Pei Dang, Min Ku
Tao Qian, Luigi G. Rodino
Editors

New Trends in Analysis and Interdisciplinary Applications

Selected Contributions of the
10th ISAAC Congress, Macau 2015

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Preface

The International Society for Analysis, its Applications and Computation (ISAAC) is organizing biennial international congresses since 1997 in different places all over the world. Besides highlighting the newest developments in analysis, its applications, and computation through plenary and session talks, these congresses became well-liked social events where young scientists are honored with ISAAC awards, highly advancing and active mathematicians are elected as honorary ISAAC members, and the society is electing its officers for the next 2-years period. After the congresses the ISAAC members elect a new board, the group in charge of electing, supporting, and controlling the officers, for the following 2 years.

The 10th International ISAAC Congress was organized at the University of Macau between the 3rd and the 8th of August 2015. The proceedings of this 10th congress are published in two volumes, one containing the plenary lectures and the other one including the session talks and some personal citations for meritorious ISAAC members. Some sessions publish their own proceeding issues separately. The plenary talks appear as "Mathematical Analysis, Probability and Applications—Plenary Lectures: ISAAC 2015, Macau, China, T. Qian and L. Rodino., eds. Springer Proceedings in Mathematics and Statistics, 177, 2016."

At the Macau congress Professor Lo Yang from the Chinese Academy of Sciences was elected as honorary member (see the citation by Gary Gundersen in this volume) and Dr. Jinsong Liu, also from the Chinese Academy of Sciences in Beijing, received the ISAAC award for young scientists. As newly introduced, five analysts were chosen for special mention of young scientists: Dr. Marcello D'Abbicco from Universidade de Sao Paulo, Brazil; Dr. Matteo Dalla Riva from Universidade de Aveiro, Portugal; Dr. Pei Dang from Macau University of Science and Technology, Macau, China; Dr. Humberto Gil Silva Rafeiro from Pontificia Universidad Javeriana, Bogota, Colombia; Dr. Yan Yang from Zhongshan (Sun Yat-Sen) University, Guangzhou, China.

Two more citations were included in this volume, one for Professor Wei Lin from Zhongshan University in Guangzhou by Yongzhi Xu, Dao-Qing Dai, and Yu-Qiu Zhao, and one for Professor Rudolf Gorenflo from FU Berlin by Francesco Mainardi. Unfortunately two colleagues from the participants of the Macau congress

have passed away recently. Alan McIntosh, a plenary speaker at the congress, passed away in August 2016, and Juri Rappoport, one of the very active special interest group and session organizers and long-time ISAAC member, passed away in March 2016. Some short obituaries will appear in the next ISAAC newsletter to be sent out in January, 2017. The Macau ISAAC congress proved to be also very efficient in recruiting a large number of new ISAAC life members. This has happened mainly because of the activities of some special interest groups. ISAAC has now over 200 life members and two institutional members, i.e., the Scientific Centre CEAF in Lisbon, Portugal, and the Springer International Publishing AG in Basel, Switzerland.

The **76** articles collected in the present volume are selected from session talks. They are the outgrowth and further development of the talks presented at the conference by participants from different countries all over the world, including United States, UK, Australia, Canada, Russia, Kazakhstan, China, India, Hong Kong, Japan, Korea, Macau, and members of the European Union. Most of them contain new results. All the papers were strictly refereed. This volume reflects the latest developments in the area of analysis, its applications, and computation. As in the previous years, some of the sessions or interest groups decided to publish their own volumes of proceedings and are therefore excluded from the present collection. This volume contains eight different chapters.

