee and played a very crucial role in helping this proposal accepted by MOE.

L: Why didn't it succeed the first time in 1991?

C: I think there are two aspects. First of all, the research environment – we had three research departments at that time [1998] – Department of Mathematics, Department of Statistics and Applied Probability (DSAP), and Department of Computational Science. Altogether we had 107 people. The two departments [Mathematics Department and DSAP] were a lot stronger in 1998 than in 1991 with more international connections. The University had a new mission, that is, to turn the University into a research university. Then that was the time when the Government began to recognize the importance of a knowledge-based economy. The environment was right for people to regard such a proposal as relevant and important to Singapore. The human factors are the people involved – they came out with a very good proposal. Of course, Judy's proposal was based on previous proposals. From 1991 to 1998, we had about 8 years of experience with writing this kind of proposal.

L: At that time, was there some kind of research institute that had already been established in NUS?

C: We were the first mathematical institute. By the way, in the first two proposals, we called it the Center for Mathematical Sciences, but this time we aimed higher and called it an institute. It wasn't clear at that time whether the center should be at the faculty level or university level.

L: Why did you need MOE's approval? The University could have just gone ahead to set up the center or institute.

C: We needed money, particularly for starting up. You need to have a place, you need to hire people, set up facilities. After you are ready for operations, you need to invite people. All these need money.

L: Was the Minister himself involved?

C: The Permanent Secretary for Education (Chiang Chie Foo) was chairing the Academic Research Fund Committee. I think all the funding has to be approved by the Minister personally. I understand that for our proposal more than one minister had to approve.

L: Did IMS use any overseas research institutes as models? How does IMS differ from such institutes at the present stage of its development?

C: From the beginning, IMS was modeled after the Mathematical Sciences Research Institute (MSRI) and the Institute for Mathematics and Applications (IMA). That is to say, we provide a platform for research interaction but we don't hire researchers. Basically, we have a Director and a Deputy Director and the rest are all support staff. The active people are visitors who come here to participate in programs and activities. In fact, our interest in establishing such an institute was inspired by them [MSRI, IMA] in 1991. These two NSF-funded institutes were set up in 1982 and they became very successful. The Newton Institute was set up later and is also one of this kind of institutes. We followed the three of them. We get people to submit proposals and organize programs on particular themes and bring people together for interaction and do joint research. But Singapore being different, we can't do exactly what they are doing. For example, our programs are short compared to theirs. In IMA and MSRI, they have year-long [nine academic months] programs; in Newton Institute, half a year. We started with half a year for the first two years, but very soon we found that this did not work quite well because our scientific community base here is small and also because we want our programs to have some local relevance and involve local people.

L: Is it because you cannot get overseas visitors to come for six months?

C: In principle, they can come for six months because they can take sabbatical for one year, but being here is not the same as being in Berkeley, Minnesota or Cambridge. Also, those institutes can draw a lot of people from all countries, but not us. Therefore, we have short programs of two months. Most of our programs are from one to three months. We have a lot of workshops, both inside and outside the programs. Workshops inside the programs are in accordance with the themes of the programs. Workshops outside the programs are ad hoc stand-alone independent workshops. In IMA, they have post-doctoral programs. They have funding for people to do post-doctoral work,

which is good because the post-doc will be there for one year and participate in a program whose theme is related to his research. He can meet all sorts of people, top people, for a year, listening to seminars, meeting with other post-docs and their own mentors. Unfortunately we don't have funds for post-doctoral programs.

L: In MSRI, even though the program is for one year, it doesn't mean that visitors will stay for one academic year, right?

C: Not everybody, the post-docs will stay. A small number of people do stay for the whole year or maybe half the time. Most of the people will come and go, and there is a lot of overlap. We do have people who stay throughout our short programs of two or three months. Newton Institute also does not have post-docs. A new institute that was set up in UCLA – Institute for Pure and Applied Mathematics (IPAM) – run only 3 months' programs, similar to ours. We are more comparable to them.

L: If IMS has to draw mainly from academic resources in NUS, do you see any serious problems on the viability of producing a continuous flow of programs for IMS in the long run?

C: We have no problems for the last 10 years. We have been able to get people from here to be interested. It is possible to have a continuous flow of programs from NUS, but I don't think this is what we want to do because we want to serve the whole of Singapore. We want to draw resources from NTU, SMU, A-star institutes and other national institutes.

L: But you do depend on overseas organizers.

C: We don't want our programs to be a completely local affair. One of the prerequisites of a program is that it must be on a theme of international interest and of local relevance. If someone from overseas wants to organize a program, we ask them to find local partners and organize the program together. It must be of sufficient local interest.

L: Were there any programs that were completely organized by local people?

C: There were some, but when they are initiated by local people, I usually ask them to bring in some prominent persons from overseas to be on their organizing committee. If it is completely local, it is usually a small workshop. For a program that is one or two months, it must be a joint effort between local people and overseas mathematicians and scientists. Even for our small workshops, most of them are jointly organized.

L: On the average, how many programs are there in one academic year?

C: On the average, about five. It is not possible to have a continuous running of programs, but if nothing is happening, it doesn't mean that we are free. There are a lot of things to do. We are preparing for coming programs. In some years, we have six programs, and in some, as few as four. In between programs, we usually have workshops and conferences. This will cover more or less the whole year, but usually there is one or two months that are low, usually September or October when we will have workshops. April is not a good time – we usually cannot get people to organize things during this month.

L: Is it easy to get people to propose programs?

C: I won't say it's difficult. We always get enough proposals to cover the year, more than enough to reject some. For example, the coming program called "Complex Quantum Systems" is proposed by someone from overseas. He's been here before and he said that he liked this place. So also is a program on "Probability and Discrete Mathematics in Mathematical Biology" scheduled for 2011, and another one on the challenges of high dimension, initiated by Peter Hall. In fact, 50 percent of the proposals were mainly initiated from overseas. Sometimes a proposal is solicited. When I say it is solicited, I mean I would tell the person what the opportunities available here are and what they could do. Of course, I have to know that the person is likely to do a good job and I have to be very selective. It is a process which is not so straightforward. It sometimes arises from a conversation or a discussion. You know, I don't receive things out of the blue. People would talk to me first.

L: That means the reputation of IMS has already gone before.

C: Yes, certainly there are some people in the scientific community who have heard about IMS. I'm not saying that IMS is as well-known as MSRI or the Newton Institute, but we certainly have quite a bit of international visibility.

L: Tell us something about the pre-proposals.

C: A pre-proposal is more like a statement of interest in organizing a program at IMS. There is a template and you really have to give a good scientific case – you know, international interest, local relevance, how mathematical sciences are involved, and so on. The SAB come here

not only to review the pre-proposals but also to listen to presentations given by the proposers. If the pre-proposal is initiated by someone overseas, then naturally he's the one who gives the presentation. Normally, we don't fly them here, but we make use of teleconferencing.

If your pre-proposal is rejected, then that's the end of story. A pre-proposal may not be very definite about who are in the organizing committee. You don't have to have a list of confirmed invited speakers or visitors, and the program structure may not be detailed enough. If accepted, it is normally subject to revision. You have to revise the pre-proposal taking into account the comments and suggestions of the SAB. When you revise the pre-proposal, you have to be definite who the organizers are and what the dates are. You should preferably have a list people who are willing to come. You should be clear about your program structure. After you have revised the pre-proposal you submit it as a proposal.

L: So you would need a lot of time to plan ahead.