In Part I, we include eleven articles on complex-analytic methods for applied sciences, complex geometry, and generalized functions. L.A. Alexeyeva and G.K. Zakir'yanova use the method of generalized functions to solve nonstationary boundary value problems (BVP) for strictly hyperbolic systems and construct the generalized solutions of BVP subject to shock waves. Olaf Bar uses a fast algorithm to determine the flux around closely spaced nonoverlapping disks in a conductive plane. Roman Czapla and Vladimir V. Mityushev construct a conformal mapping of the square with disjoint circular holes onto the square with disjoint slits. Piotr Drygas and Vladimir Mityushev study two-dimensional elastic composites with nonoverlapping inclusions by means of boundary value problems for analytic functions, following Muskhelishvili's approach. Victoria Hoskins gives an example of a linear action of the additive group on an affine algebraic variety arising in the construction of an algebraic symplectic reduction, with nonfinitely generated ring of invariants. Priska Jahnke and Ivo Radloff generalize a theorem of Van de Ven to the case when the ambient space is a homogeneous manifold different from a projective space. Irina V. Melnikova considers different types of solutions to abstract stochastic Cauchy problems, especially generalized solutions, as regularized in a broad sense. Mateusz Muchacki discusses image processing algorithms in different areas of science. E. Pesetskaya and N. Rylko extend the method of functional equations to boundary value problems for a half-plane, strips, and rectangles with circular inclusions. Daniel S. Sage illustrates the theory of meromorphic connections on curves whose leading term is nilpotent in the case of rank-2 flat vector bundles, where much of the Lie-theoretic complexity is absent. Finally, Anna Stolińska and Magdalena Andrzejewska present a result of a qualitative investigation where a case study is treated using an eye tracking technology.

In Part II, we include eleven articles on complex and functional-analytic methods for differential equations and applications. H. Begehr constructs harmonic Green and Neumann functions using the parqueting-reflection principle for strips and hyperbolic strips in the complex plane. Zaiqiang Ku and Li Cheng study the SIR model and obtain the relationship between the number of affected individuals within a special period of time with applications to Ebata virus propagation. M.B. Muratbekov treats such issues as existence of the resolvent and discreteness of the spectrum for the Schrödinger operator with a parameter changing sign. S.A. Avdonin, G.Y. Murzabekova, and K.B. Nurtazina consider source identification problems for the heat equation with memory on an interval and on graphs without cycles and propose a stable efficient identification algorithm. N. Rajabov suggests new methods for investigating the model Volterra type integral equation with logarithmic singularity and the kernel of which consists of a composition of polynomial functions with logarithmic singularity and functions with singular points. K.N. Ospanov studies a three-term second-order differential equation with unbounded intermediate coefficient and gives solvability results and some conditions for compactness of the resolvent of the corresponding operator. Gian Rossodivita and Judith Vanegas find all linear first-order partial differential operators with elliptic complex numbers-valued coefficients associated with an elliptic generalized-analytic operator. Simon Serovajsky and collaborators consider a bacteria population under the action of bactericidal antibiotics. A. Tungatarov solves the Cauchy problem for a system of n-th order nonlinear ordinary differential equations. Yufeng Wang and Yanjin Wang study the Hilbert-type boundary-value problem for rotation-invariant polyanalytic functions on the unit disc. Finally, Shouguo Zhong, Ying Wang, and Pei Dang study a Riemann boundary value problem with square roots on the real axis for a sectionally holomorphic unknown function having zeros in the upper and lower half-planes, and obtain a solution and the explicit solvability condition.

Part III includes twelve articles on functions theory of one and several complex variables. Zhixue Liu and Tingbin Cao make use of Nevanlinna theory and the Zalcman-Pang lemma to obtain interesting results of normalness criteria for a certain type of differential polynomials studied. Guantie Deng, Haichou Li, and Tao Qian present some results on rational approximation, Laplace integral representation, and Fourier spectrum characterization of functions in Hardy H^p spaces on tubes for the whole range of p in $[1, +\infty]$ in the several complex variables setting. Robert Xin Dong obtains lower bounds for the Arakelov metrics for certain compact Riemann surfaces. Min Ku and Fuli He construct the Bergman kernel on the unit ball of $\mathbb{R}^{2n}$ in the setting of Hermitian Clifford analysis and then derive the Plemelj formula for the Bergman integral on the unit ball. Further, Xiao-Min Li, Cui Liu, and Hong-Xun Yi study the uniqueness question for transcendental meromorphic functions that share four distinct finite real values. Fanning Meng, Jianming Lin, Wenjun Yuan, and Zhigang Wang study a complete intersection surface singularity of Brieskorn type and propose a sufficient condition for coincidence of the fundamental cycle and the minimal cycle on a minimal resolution space. Ming-Sheng Liu investigates properties and characteristics of a subclass of starlike functions on the unit disk and proves a covering theorem. Yongmin Liu and Yanyan

Yu obtain the boundedness and compactness of the generalized integration operator from the $Q_K(p;q)$ space to the little Zygmund-type space. Katsuhiko Matsuzaki studies the hyperbolic metric a domain in the plane obtained by removing its integer lattice points. Wenjun Yuan, Fanning Meng, and Shengjiang Chen study a normality criterion related to the famous Hayman conjecture and obtain four criteria. Jingshi Xu and Xiaodi Yang introduce variable exponent Besov and Triebel-Lizorkin spaces associated with a non-negative self-adjoint operator and give equivalent norms and atomic decompositions of these new spaces. Hongfen Yuan, Tieguo Ji, and Hongyan Ji derive a decomposition theorem for the kernel of the polynomial slice Dirac operator using the generalized Euler operator in $\mathbb{R}^{m+1}$, generalizing the well-known Almansi decomposition theorem. Shengjiang Chen, Weichuan Lin, and Wenjun Yuan consider properties of meromorphic functions, which share a set with their first derivatives. Finally, Cuiping Zeng derives a normality criterion for differential polynomials, which improves an earlier result by Fang and Hong.

Part IV is devoted to harmonic analysis and nonlinear PDEs and includes seven articles. Neal Bez et al. propose a conjecture concerning the shape of initial data that make the classical Strichartz estimates extremal for the wave propagator with initial data of Sobolev regularity $\frac{d-1}{4}$ in all spatial dimensions $d > 3$, complementing an earlier conjecture of Foschi in the critical case of $\frac{1}{2}$ regularity. Jishan Fan and Tohru Ozawa study global weak solutions to the 3D time-dependent Ginzburg-Landau-Maxwell equations with the Coulomb gauge and obtain uniform bounds of solutions with respect to the dielectric constant. Tokio Matsuyama and collaborators prove L_p-boundedness of functions of Schrödinger operators on an open set of $\mathbb{R}^d$. Tokio Matsuyama and Michael Ruzhansky consider the Cauchy problem for the Kirchhoff equation and establish the almost global existence of Gevrey space solutions. Kiyoshi Mochizuk and Igor Trooshin treat an inverse scattering problem on a graph with infinite rays and a loop joined at different points, and reconstruct a potential on the basis of the scattering data of the operator. Lukasz T. Stępień presents some exact (functionally invariant) solutions of self-dual Yang-Mills equations in the $SU(2)$ case. Finally, Vladimir B. Vasilyev discusses basic principles for constructing a theory of boundary value problems on manifolds with nonsmooth boundaries.

Part V contains ten articles on integral transforms and reproducing kernels. Miki Aoyagi considers the Vandermonde matrix-type singularity learning coefficients in statistical learning theory. Dong Hyun Cho, Suk Bong Park, and Min Hee Park introduce several scale formulas on $C[0;t]$ for the generalized analytic conditional Wiener integrals of cylinder functions and of functions in a Banach algebra, which corresponds to the Cameron-Storvick Banach algebra. B.I. Golubov and S.S. Volosivets generalize the results of C.W. Onneweer on membership of multiplicative Fourier transforms to Besov-Lipschitz or Herz spaces. Byoung Soo Kim reviews results on shifting for the Fourier-Feynman transform. T. Matsuura and S. Saitoh develop some general integral transform theory, based on the recent general concept of generalized reproducing kernels. Juri Rappoport considers the application of the Kontorovich-Lebedev integral transforms and dual integral equations to the solution of certain mixed boundary value problems and reduces the diffusion and