C: Yes, the pre-proposal should be submitted about two years ahead of the program. We also want pre-proposals for workshops. But we don't expect you to write too much about the workshops. For workshops, we often don't need you to revise. We say, "Okay, we accept yours. You just follow the suggestions and comments of the SAB, but you don't have to revise." People don't normally submit pre-proposals for workshops two years ahead, maybe one year or one and a half years ahead.

L: The money for the program is presumably taken care of by IMS. Does the proposer have to dig into his own research funds?

C: Sometimes we do suggest co-sharing. For example, in the coming program on complex quantum systems, it is jointly organized with the Center for Quantum Technology. We co-share the costs, about half to half.

Guiding and charting directions: Founding members of Scientific Advisory Board (SAB) in a meeting — (clockwise) Hans FÖLLMER, Keith MOFFATT, Louis CHEN (IMS Director), Roger HOWE (SAB Chair), LUI Pao Chuen, CHONG Chi Tat (Management Board Chair), Avner FRIEDMAN, David SIEGMUND and LEUNG Ka Hin (IMS Deputy Director).

L: Must the chair of a program be local?

C: No, not necessarily. In some cases, the chair is not local. There are some with one local co-chair and one foreign co-chair.

L: If you don't have a local co-chair, the administration can be something of a problem, wouldn't it?

C: You're right. You should always have a local co-chair or get somebody to agree to be a local coordinator who directly oversees the organizing. Usually, we would make him a co-chair. In almost every program, there is joint organization.

L: With a few exceptions like programs on logic, Lie groups and analysis, most of the Institute's programs are focused on applications of mathematics to other fields rather than on pure mathematics. Why is that so?

C: First of all, we model ourselves along the NSF-funded institutes, in particular, the IMA, which hosts mostly programs on mathematics applied to other disciplines. But we would not leave out pure mathematics. If you look at our mission statement which is to foster research both fundamental and multi-disciplinary, then applied mathematics and applications of mathematics to other disciplines will be an important component of the institute. At the same time, we also serve the pure mathematics community. In Singapore, we cannot have too narrow a focus. We have to broaden our focus. We are a small community. If you focus only on applied mathematics or pure mathematics, then we have less people coming forward to organize programs at the Institute.

L: How about more programs in pure mathematics?

C: Well, applications of mathematics to other disciplines are very varied. There are all sorts of applications. You want to bring mathematics to the scientists. You want to develop mathematical expertise among scientists, and there are many other disciplines – engineering, physics, chemistry, biology, business, economics and medicine. So naturally you end up with more programs that are applied in nature.

L: In pure mathematics programs there seem to be more programs in logic than in say number theory or geometry.

C: This depends on the local community itself. Some pure mathematics groups are more active than others. If they are more active, they come forward more. It all depends on people. We have a two-month program in the coming June to August on geometry and topology, organized by Tan Ser Peow. According to him, it's attracting a lot of people world-wide. So you cannot say it's only logic. On the other hand, logic has its own funding. So we expect more regular logic programs.

L: IMS was launched with generous funds from NUS and MOE. Are such grants still forthcoming and adequate or is IMS seeking funding from other independent sources? How difficult is it to get such funding?

C: Of course, we get some funding from MOE and NUS. Initially, it was adequate. After that, it was actually very difficult to get funding. What MOE gave us was only for startup and we have to seek funding for recurrent costs and programs. For some reason, the local funding agencies do not give funding for this kind of institute. So we cannot get funding from them because we don't have researchers working on a term project of say two years. Fortunately, the University is willing to support and continue funding the institute. We don't get a lot of money but we are able to survive.

We are very lucky that recently the logic group has been able to secure a grant of about US one million dollars from the John Templeton Foundation for a project called AII (Asian Initiative for Infinity). This is through the work of top logicians in Berkeley, Hugh Woodin and Ted Slaman, and our colleague Chong Chi Tat. This grant is to fund logic at the Institute for the next three years. We are applying for dollar-for-dollar matching from the Government. If we succeed in getting the matching, the one million dollar matching fund will go into an endowment fund for the Institute. The Institute will use the proceeds of this endowment fund for logic activities and other projects.

L: What happens after the one-million-dollar grant?

C: I cannot speak for them. I think that possibly they will ask for further funding, not just for logic but for other areas.

L: Computer science should be quite relevant. A lot of things are computational. Why not explore funding from Microsoft? They give a lot of funding to all sorts of people, like medicine and so on.

C: I cannot do it myself. I'm not in computer science. I think that people who are interested in organizing activities in IMS should also have an interest in applying for additional grants although the institute does provide funding. I cannot help them write the proposals but as Director, I can work with them and provide the planning, the facilities, the administrative support and the logistics support. All they have to do is to concentrate on the scientific aspects of the program.

Balancing Administration and Research

L: As early as 1993, you were actively involved with the Bernoulli Society for Mathematical Statistics and Probability and in 1997 you became the first Asian President of the Bernoulli Society. Since then your engagement with international scientific bodies has continued unabated. In 2004 you became the first East Asian President of the Institute of Mathematical Statistics. So in a sense, you anticipated the "globalization" of NUS. What motivated you to take on such heavy responsibilities?

C: I won't say that I anticipated the globalization of NUS. Globalization of the university is very much synonymous with the globalization of its faculty members. Over the years faculty members have "globalized". Many of us have international linkages; many of us are well-known scientists and mathematicians. I have some linkages and I was nominated [for the presidency of Bernoulli Society and Institute of Mathematical Statistics]. I didn't want to turn them down, so I said yes and I got elected.

L: But you yourself must want to, in some sense, take on such responsibilities. Some people may have declined.

C: It's such an honor that it's hard to turn it down. Secondly, it's such a challenge and you want to contribute to the challenge.

L: About your research – I believe that there is so much research generated by Stein's Method that it has now become a field in itself. Could you describe briefly some of the recent developments in this field?

C: There are three developments which impress me. One is the work of Sourav Chatterjee who has applied Stein's Method to concentration of measures inequalities, eigenvalues of random matrices and problems in statistical mechanics. The other is the work of Jason Fulman who has applied Stein's Method to problems with a strong algebraic component such as characters of Lie groups. The third is the work of Giovanni Peccati and Ivan Nourdin who combine Stein's Method with the Malliavin Calculus to do normal approximation for functionals on infinite-dimensional Gaussian spaces. I think these are fascinating developments of Stein's Method.

L: Are these very theoretical?

C: All these are theoretical in a sense although you can say they have applications in mechanics and random matrices. Actually the sort of things we do in probability is kind of like pure mathematics.

L: Your work on Poisson approximation published in 1975 began to be applied in many areas inside and outside of probability theory some 15 years later. Did you yourself contribute to these applications?

C: Unfortunately no. I did not contribute to these applications using Poisson approximation. But in studying compound Poisson approximation and Poisson process approximation, which are generalizations of Poisson approximation, my collaborators and I did apply our results to problems in probability as well as in computational biology.

L: What is your most recent research about?

C: My main focus in the last few years has been on normal approximation. One of my recent works is on moderate deviations, which is about relative errors in the approximation of tail probabilities. This has been submitted for publication in a joint paper with Shao Qi-Man and my PhD student Fang Xiao.

L: What about books? I don't think you have written too many books.

C: I'm actually in the process of jointly writing a book with Larry Goldstein and Shao Qi-Man. They are very kind and writing more than I do. This book is based on our work. It's a monograph called "Normal approximation by Stein's Method" which is going to be published by Springer Verlag. The book is coming to its final stage. My co-authors are "pressurizing" me to finish a chapter on discretized normal approximation.

L: You did not go overseas for graduate studies immediately after your Honors degree at the then University of Singapore. Was it due to the limited opportunities for overseas graduate studies at that time?