elasticity problems to the solution of a proper mixed boundary value problem for the Helmholtz equation. S. Saitoh and Y. Sawano introduce a general concept of a generalized delta function as a generalized reproducing kernel and consider all separable Hilbert spaces. Yoshihiro Sawano proves that the mapping $R : H_K(E) \ni f \mapsto (f|E_1, f|E_2) \in H_{K|E_1 \times E_2}(E_1) \oplus H_{K|E_2 \times E_2}(E_2)$ is isomorphic if and only if $K|E_1 \times E_2 = 0$, where K is a positive definite function on $E = E_1 + E_2$. G.K. Zakir'yanova studies a system of hyperbolic equations of second order, and by using the Fourier transform of generalized functions constructs the fundamental and generalized solutions. Finally, Haizhang Zhang and Jun Zhang justify substituting inner products with semi-inner-products in Banach spaces, discuss the notion of reproducing kernel Banach spaces, and develop regularized learning schemes in the spaces.

Part VI deals with recent advances in sequence spaces and includes five articles. Awad A. Bakery gives sufficient conditions on a sequence space under which the finite-rank operators are dense in the space of all the operators considered. Binod Chandra Tripathy addresses developments on rates of convergence of sequences. Further, Paritosh Chandra Das studies a bounded difference sequence space with a statistical metric. Shyamal Debnath and Debjani Rakshit introduce the notion of rough convergence in general metric spaces and the set of rough limit points and prove several results concerning this set. Finally, Amar Jyoti Dutta introduces a class of sequences of interval numbers and establishes some properties like completeness, linearity, symmetry, as well as some inclusion relations.

Part VII focuses on recent progress in evolution equations and includes twelve articles. Marcello D'Abbicco and his collaborators find a critical exponent for the global existence of small-data solutions to the semilinear fractional wave equation in low space dimensions. Andrei V. Faminskii applies a classical Strichartz-type argument for an abstract one-parameter set of linear continuous operators and rigorously justifies a Strichartz-type estimate in a non-endpoint case. M.R. Ebert, L. Fitriana, and F. Hirosawa prove that the elastic energy satisfies a better estimate than the kinetic energy if the propagation speed is in $L_1(\mathbb{R}_+)$. Anahit Galstian gives estimates for the lifespan of solutions of a semilinear wave equation in the de Sitter spacetime with flat and hyperbolic spatial part under some conditions on the order of the nonlinearity. Christian P. Jäh discusses the connection of the backward uniqueness property with the regularity of the principal part coefficients measured by moduli of continuity and obtains a new backward uniqueness result for higher-order equations. Xiaojun Lu and Xiaofen Lv study the strong unique continuation property for the electromagnetic Schrödinger operator with complex-valued coefficients and its applications. Makoto Nakamura studies the Cauchy problem for nonlinear complex Ginzburg-Landau type equations in Sobolev spaces under the variance of the space and remarks some properties of the spatial variance on the problem. Belkacem Aksas and Salah-Eddine Rebiai consider boundary and internal stabilization problems for the fourth-order Schrödinger equation in a smooth bounded domain of $\mathbb{R}^n$ and establish the decay of the solutions. Pham Trieu Duong and Michael Reissig give a survey of an external damping problem and present a research approach to show essential conditions for the differential

operators that influence the decay estimates and the global existence of solutions to initial value problems. Yuta Wakasugi deals with the critical exponent for the Cauchy problem of the system of semilinear damped wave and wave equations and proves some blow-up results. Jens Wirth's work is devoted to Cauchy problems for t-dependent hyperbolic systems with lower order terms allowed to become singular at a final time and describes the associated loss of Sobolev regularity in terms of the full symbol of the operator.

Part VIII is devoted to wavelet theory and image processing and includes six articles. Kensuke Fujinoki considers two-dimensional average interpolating wavelets and describes properties of the bi-orthogonal bases and associated filters, such as order of zeros, regularity, and decay. Keiko Fujita studies the Gabor transformation for a square integrable function on the two-dimensional sphere and its inverse transformation, and by using an integral over $\mathbb{R}^3$ gives the inverse Gabor transformation in explicit form. Nobuko Ikawa and his collaborators investigate the relation between the slow component of auditory brainstem response and the number of averagings using discrete stationary wavelet analysis and present a new model to analyze the phase shifts of the spontaneous electroencephalogram. Further, Kiyoshi Mizohata shows how to deal with big data written in Japanese and explains several interesting results obtained by wavelet analysis. Akira Morimoto and collaborators propose an image source separation method using N-tree discrete wavelet transforms and present the results of numerical experiments to show the validity of the proposed method. Finally, Marcin Piekarczyk and Marek R. Ogiela undertake a study of the approach to personal authentication based on analyzing biomechanical characteristics related to palm movements and propose a matching scheme.

The editors wish to sincerely thank Macau government and the University of Macau, whose support made possible the success of the conference. We wish to thank the postgraduates in the Department of Mathematics who contributed kind and generous support as volunteers during the congress. We are grateful to the organizers of the 21 sessions of the congress for their work. They spent a key large amount of time inviting participants, arranging and chairing their sessions, and creating a familiar and workshop-like atmosphere within their sessions. Finally, we sincerely thank the session leaders, including V. Mityushev, H. Begehr, A. Schmitt, Wenjun Yuan, Ming-Sheng Liu, Michael Oberguggenberger, J. Wirth, Juri Rappoport, V. Georgiev, B.C. Tripathy, Marcello D'Abbicco, Qiuhui Chen, and Keiko Fujita, who participated in collecting contributions to this proceedings volume and in the refereeing process of the submissions.

Macau, China	Pei Dang
Aveiro, Portugal	Min Ku
Macau, China	Tao Qian
Torino, Italy	Luigi G. Rodino

Citation

Professor Lo Yang: Honorary Member of ISAAC

Professor Lo Yang is a well-known outstanding mathematician whose research achievements and contributions to the mathematical community are invaluable. His extensive collection of high-quality research contains profound results on a variety of topics in complex analysis. Most of his research is in the value distribution theory of meromorphic functions, which is the study of the growth and distribution of values of entire and meromorphic functions. Modern value distribution theory began with the fundamental work of Rolf Nevanlinna.

Particular areas of Lo Yang's research include Nevanlinna deficiencies of meromorphic functions and their derivatives and primitives, deficient functions, angular distribution theory, Borel directions and other singular directions, normal families, and other areas. His research has had a far-reaching impact on value distribution theory. He likes to work on big problems and has had outstanding success.

His many striking results include the following: (a) Lo Yang and G. H. Zhang showed that the number of deficient values of a meromorphic function f of finite positive order cannot exceed the number of Borel directions of f (with a corresponding result for entire functions). (b) Lo Yang showed that the sum of the deficiencies of the kth derivative of a meromorphic function cannot exceed a specific constant that depends on k, which improved results of E. Mues and W.K. Hayman. (c) Lo Yang and Y. Wang proved an inequality for the sums of deficiencies of a meromorphic function and its kth derivative and found all cases of equality.

(d) Lo Yang showed that a meromorphic function of finite lower order p has at most a countable number of deficient functions, and the sum of the corresponding deficiencies cannot exceed a specific constant that depends on p. (e) For every transcendental meromorphic function, Lo Yang proved the existence of a Hayman direction of Picard type, and with Q.D. Zhang, proved the existence of a Hayman direction of Borel type. As an expert in the field, Lo Yang wrote the very important reference book, *Value Distribution Theory*, which is an invaluable resource for both established researchers and mathematicians entering the field.

His publications are very well written and they exhibit his love of mathematics. His style of writing is a pleasure to read. Lo Yang has achieved numerous honors and awards and he has held many important positions. He was elected Member of the Chinese Academy of Sciences in 1980, where he was the youngest Academician from 1980 to 1990. Lo Yang was the Director of the Institute of Mathematics (1987–1995) and the founding President of the Academy of Mathematics and Systems Science (1998–2002) in the Chinese Academy of Sciences. He was the Secretary General (1983–1987) and President (1992–1995) of the Chinese Mathematical Society.

In addition to the enormous contributions of his research and his excellent work in the above important positions, Lo Yang has contributed to the mathematical community in many other significant ways. These additional contributions include his several expository surveys of important results in complex analysis, his numerous lectures at universities throughout the world, his extensive work at developing Chinese mathematics and arranging international scientific exchanges, his service on editorial boards of several mathematical publications, and the countless times he has helped others with their research.