C: Not exactly. Although it is true that opportunities for graduate studies were more limited in those days, I did not go overseas for graduate studies after my Honors degree because I failed to get a PhD scholarship from PSC (Public Service Commission). I wanted to do pure mathematics and I chose complex analysis as my field of study. At the PSC interview I was asked what applications complex analysis would have to Singapore. I was dumbfounded and could not give a satisfactory answer, and that, I believe, cost me the scholarship.

I then got a lectureship to teach at the Singapore Polytechnic. I taught there for a year before returning to the then University of Singapore to study for a Masters degree under U.C. Guha. I was working on summability, some very classical stuff. After a year, I was appointed temporary assistant lecturer and I taught one or two classes. I recall that you and Cheng Kai Nah were in my class.

It was during that time that I saw a circular about the Fulbright-Hayes Travel Grant. I applied for it and was successful. At the same time the Department of Statistics at Stanford University offered me an assistantship. Of course I accepted both and headed for Stanford. That was in 1967, three years after my Honors degree.

L: Before you went to Stanford, you didn't know who was going to be your advisor. How did you choose your advisor?

C: I was looking for people who could advise me on probability theory, like Kai Lai Chung and Samuel Karlin in the Mathematics Department. But it would not be easy because I had to leave the Department of Statistics and go to the Mathematics Department and start all over again. That meant I would lose two years. The Chairman of the Department of Statistics at that time was Rupert Miller. He was a very nice man and I asked him whether he could advise me. He had advised somebody else in applied probability before. But he told me that he had stopped working in applied probability and could not advise me. "However," he said, "Charles Stein has come up with a new theory, a new technique for normal approximation. Why don't you work with him?" I took his advice and went to Charles Stein. I asked him, "Could I be your student?" Then Stein said, "I think it's okay since I don't have any student right now."

L: Did Stein suggest the problem that you should work on?

C: I never really took Stein's course on what is now called "Stein's Method". I learned it from some lecture notes taken by other graduate students. As far as I remember, those were the lecture notes of Bobby Mariano who is now the Dean of the School of Economics at SMU. The notes had been passed on to another fellow student, Dick Shorrock, who gave them to me and encouraged me to learn Stein's Method. Dick unfortunately passed away fifteen years ago. When I went to Charles Stein, I was, for some reason, interested in getting the rate of convergence in Donsker's Theorem. That wasn't an easy problem. You need to master a core of special techniques first, but I didn't have the opportunity. Charles gave me some advice but that did not seem to work. One day, Charles saw me and said, "Mr Chen, I have bad mathematical news for you. Your problem has been solved by a Russian mathematician by the name of Nagaev. The paper is in Russian but there is an English summary." Then he gave me the reference.

That was a blessing in disguise because after that, I said, "Okay, I'll have to work on a problem of Stein." Then I thought I would work on decision theory, another of Charles' major contribution to statistics. Charles said, "Go and read this book on topological groups by Nachbin." This was to prepare the background. I was reading the lecture notes [on Stein's Method] at the same time that I was reading the book by Nachbin. But somehow I was more interested in the lecture notes. Maybe it's because I didn't see the connection of topological groups with

decision theory. Then I started to try to prove theorems. I thought I proved a theorem but it turned out to be wrong. After reading those notes, I thought to myself, "Well, all these are about normal approximation. Maybe I should do Poisson approximation, the discrete analog of normal approximation." I asked Stein what he thought of applying his method to the Poisson approximation, and he said, "Of course, it will work." That was how I got into Poisson approximation.

L: You have been working practically non-stop in research and administration for some 40 years. What is the source of all this mental and physical energy?

C: It is true that I have been involved in administration in one way or another from the beginning of my career and still get engaged in research all these years. But there were periods when I had few administrative duties and periods when I was very slow in research. The problem is that it is difficult to mix them and strike a balance between the two. I think what keeps me going is interest. If you are interested in something, you can go on doing it for a long time.

Future Plans and Vision

L: If you do ever retire from your formal duties, what do you plan to do?

C: Well, I will spend more time on my second love, music. I will read about music, attend more concerts and go back to playing the recorder, a woodwind instrument from medieval times. In fact, when I was in The Hague, Netherlands, last year, I made it a point to go to a music store and I bought many musical scores composed or arranged for the recorder. I have four very good recorders, two Hans Coolsma and two Moeck Rottenburgh. I will also spend some time re-learning some Chinese literature which I had neglected when I was in school.

L: What kind of literature?

C: Poetry. Tang *shi,* Song *ci* [Tang and Song poems]; also some modern (but not very contemporary) literature which I learned in school but did not pay much attention to as I was too interested in mathematics.

L: When you say you retire you mean you will not be the Director, but then you may be given an office here.

C: What you mean is that I will not be on their payroll. You know, if you are on payroll, you have duties to perform.

L: It's possible you could be given some kind of adjunct or even emeritus position.

C: Well, I would be happy to have that position. I certainly would like to have an office so that I am still connected to the academic community. I think I still have some stamina. I would talk to people. Usually after seminars there will be tea and reception.

L: You could still continue to do joint research with other people.

C: Yeah, yeah. I don't think I will give up research completely but probably at the pace of a snail.

L: Maybe you could give a course or something.

C: I may or may not. It's good to give a course because you will have to remember what you have learned. Sometimes you may get ideas from giving a course and this may lead to a research paper.

L: As you reflect on the past ten years' of accomplishments for IMS, in what direction would you like to see IMS developing in the next ten years?

C: The current model for the Institute will remain the same. IMS will continue to contribute in a significant way to research vibrancy in the mathematical sciences in Singapore. It will continue to bring about greater interaction and research collaboration between mathematicians and scientists of different disciplines and between the local scientific community and the wider international community. For the future I would like to see IMS developing into a major player in the world contributing to mathematical research internationally. It should come to everybody's mind as a foremost mathematical institute in Asia.

Deputy Directors' Reminiscences

Interviews of Deputy Directors by Y.K. LEONG

Since the establishment of IMS in 2000, the following served as Deputy Directors and played an important role in the development of the Institute in the first ten years:

CHEN Kan (1 Jul 2000 – 22 Jul 2001)

SUN Yeneng (23 Jul 2001 – 31 Jul 2004)

Denny LEUNG (1 Aug 2004 – 31 Dec 2006)

LEUNG Ka Hin (1 Jan 2007 – 31 Dec 2008)

TAN Ser Peow (1 Jan 2009 –)

Except for Chen, who has left academia and is now an executive director (Global Equity) at JP Morgan in New York, the others continue to pursue their carriers in National University of Singapore. Sun is Raffles Professor of Social Sciences and holds joint professorial appointments with the economics and mathematics departments. Denny Leung and Leung Ka Hin are Associate Professors while Tan is a Professor in the Department of Mathematics.

Within a short span of ten years, they helped to build an institute that is arguably comparable to some of the top research institutes of mathematical sciences in the west and, with little doubt, in the east. In their own supporting roles, they had to build, almost literally from scratch, and subsequently maintain the operational and organizational infrastructure needed for an institute to function efficiently. As they tell us in response to individual email interviews, even the modest buildings of the Institute had to be built anew or renovated in an essential way. In addition to the difficulty of recruiting and keeping suitable supporting staff, they also tell us of the constant need to negotiate and bargain with the not always empathetic fund administrators. Ten years after it was formed, the IMS that we know today is also the result of their collective efforts.

The past and present Deputy Directors were interviewed through email. As the experience of the first deputy director might be somewhat unique, the questions put forward to the first Deputy Director were slightly different from those for his successors who would have some foundation to build on subsequently,

Interview with CHEN Kan

How did you become the Deputy Director when IMS was first established?

Chen Kan: It was Lai Choy Heng who introduced me to Louis. Louis wanted to have some programs emphasizing mathematical applications and he thought a person of my background (physics and computational science) would be suitable as the deputy director.

Was there any attempt to define the duties of the Deputy Director?

CK: It was still a planning stage for the institute. Given a myriad of problems associated with setting up a new institute, I am not sure if the duties can be defined.

Did you have to oversee much of the administrative and technical operations in the beginning?

CK: In the beginning I was mostly helping Louis with all aspects of administrative and technical operations. I think I needed to do a bit of overseeing after we hired an AO (administrative officer) and an IT manager.

What were the main difficulties and problems you faced during IMS's first year of operation?

CK: Lots of unknowns. Even hiring suitable support staff members took much longer than we originally thought.

What was the greatest satisfaction you had as Deputy Director?

CK: Being involved in setting up a premier institute in Singapore – even though my contribution was probably quite limited.

What was the most memorable experience you had during your term at IMS?

CK: Working with Louis was always very memorable. Louis worked very hard to get the institute established. I still remember getting calls from him late at night, and receiving emails which were sent at 2 or 3 am from him.

Why did you relinquish the post of Deputy Director after only one year? Would you have continued in that post otherwise?

CK: I became the acting head of Department of Computational Science. It was increasingly difficult for me to juggle my time and effort required for both positions. I thought that Computational Science might need my services more. I would have continued as the deputy director if I was not involved in the running of Computational Science Department and if my service to IMS was still needed.

Interviews with SUN Yeneng, Denny LEUNG, LEUNG Ka Hin, TAN Ser Peow

How did you get involved with IMS?

Sun Yeneng: When the first IMS Deputy Director, Chen Kan was asked to be the Acting Head of the Computational Science Department, the IMS Director, Prof Louis Chen approached me to be his Deputy.

Denny Leung: One day back in 2004, I received a lunch invitation from Louis. After I had settled into his car, he asked me if I knew why he'd asked me out to lunch. Up to that point, even though we had been colleagues in the same department for a number of years, our paths had not crossed very often. So I could only think of one reason for the unexpected lunch invitation and I said "I think you're going to offer me a job".

Leung Ka Hin: When Denny opted not to continue serving as Deputy Director. Louis asked me to help him, So I did.

Tan Ser Peow: I was invited to lunch with Louis, around May or June of 2008 when he broached the subject to me. The then deputy director (Ka Hin) was planning to go on sabbatical in 2009 and he (Louis) thought (at that time) that I would make a good replacement.

Did you have any expectations for IMS when you became the Deputy Director?

YN: IMS was established in July 2000. It was initially housed in the Mathematics Department. When Louis asked me to be the Deputy Director in May 2001, the IMS buildings at Prince George Park were still under renovation. The first IMS program was to start in July 2001. So I had the expectation that there would be much to do in the new institute under Louis's dynamic leadership.

DL: To be honest, I did not know much about IMS before becoming Deputy Director. I may have attended a few IMS public lectures, but that was about it. So part of the reason for taking up the position was out of curiosity in finding out what IMS does and how it really works.

KH: I had certainly hoped I could help IMS achieve its scientific mission.

SP: Not really, I knew that it had been running well for close to a decade, and had been organizing many programs in different areas of the mathematical sciences.

I understand that the Deputy Director appointment was jointly made with your regular academic duties. Did it affect your regular research and teaching?

YN: I had 60% appointment in IMS and 20% each in Math and CFE (Center of Financial Engineering) for the first year, and then 80% in IMS and 20% in Math when Louis was appointed concurrently as Head of DSAP (Department of Statistics and Applied Probability) for 2 years. So my main duty during the three years was to work for IMS. Though the administrative work took a significant portion of my time and my research was somewhat slowed down, the stimulating environment of IMS still allowed me to engage in research actively.

DL: I was on a 50% time appointment with IMS, which meant that I was relieved of teaching duties every other semester. So my research time was not really affected. But after a while I did start to miss the teaching.

KH: It did. In the early stage when I was a deputy director, the two AOs and the IT manager were not that experienced. On one hand, I needed to be familiarized with how IMS was run. On the other hand, I also needed to help them solve their problems. Luckily, I didn't have to teach in my first semester in IMS. During the semester when I had to teach, I found staying in the IMS office did affect my preparation for teaching and research. There were too many small problems that needed my attention and I found I was not that efficient in using my time.

SP: There was a reduction in teaching load, so it did not affect my teaching too much, except that probably I was a little less available to the students as part of the time was spent at IMS instead of at my office in the department. I tried not to let it affect my research too much, and tried to continue to have regular discussions with my collaborators in the department. However, I have to say that it has affected my output somewhat as it was difficult to find a continuous stretch of time to concentrate and write things up.

What do you think was your greatest challenge as Deputy Director?

YN: Following practices in the established institutes like MSRI, IMA and Newton Institute, the initial IMS programs lasted 6 months long. Due to the limited size of the local community of mathematical scientists, sustainability at a high participation level for a long program was an issue in general. Louis and I proposed that IMS organize more short programs than the planned two 6-month programs per year. This has become the norm for IMS programs.

DL: For me personally, being Deputy Director of IMS was the closest I had come up to "real" work up to that time. Teaching and doing mathematics are not so much "real" work for me. Sure, I get paid for doing them; but they are sort of in my system anyway, like part of everyday life. But being an administrator is different. There are many contingencies. The mathematician side of me tried to impose order, but events were not always under our control. I must say that we had a great group of staff working at IMS. They helped me a lot, especially at the beginning of my term.

KH: When I was in IMS, we had quite a number of personnel changes. Finding suitable replacements was not easy, not only because of prevailing job market conditions but because of the amount of time spent over administrative procedures and "bargaining" with administration. We also had to depend on some part timers to help out.

SP: To facilitate the general running of the Institute and communication between staff and Director well enough so that I appear completely superfluous and dispensable.

Are there any areas of administration, organization or facilities that you feel could be improved on?

YN: It was fortunate that IMS had very good support staff. We joked with Louis that if we hire a support staff member, we could send the person to IMS to be trained by Louis first. Anyone who survives will be very good.

DL: For almost every program, one gets that feeling that it would be nice if things got settled earlier than they actually were. But I suspect that this is a universal tug-of-war between an administrator's and a program organizer's point of view. "Universal" in the sense that it happens at other institutes as well. I've heard the same kind of stories about things getting done at the last minute from friends who had organized programs at other institutes.

KH: Now, our AOs in IMS are very capable. We need to find ways to retain them. IMS offers limited exposure for our staff once they are familiar with the routines. Surely, they can still excel but there are limited opportunities. This affects their promotion, salary adjustment and bonus.

Another problem is to control the program quality and getting meaningful reports and feedback from the programs organized. For example, since IMS pays so much to invite researchers to come to Singapore, we expect them to interact with participants and local researchers, but if they only stay for a few days, it doesn't seem that the money is well spent. After the program, it is often very difficult and it generally takes a lot of time to get reports from organizers. Without their reports, it will be difficult for us to assess if the programs organized did benefit our local researchers, which is one of the objectives of IMS.

SP: There are always areas for improvement, and we try to discuss these during staff meetings as well as on an ad hoc basis whenever something comes up. However, there isn't any particularly glaring problem which needs fixing.

Did you get to interact with participants from fields outside your own?