Gary G. Gundersen

Citation

Professor Wei Lin: Citation for His 80th Birthday

Professor Wei Lin is a professor in the Department of Mathematics at Zhongshan (Sun Yat-sen) University in Guangzhou, China. Lin is perhaps most well known for his involvement in the development of a new classification system for partial differential equations, a project completed in collaboration with Ci-Quian Wu, under the direction of Professor Loo-Keng Hua, and published in their 1979 work, Systems of Second-Order Linear Partial Differential Equations with Constant Coefficients, Two Independent Variables and Two Functions. Professor Lin's research continues to expand upon his earlier work, though since the 1990s he has developed an increased focus on wavelet theory, publishing papers on the nonuniform sampling problems in shift-invariant spaces and the Galerkin Method and the subdivision algorithm, among many others.

Lin was born on September 7, 1934, in Shantou, Guangdong Province, China. In 1952, he was admitted to Zhongshan University, and he completed his undergraduate work there by 1956. Following his graduation, Lin remained at Zhongshan, where he began his postgraduate studies, majoring in geometric theory of complex functions and completing his thesis in 1960 (no degree was conferred, as prior to 1977 no degree system existed in China). Following completion of his thesis, Lin received an appointment as a lecturer at Zhongshan, a position he held until 1978, this duration due largely to the ossification of positions in Chinese universities during the period. Lin was promoted to associate professor in 1978 and achieved full professor status in 1983. The Academic Degrees Committee of the State Council approved Professor Lin as an advisor for PhD students in 1986.

In addition to his work at Zhongshan University, Lin has also been actively involved in a variety of other roles in the mathematical community. Between 1990 and 1995, he was the Chairman of the Mathematical Society of Guangdong; he was later named Honor Chairman, a position that he continues to hold. Lin was a member of the board of directors of the International Society for Analysis, its Applications and Computation (ISAAC) between 1997 and 2002, and from 2006 to 2010. Professor Lin has served on the editorial committee of several well-respected journals, including the *Journal of Applicable Analysis*, *Advances in Mathematics*, and *Control Theory and Application.*

Among the most important of Professor Lin's myriad publications is the aforementioned Systems of Second-Order Linear Partial Differential Equations. Lin and his coauthors completed the classification of the system with two variables and two unknown functions, underwent theoretical analysis of the canonic systems, and found applications in mathematical physics, such as elasticity. Their initial 1979 Chinese-language publication was later enhanced by a 1985 English companion, which carried the work further and included revisions and research reports by Professors Robert Gilbert, Y.K. Cheung, C.Q. Wu, and, of course, Lin himself.

On top of his impressive theoretical work, the issues of applying mathematics to practical systems have been one of Professor Lin's concerns since the 1970s. During this period, Lin turned to a brand new mathematical-related field, automatic control theory and applications. On the theoretical level, Lin and his colleagues developed the distributed control systems, while simultaneously applying their work to the creation of a digitally controlled steel-cutting machine for Wen Chong Shipyard in Guangzhou.

Throughout his career, Professor Lin has worked not only to advance his field but also to create bridges within the international community. In 1982, Professor Lin visited Professor Gilbert at the University of Delaware. During this 1 year visit, Lin's warm and friendly personality helped to build a bridge for long-lasting international collaborations among Gilbert, Lin, Heinrich Begehr, and other mathematicians in analysis, application, and computation. Lin has also received visiting appointments at a number of institutions across the globe, including the University of Delaware, the Free University of Berlin, the University of Kazan, and the National University of Singapore.

Yongzhi Xu
Dao-Qing Dai
Yu-Qiu Zhao

Citation

Professor Rudolf Gorenflo: Citation for His 85th Birthday

As a long standing collaborator of Professor Rudolf Gorenflo (since 1994), I am pleased and honored to edit an overview of his life story and professional career on the occasion of his 85th birthday for ISAAC readers. He is a well-known mathematician, an expert in the fields of Differential and Integral Equations, Numerical Mathematics, Fractional Calculus, Applied Analysis, Special Functions, and Mathematical Modeling. His list of publications yields a vivid sight of his ability for collaboration with other researchers and on his wide spectrum of research activities; see his profile in GOOGLE SCHOLAR and the cited paper of FCAA in 2011.