YN: Yes, one of the most enjoyable experiences at IMS was the opportunity to interact with so many distinguished scholars in different fields who use mathematics successfully in their work.

DL: Actually, I've had more interactions with program organizers; and they are from all sorts of different fields. It is quite interesting for me to at least find out a little bit about what goes on in different areas. For example, I knew very little about bioinformatics, and more generally, about applications of mathematics to biology. It was interesting to get some understanding of what these areas are about.

KH: I did have a lot of chances meeting many participants from fields outside my own. For example, the *Symposium on Mathematics and Science in Digital Media, Technology and Entertainment* did open my eyes in learning how mathematics is applied. Interacting with the members of the Scientific Advisory Board is another eye opener.

SP: Yes, certainly, and it has been extremely interesting and educational.

Do you think that there is sufficient awareness of the activities of IMS within Singapore itself?

YN: Though more can be done, IMS now has a considerable visibility in the universities and schools in Singapore.

DL: Probably not enough. But it is a problem in general with mathematics, I think.

KH: Our staff seems to be more interested in areas that they are active in. Even if we advertised a program, we didn't seem to get very good response from researchers outside the field of the program. When I was Deputy Director, we sent out posters to various departments to advertise our programs. We did try our best to raise the awareness of IMS activities among NUS researchers. As for the general public, the perception is that they won't be able to understand much in those public talks. Occasionally, we did have some very good speakers who could speak at a level that even laymen could understand something. But far too often, our talks are too technical for laymen to understand.

SP: To a certain extent, no. I think we do not get enough publicity in the public media although the activities are well-publicized in the academic community in Singapore.

Thoughts of Program Organizers and Participants

LING San
School of Physical & Mathematical Sciences
NTU

The inaugural IMS program – on Coding Theory and Data Integrity – was held at a time when research activities in these areas were beginning to emerge and develop in Singapore. The program provided invaluable opportunities for researchers and practitioners in these fields to interact, learn from one another, and collaborate. Many of the ties formed between the Singapore-based researchers and the visiting mathematical scientists at the program, as well as between the academia and industry here, remain active to this day, and this network continues to grow. These strong connections have resulted in greater visibility for Singapore in these fields, thus attracting more to work or study here, where the community in these areas has grown significantly over the past decade. The inaugural IMS program has made important contributions to the sustained and visible growth of the research in coding, cryptography and related areas, both in Singapore and internationally.

ZHANG Louxin
Department of Mathematics, NUS

In the past ten years, 4 programs and 2 workshops on a variety of topics in bioinformatics have been organized. It attracted about 180 overseas visitors from all over the world and in the order of 200 local participants (researchers and students). The mix of participants ranged across many disciplines (mathematics, statistics, computer science, biology, medicine). In addition to the workshop talks, 7 public lectures and 4 school lectures were also delivered in NUS and 4 high schools across Singapore.

The organized activities gave local participants an excellent opportunity to make new contacts at international level. The flow of leading experts in the fields provided a stream of new ideas to work on. The participants benefited from both formal and informal discussions with each other. Many collaborations were started and developed during the programs and workshops. The programs and workshops also led to new research directions and played a role in attracting overseas visitors to work in Singapore

I certainly hope that the program "Representation Theory of Lie Groups (Jul 2002 – Jan 2003)" that I helped to organize belongs to the (long) list of high quality IMS programs, in terms of international interests and caliber of its participants. Led by a director with vision and dynamism, IMS sets itself world class targets and has done admirable work in promoting mathematical sciences in Singapore and beyond. Through its activities, IMS has undoubtedly enhanced NUS's reputation as one of the most vibrant and important universities in the Asia Pacific and indeed a university on the go. On a more specific level, our program helped to initiate, renew and strengthen (many) collaborations between members of NUS research group and international researchers, and in so doing has greatly facilitated the continuing growth of NUS Math as a center of activity for representation theory, a subject of critical importance in modern mathematics.

ZHU Chengbo
Department of Mathematics, NUS

The research group in wavelets at the Department of Mathematics, National University of Singapore, has organized two IMS programs in the last decade. Both programs provided invaluable opportunities for researchers in the group to interact and collaborate with experts around the world. These fruitful collaborations greatly facilitated the group to expand its research interests beyond the area of wavelets to the rapidly developing field of imaging science. The IMS is indeed the symbol of Initiating, Motivating and Surpassing!

SHEN Zuowei
Department of Mathematics, NUS

Louis Chen, the inaugural director of the IMS, was a Ph.D. student of Charles Stein. His academic career has owed much to Stein's original ideas; conversely, Chen's early work on what has now come to be known as Stein's method was instrumental in establishing it as one of the fundamental techniques for probability approximations. It is therefore fitting that the IMS has been able to provide the means to stimulate research in the area: through programs in 2003 and 2009, a workshop in 2008, and two books published in 2005. One of the books, "An introduction to Stein's method", which contains tutorial expositions on a number of different aspects, has helped to bring the mysteries of Stein's method to a much wider audience. The last five years have seen many substantial developments in the method; much of this can be traced back to the influence and support of the IMS.

Andrew BARBOUR
Institute for Mathematics
University of Zurich

Brief impressions of a program co-organizer - Initial invitation: most welcome. IMS administration: courteous, efficient. Effort on my behalf: minimal. Success rate with invitees: high. Program: broad, deep. Size: perfect. Number of talks: just right. Speaker quality: outstanding. Auditorium facilities: excellent. Presentations: exceptional. Audience: attentive, appreciative. Discussions: vigorous. Students: numerous, keen. Coffee breaks: welcome. Interactions: easy. Collaborations: facilitated. Walking over the hill: diaphoretic. Lunch near LT31: a pleasure. Re-entering the Auditorium: deliciously cool. Social functions: enjoyable. Restaurant dining: superb. Evenings along Singapore River: unrivalled. Visitor accommodation: comfortable. Botanic Gardens: inspirational. Hiking about MacRitchie Reservoir: perspirational. Morning jogging: conversational. East Coast Park dining: delightful. Singapore ambience: safe, relaxing. Quarantine facilities: adequate. Relationships established: numerous. Impact: lasting. Overall experience: memorable.

Terry SPEED
Department of Statistics
UC Berkeley and
Walter and Eliza Hall Institute
of Medical Research

Early in 2004, I was invited to participate in a program on Statistical Methods in Microarray Analysis organized by the IMS. This was my first visit to Asia and getting off the plane I must admit I knew nothing about Singapore. In the end though, I was pleasantly surprised at all levels. First, the workshop itself was very interesting and provided a great opportunity to meet new colleagues and discuss Science. Second, on a more personal level, I realized how accessible Singapore was and how exciting living in Asia could be. Later that year, strong from the contacts I had made during the workshop, I moved to Singapore and I have not looked back since.

Guillaume BOURQUE
Genome Institute of Singapore

Over the last six years, I have attended many great talks at the spacious but intimate IMS auditorium. The coffee break in the cozy house is always a pleasant occasion to rub shoulders with intellectual giants. Congratulations to the IMS for fostering meaningful exchanges among scholars, from multiple countries, working in an amazingly wide spectrum of theoretical and applied mathematical disciplines.

YAP Von Bing
Department of Statistics and
Applied Probability, NUS

In April – May, 2004, I had the pleasure of working closely with Louis Chen in organizing and staging a Program on Econometric Forecasting and High-Frequency Data Analysis at the premises of the Institute for Mathematical Sciences in the National University of Singapore. My Program Co-chairs in this venture were Professors Yiu Kuen Tse (Singapore Management University) and Tilak Abeysinghe (National University of Singapore).

I have known Louis since we were graduate students in Stanford in the mid 1960's. The energy and passion and attention to detail that he exuded then as a young man were even more amplified and clearly evident to me as we jointly planned and staged the 2004 Program. He would not settle for a two-day or five-day conference. "No," he said, "It must go on for at least a month or two, as in the usual pattern of IMS programs." And, as to be expected, Louis had his way. The Program, to the benefit of the local and regional statisticians and econometricians, culminated in a refereed proceedings volume in the IMS Lecture Notes Series. The Program consisted of seminars and workshops by local and invited visitors, special tutorial lectures by leading experts, and a two-day symposium of invited papers by distinguished researchers in the field. All participants, especially the visiting experts, enjoyed the pleasant and inspired facilities of the Institute.

Looking back on my stay in Singapore in the past eight years, mounting this Program is indeed one of the main highlights of my long Singapore visit – many thanks to the collaborative partnership with Louis Chen and the Institute for Mathematical Sciences.

Roberto S. MARIANO
School of Economics, SMU
and Department of Economics
University of Pennsylvania

I was fortunate to be involved in organizing three activities at IMS: as a committee member for the "Wall-Bounded and Free surface Turbulence and its Computation (Jul -Dec 2004)", chair of the "Moving Interface Problems and Applications in Fluid Dynamics (8 Jan - 31 Mar 2007)" and local chair of the "Spring School on Fluid Mechanics and Geophysics of Environmental Hazards (19 Apr – 2 May 2009)". Although my involvement in such activities demanded much time and effort from me, it gave me and many other participants a rare and golden opportunity to work with world renowned luminaries. This in turn has helped us broaden our outlook and reinforced our multidisciplinary approaches to scientific problems. Acquaintances developed with overseas co-organizers and participants have led to many other unintended outcomes which are still taking place: (i) Organizing with C B Lee (Peking University) the series of International Symposium of Physics of Fluids (ISPF); (ii) Research team-up with J N Reddy (TAMU) on a project funded by Qatar National Research Foundation; (iii) Research team-up with Frank Lu (UT@ Arlington) on a project at Temasek Laboratories; (iv) Research collaboration with C D Ohl (formerly at University Twente now at NTU) on bubble dynamics. There are many other developments. IMS is one important key for a faculty seeking to develop external collaborations.

KHOO Boo Cheong
Department of Mechanical Engineering
NUS

As an organizer of a few programs at IMS, I have benefited significantly - these activities have helped in building my international and local collaboration networks, establishing myself in my research fields internationally and in training my graduate students at NUS. From the program on Bose-Einstein condensation (BEC), I established international collaboration with many leading universities such as University of Cambridge, University of Oxford, Courant Institute, etc. I was also invited to be a member of the Editorial Board of SIAM on Journal of Scientific Computing in 2009 and to be a member of the Organizing Committee of SIAM Conference on Computational Science and Engineering (CSE11) to be held in Reno, USA in 2011. From the interaction between Dr. Yanzhi Zhang who graduated at NUS under my supervision in 2006 and an overseas visitor to IMS, Dr. Zhang was offered a three-year postdoc position in the USA and she found a tenure-track Assistant Professor position in a research university in the USA in 2010. Activities at IMS also helped me to build my own research team at NUS and to carry out collaborative research with local people in interdisciplinary fields such as computational physics and computational materials simulation and design.

Congratulations to IMS for its great achievements over the last 10 years!

BAO Weizhu
Department of Mathematics, NUS

Congratulations to the IMS on its tenth anniversary. By the hard work of Chong Chi Tat and Feng Qi and the vigorous support of NUS and IMS, it has been a remarkable time for Mathematical Logic in Asia. IMS hosted a very successful two-month program, "Computational Prospects of Infinity," in the summer of 2005. During that meeting, Chong and Feng presented an ambitious and transformational proposal to me and to Hugh Woodin. Namely, to run a sequence of summer schools for graduate students from Southeast Asia to introduce them to topics in Mathematical Logic, especially Set Theory and Recursion Theory, and attract some of them to pursue research careers in this area. It was a magnificent idea. Five years later, with dedicated attention from all of us and vigorous support from IMS and NUS, the Asian Initiative for Infinity is an established enterprise. Thanks to the John Templeton Foundation, we now have the resources to support a summer school for 50 graduate students (an international mix with a strong Asian emphasis), postdoctoral scholars, senior participants, and senior lecturers. Incredibly, we believe that five years from now the "IMS Summer in Singapore" will be one of the important events in the expected graduate student life of an aspiring Mathematical Logician.

Theodore A. SLAMAN
Department of Mathematics, UC Berkeley

I have been involved in research, education and care of patients with infectious diseases for nearly 20 years. I have always been curious about how or why infectious diseases tend to cluster or appear and disappear. I was thus very pleased when Prof Louis Chen contacted me five years ago to ask if I was interested in a program in mathematical modeling of infectious diseases. I have taken part in the first three workshops on the mathematical modeling of infectious diseases in 2005, 2007 and 2010 and in the process, have met many distinguished mathematicians and statisticians. Most physicians do medicine at least partly because we cannot handle mathematics but I found the workshops to be surprisingly accessible. They have helped a great deal in my understanding of infectious diseases beyond the individual patient and led to many productive friendships and collaborations. Thanks IMS!

Paul Anantharajah TAMBYAH
Department of Medicine, NUS

It is always exciting to stage an international conference. What gave the 2007 Braids Program an extra boost was the Summer School for around 40 graduate students from all around the world. At first, I was concerned about whether the students would stay within their language groupings (English, Chinese, Indian, Spanish, Russian, etc.). However, I needn't have worried. For, from about the second day all participants (including the lecturers) relaxed and started socializing. Perhaps it helped to have some participants for whom this was their first time in Asia, and so were keen to find out as much as possible. It was lovely to see the spirit that developed, and made for an enthusiastic learning environment.

Jon BERRICK
Department of Mathematics, NUS

I participated in the program on Braids (14 May – 13 Jul 2007) at IMS, I got a lot out of it. First, from the summer school and the conference, I learned the necessary basic knowledge and also the new developments in the field of braids. The basic knowledge is very helpful for the beginners like myself, and the new developments could be good choices for future study topics. The second thing is that I met many people in the program, the graduate students interested in this topic and the helpful professors. Communicating with them is full of happiness. I discussed questions with my peers; asked questions, even the study experience from the professors. I really got a lot from the program.

YUAN Zihong (graduate student)
Department of Mathematics, NUS

The program on "Data-driven and Physically-based Models for Characterization of Processes in Hydrology, Hydraulics, Oceanography and Climate Change" (6 - 28 Jan 2008) gave many of us who conducted and attended the workshop a tremendous sense of accomplishment. The workshop (sufficiently long and with excellent environment) provided a platform for exchanges of ideas and collaborations. Speaking from my own experience, one participant joined TMSI to contribute in our first-of-its kind "Climate Change Impact on Singapore" study, commissioned by the National Environment Agency; and TMSI is closely collaborating on climate change research projects (specifically on dynamical and statistical downscaling) with a colleague in the US (UIUC) and another in Canada (McGill). Many thanks to IMS! Congratulations to IMS in celebrating its 10th Year Anniversary and wishing IMS another very successful decade!