Footnote: For readers interested in Fractional Calculus and in other details of Gorenflo's scientific life may I refer to the survey paper published in the journal *Fractional Calculus and Applied Analysis*, Vol. 14 No. 1 (2011), pp. 3–18, entitled Professor Rudolf Gorenflo and his contribution to fractional calculus by Yuri Luchko, Francesco Mainardi, and Sergei Rogosin.

Rudolf Gorenflo is a descendant of Huguenots who in the seventeenth century came to Germany as religious refugees. He was born on July 31, 1930, as first son of a farmer in Friedrichstal near Karlsruhe. As a child he learnt and practiced all kinds of agricultural work, thereby during the war also learning how to hide in holes against low-flying fighter planes hunting peasants in the fields. As a remarkable fact it may be noted that between ages 12 and 16 he played the organ in the village church at religious services, replacing the regular organist who served in the army during the war. His mathematical talents showed early. He mastered the number system before he learnt to read alphabetical texts; aged 5 years he well knew the

multiplication table, and a little later he liked to play with decimal expansions of fractions, for example by pencil and paper calculation he found the length of the period of the number 1/49 to be 42, contrary to the naive expectation that it should be 48. When he was 12 his parents (recognizing his inclination) arranged for him school education in a gymnasium, and he could get a kind of higher instruction (languages including Latin, mathematics and science, history, religion). He has in living grateful memory his teachers of mathematics. He was, e.g., fascinated learning that the power, the imaginary unit raised to itself, turns out to be a real number.

After Matura examination he became a student of mathematics at the Technical University of Karlsruhe. Under the guidance of Professor Hans Wittich he choose theory of analytic functions as his field of research for his diploma (1956) and degree of Doctor rerum naturalium (1960). His diploma thesis "Meromorphic Periodic Functions of Finite Order" was a critical detailed exposition of papers by Pham Tinh-Quat, a Vietnamese researcher working in Paris with the famous Georges Valiron. His doctoral thesis treated questions of deducing asymptotic properties of an entire function from the infinitary behavior of the sequence of its Taylor coefficients. It has the horribly long title "On the Wiman-Valiron comparison method for power series and its application to the theory of entire transcendental functions." In it appears as an example the Mittag-Leffler function which now, 55 years later, still is a companion of Rudolf Gorenflo. From 1955 until 1961 R. Gorenflo was a teaching assistant in Prof. Wittich's institute. Feeling that there are no promising career prospects for pure mathematicians at the beginning of the 1960s R. Gorenflo looked around for and found a position in industry. Now, leaving the warm environment of university research and teaching made him scientifically homeless. Instead of developing a clear mathematical profile by working for the rest of his life deeper and deeper in the specialization he had entered through his two theses he became a random walker through mathematics and its applications. Entering a commercial-industrial enterprise was not his death as a scientist. After having received his degree of Dr. rer. nat, he worked as a research mathematician first in a telecommunication company in Stuttgart (Standard Electric Lorenz, then in the German branch of US International Telephone and Telegraph Company ITT), then 8 years (1962–1970) in the Max Planck Institute for Plasma Physics in Garching near Munich, then as professor of Mathematics 3 years at the Technical University in Aachen, and since 1973 at the Free University of Berlin. He has collaborated with very different kinds of coauthors in several countries, in varying mathematical and physical disciplines and has supervised many students. His fields of research comprise complex analysis, random numbers and Monte-Carlo simulation, integral transforms and special functions, fractional calculus, diffusion processes (analysis, discretization, stochastics, and simulation), and recent specialization distributed order fractional diffusion processes. A few applications may be mentioned: simulation of queuing systems, simulation of particle flights in rarefied gases, evaluation of spectroscopic measurements, calculation of magnetic fields for toroidal devices of plasma containment in controlled nuclear fusion. At SEL and in the Institute for Plasma-Physics large part of his work consisted in close

collaboration with engineers and physicists by which he developed his outstanding ability to work fruitfully with non-mathematicians.