LIONG Shie-Yui
Tropical Marine Science Institute, NUS

Twice already, IMS has offered us the unique opportunity to bring together outstanding representatives of the overlapping communities of researchers in mathematics, mathematical physics, and theoretical physics who are actively studying mathematical problems with a bearing on physics. These programs were rewarding, indeed. By all accounts, the participants learned much from their colleagues in neighboring fields, even starting new collaborations that produced published results. Senior participants did a great service to the local graduate students and faculty members by many tutorials of amazingly high standard. I remember these events with a profound feeling of gratitude and the silent hope for a third such occasion. IMS is the realization of a brilliant idea, an accomplishment of many under the leadership of a few. A loud THANK YOU to all of them – and a big hug.

Berthold-Georg ENGLERT
Department of Physics and Centre for Quantum Technologies, NUS

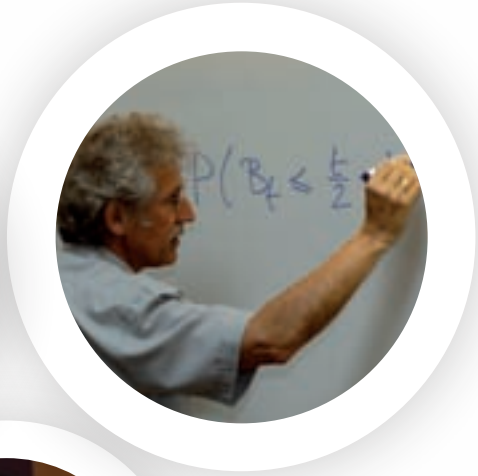
It has been more than a year since I attended this exciting program on Stein's method. The lectures and seminars given by top experts not only showed how powerful and widely applicable Stein's method is, but also increased my research interest in this field. I cannot remember how many times I have looked at my notes which continue to inspire my research. The graduate seminar in the program also provided me with the opportunity to let others know about my work and enhanced my skill of presentation.

FANG Xiao (graduate student)
Department of Statistics and
Applied Probability, NUS

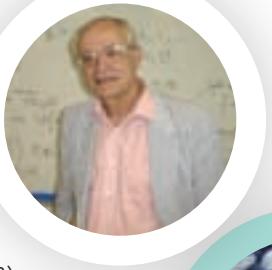
It was particularly relevant that the Financial Mathematics Program (November 2 - December 23, 2009) took place during one of the worst financial crises ever. The discussions on some of the more mathematical developments, i.e. on risk measures and energy markets, made fully clear that for several years "mathematicians did care", and indeed, as exemplified through several participating scientists, "did warn early on". An intensive discussion took place over several days, not only among the scientists themselves, but equally importantly, with the general public (through public lectures) as well as with the MAS, the local regulators. Also through numerous discussions with economists and finance specialists from industry, this program was unique in having been able to map the various challenges for the field going forward. A particular point worth mentioning is the renewed convergence between fundamental questions in economics, and related ones in mathematics.

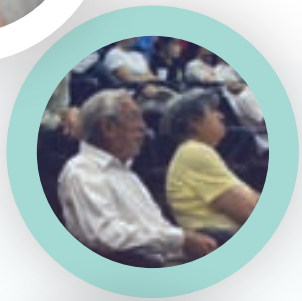
Paul EMBRECHTS
Department of Mathematics, ETH Zurich

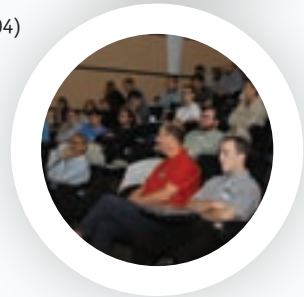
List of IMS Programs and Activities



PROGRAMS







2001

Coding Theory and Data Integrity (Jul 2001 – Dec 2001)

2002 – 2003

Post-Genome Knowledge Discovery (Jan 2002 – Jun 2002)

Representation Theory of Lie Groups (Jul 2002 – Jan 2003)

Advances and Mathematical Issues in Large Scale Simulation (Dec 2002 – Mar 2003, Oct – Nov 2003)

Stein's Method and its Application: A Program in Honor of Charles Stein (28 Jul – 31 Aug 2003)

Mathematics and Computation in Imaging Science and Information Processing (Jul – Dec 2003, Aug 2004)

2004

Statistical Methods in Microarray Analysis (2 – 31 Jan 2004)

Markov Chain Monte Carlo: Innovations and Applications in Statistics, Physics, and Bioinformatics (1 – 28 Mar 2004)

Econometric Forecasting in High-Frequency Data Analysis (5 Apr – 22 May 2004)

Geometric Partial Differential Equations (3 May – 26 Jun 2004)

Wall-Bounded and Free-Surface Turbulence and its Computation (Jul – Dec 2004)

Nanoscale Material Interfaces: Experiment, Theory and Simulation (24 Nov 2004 – 23 Jan 2005)

2005

Semi-parametric Methods for Survival and Longitudinal Data (26 Feb - 24 Apr 2005)

Uncertainty and Information in Economics (9 May – 3 Jul 2005)

Computational Prospects of Infinity (20 Jun – 15 Aug 2005)

Mathematical Modeling of Infectious Diseases: Dynamics and Control (15 Aug – 9 Oct 2005)

Semidefinite Programming and Applications (15 Dec 2005 – 31 Jan 2006)

2006

Random Matrix Theory and its Applications to Statistics and Wireless Communications (26 Feb – 31 Mar 2006)

Random Graphs and Large-Scale Real-World Networks (1 May – 30 Jun 2006)

Algorithmic Biology: Algorithmic Techniques in Computational Biology (1 Jun – 31 Jul 2006)

Dynamical Chaos and Non-Equilibrium Statistical Mechanics: From Rigorous Results to Applications in Nano-systems (1 Aug – 30 Sep 2006)

Geophysical Fluid Dynamics and Scalar Transport in the Tropics (13 Nov – 22 Dec 2006)

2007

Moving Interface Problems and Applications to Fluid Dynamics (8 Jan – 31 Mar 2007)

Braids (14 May – 13 Jul 2007)

Computational Methods in Biomolecular Structures and Interaction Networks (9 Jul – 3 Aug 2007)

Bose-Einstein Condensation and Quantized Vortices in Superfluidity and Superconductivity (1 Nov – 31 Dec 2007)

2008

Data-driven and Physically-based Models for Characterization of Processes in Hydrology, Hydraulics, Oceanography and Climate Change (6 – 28 Jan 2008)

Mathematical Imaging and Digital Media (5 May – 27 Jun 2008)

Mathematical Horizons for Quantum Physics (28 Jul – 21 Sep 2008)

Algebraic Topology, Braids and Mapping Class Groups (4 – 19 Dec 2008)

2009

Progress in Stein's Method (5 Jan – 6 Feb 2009)

Statistical Genomics (1 – 28 Jun 2009)

Mathematical Theory and Numerical Methods for Computational Materials Simulation and Design (1 Jul – 31 Aug 2009)

Financial Mathematics (2 Nov – 23 Dec 2009)

2010

Complex Quantum Systems (17 Feb – 27 Mar 2010)

Geometry, Topology and Dynamics of Character Varieties (18 Jun – 15 Aug 2010)

Hyperbolic Conservation Laws and Kinetic Equations: Theory, Computation, and Applications (1 Nov – 19 Dec 2010)

OTHER SCIENTIFIC ACTIVITIES

Stand-Alone Workshops and Conferences

2002

Inter-Faculty Workshop on Financial Mathematics (12 Jan 2002)

ICM 2002 Satellite Conference: Symposium on Stochastics and Applications (15 – 17 Aug 2002)

IMS-BII Population Genetics Workshop (29 Nov and 2 – 3 Dec 2002)

2003

Workshop on Mathematical Finance (17 Jan 2003)

One-day Workshop on Mathematics and Statistics of SARS (4 Jun 2003)

2004

Workshop on Mathematical Logic and its Applications (17 – 18 Jun 2004)

International Conference on Scientific and Engineering Computation (IC-SEC 2004) (30 Jun – 2 Jul 2004)

The 6th ICSA International Conference (21 – 23 Jul 2004)

2005

3rd Asia Pacific Workshop on Quantum Information Science (3 – 15 Jan 2005)

Workshop on Nonlinear Partial Differential Equations: Analysis, Computation and Applications (3 – 6 May 2005)

Workshop on Data Analysis and Data Mining in Proteomics (9 – 12 May 2005)

Satellite Mascot Workshop (13 May 2005)

Asian Mathematical Conference (20 – 23 Jul 2005)

Workshop on Computational Finance (29 – 30 Aug 2005)

Workshop on Genomics (14 – 17 Nov 2005)

Figuring out life: NUS- Karolinska Joint Symposium on Application of Mathematics in Biomedicine (28 – 29 Nov 2005)

2006

International Conference on Harmonic Analysis, Group Representations, Automorphic Forms and Invariant Theory (on the occasion of Professor Roger Howe's 60th Birthday) (9 – 11 Jan 2006)

Biostatistics Workshop (25 Oct 2006)

2007

Symposium on Mathematics and Science in Digital Media, Technology and Entertainment (1 Jul 2007)

Workshop on Mathematical Models for the Study of the Infection Dynamics of Emergent and Re-emergent Diseases in Human (22 – 26 Oct 2007)

2008

Fourth Asia Pacific Meeting of the Economic Science Association 2008 incorporating a neuroeconomics symposium (22 – 24 Feb 2008)

Workshop on High-Dimensional Data Analysis (27 – 29 Feb 2008)

Workshop on Stein's Method (31 Mar – 4 Apr 2008)

Symposium on Pure and Applied Analysis (21 Apr 2008)

Symposium in honor of Kiyosi Itô: Stochastic Analysis and Its Impact in Mathematics and Science (10 – 11 Jul 2008)

7th World Congress in Probability and Statistics (14 – 19 Jul 2008)

Joint NUS-ISI Workshop on Recent Advances in Statistics and Probability (18 – 19 Nov 2008)

Workshop on Computational Systems Biology Approaches to Analysis of Genome Complexity and Regulatory Gene Networks (20 – 25 Nov 2008)

2009

First Singapore Conference on Quantitative Finance (23 Feb 2009)

Eleventh Asian Logic Conference (22 – 27 Jun 2009)

2010

Workshop on Epidemiology of Infectious Diseases: Emerging Challenges (4 – 8 Jan 2010)

2nd Singapore Conference on Quantitative Finance (5 Mar 2010)

Symposium in Probability and Statistics in honor of Charles Stein on his 90th Birthday (22 Mar 2010)

From Markov Processes to Brownian Motion and Beyond: An International Conference in Memory of Kai Lai Chung (13 – 16 Jun 2010)

Workshop on Recent Advances in Bayesian Computation (20 – 22 Sep 2010)

SUMMER SCHOOLS

2006

Summer School in Combinatorics (8 – 26 May 2006)

Summer School in Logic (3 – 28 Jul 2006)

2007

Winter School in Computational Methods in Fluid Dynamics (8 – 26 Jan 2007)

PRIMA Summer School on Braids (4 – 29 Jun 2007)

Summer School in Logic (2 – 31 Jul 2007)

2008

Summer School on Mathematical Imaging and Digital Media (26 May – 20 Jun 2008)

Summer School in Logic (30 Jun – 26 Jul 2008)

2009

Spring School on Fluid Mechanics and Geophysics of Environmental Hazards (19 Apr – 2 May 2009)

Summer School on Statistical Genomics (1 – 19 Jun 2009)

Summer School in Logic (29 Jun – 24 Jul 2009)

Summer School on Mathematical Theory and Numerical Methods for Computational Materials Simulation and Design (17 Jul – 14 Aug 2009)

2010

Summer School on Geometry, Topology and Dynamics of Character Varieties (28 Jun – 16 Jul 2010)

Asian Initiative for Infinity (AII) Graduate Summer School (28 Jun – 23 Jul 2010)

Publications

Lecture Notes Series

Vol. 1 : Coding Theory and Cryptology, Dec 2002

Vol. 2 : Representations of Real and *p*-Adic Groups, Apr 2004

Vol. 3 : Selected Topics in Post-Genome Knowledge Discovery, Jun 2004

Vol. 4 : An Introduction to Stein's Method, Apr 2005

Vol. 5 : Stein's Method and Applications, May 2005

Vol. 6 : Computational Methods in Large Scale Simulation, Oct 2005

Vol. 7 : Markov Chain Monte Carlo: Innovations and Applications, Nov 2005

Vol. 8 : Transition and Turbulence Control, Dec 2005

Vol. 9 : Dynamics in Models of Coarsening, Coagulation, Condensation and Quantization, Jun 2007

Vol. 10 : Gabor and Wavelet Frames, Aug 2007

Vol. 11 : Mathematics and Computation in Imaging Science and Information Processing, Oct 2007

Vol. 12 : Harmonic Analysis, Group Representations, Automorphic Forms and Invariant Theory, Nov 2007

Vol. 13 : Econometric Forecasting and High-Frequency Data Analysis, Mar 2008

Vol. 14 : Computational Prospects of Infinity, Part I: Tutorials, May 2008

Vol. 15 : Computational Prospects of Infinity, Part II: Presented Talks, Jun 2008

Vol. 16 : Mathematical Understanding of Infectious Disease Dynamics, Dec 2008

Vol. 17 : Interface Problems and Methods in Biological and Physical Flows, May 2009

Vol. 18 : Random Matrix and its Applications: Multivariate Statistics and Wireless Communications, Jul 2009

Vol. 19 : Braids: Introductory Lectures on Braids, Configurations and Their Applications, Dec 2009

Newsletter *Imprints*

Issue 1 – May 2003
Issue 2 – Oct 2003
Issue 3 – Mar 2004
Issue 4 – Jun 2004
Issue 5 – Dec 2004
Issue 6 – Apr 2005
Issue 7 – Aug 2005
Issue 8 – Apr 2006
Issue 9 – Oct 2006
Issue 10 – Mar 2007
Issue 11 – Sep 2007
Issue 12 – Mar 2008
Issue 13 – Oct 2008
Issue 14 – Jun 2009
Issue 15 – Nov 2009

Celebration Program

Thursday, 24 Jun 2010

09:15am - 09:25am	**Guests to be seated**
09:25am - 09:30am	**Arrival of Guest of Honor** **Professor TAN Chorh Chuan** **President, NUS**
09:30am - 10:45am	**Speeches** **Professor Louis CHEN, – Director, IMS** **Professor CHONG Chi Tat – Chair, Management Board** **Professor Roger HOWE – Chair, Scientific Advisory Board** **Professor TAN Chorh Chuan – President, NUS** **Musical performance** **Kelly LOH** ***flute;*** **Mifiona QUAH** ***harp*** **Video presentation** **Group Photo**
10:45am - 11:15am	— Reception —
11:15am - 12:15pm	***Supporting mathematical sciences: An NSF perspective*** **Professor Tony CHAN, HKUST**
12:15pm - 02:00pm	— Lunch —
02:00pm - 03:00pm	***The universe of sets*** **Professor Hugh WOODIN, UC Berkeley**
03:00pm - 03:30pm	— Coffee Break —
03:30pm - 04:30pm	***Is economics a mathematical science?*** **Professor SUN Yeneng, NUS**
04:30pm	— End of program —

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