Thus, a researcher, he has worked in complex analysis. He contributed to the theory of entire and meromorphic functions and complex differential equations. Later he devoted to its application to modeling plane electric and magnetic fields and flows, in analysis, simulation, and numerical treatment of diffusion processes (of one- and of multicomponent type). All the applications were achieved by systems of parabolic differential equations in theory and numerical treatment of integral equations occurring in evaluation of physical measurements. In this latter activity he found his way into the field of inverse and ill-posed problems, first to integral equations of Abel type where he made acquaintance with differential and integral operators of non-integer order and to whose theory and practice he later worked intensively with several coauthors. Noteworthy to mention here are his joint books with Sergio Vessella on Abel Integral Equations: Analysis and Applications (Springer1991) and with Dang Dinh Ang et al. on Moment Theory and Some Inverse Problems in Potential Theory and Heat Conduction (Springer 2002). In the 1980s R. Gorenflo jointly with the geophysicist Prof. Andreas Vogel was a chief organizer of several conferences on applications of mathematics in geophysics with main emphasis on inverse problems. Gorenflo's research results attained international peer recognition. Then he were invited to have a research visit the universities in Delaware (Newark, Del.), Kingston Ontario, Florence (Italy), Beijing, Tokyo, Hanoi, Ho Chi Minh City, Manila, Kraków. In recent years he developed close collaboration with the Centre for Mathematical and Statistical Sciences (Director Prof. A.M. Mathai) in Pala in the southern Indian state of Kerala, India, starting in 2009 with a course he gave there on power laws and their applications.

Around 1990 R. Gorenflo started his final career as a specialist in fractional calculus which was highly stimulated through friendship and collaboration with myself (Francesco Mainardi). This started with the conference hold in Summer of 1994 in Bordeaux. As their field of highest common interest they choose fractional relaxation and diffusion with related stochastic processes. Jointly with several coauthors, including Mainardi's students, they contributed substantially to the development and applications of fractional calculus and propagated their results in many international conferences. Their joint work culminated in their joint book with the late Prof. Anatoly Kilbas and Prof. Sergei Rogosin from Minsk on *Mittag-Leffler Functions: Related Topics and Applications. Theory and Applications*. Springer-Verlag 2014.

Other aspects should not be forgotten. R. Gorenflo was one of West German mathematicians who during the Cold War cultivated close personal and scientific contacts with colleagues in the other separated part of Germany and with colleagues from socialist countries. He participated in conferences in eastern parts of the world and had visitors and research fellows from there in Berlin, contacts that were strengthened and continued after the great change of 1989. He acted as one of the founding editors of the journal *Fractional Calculus and Applied Analysis* and is member of editorial committees of several other journals. In Aachen and Berlin he

has guided many students in their works for diploma, doctor's degree, and teacher's examination, among them several from outside of Germany.

Rudolf Gorenflo: a short outline of his life.

Born on 31 July 1930 in Friedrichstal near Karlsruhe.
1950–1956: Student of Mathematics and Physics at Technical University in Karlsruhe.
1956: Diploma in mathematics.
1960: Promotion to Dr. rer. nat. (doctor rerum naturalium).
1957–1961: Scientific assistant at Technical University in Karlsruhe.
1961–1962: Mathematician at Standard Electric Lorenz Company in Stuttgart.
1962–1970: Research mathematician at Max-Planck Institute for Plasma Physics in Garching near Munich.
1970: Habilitation in Mathematics at Technical University in Aachen.
1971–1973: Professor at Technical University in Aachen.
1972: Guest professor at the University of Heidelberg.
since October 1973: Full professor at Free University of Berlin.
1976–1982: Deputy leader of Free University Research Project Optimization and Approximation (Leader K.-H. Hoffmann).
1982–1989: Director of Third Mathematical Institute of Free University of Berlin.
1980–1984: President of Berlin Mathematical Society.
1983–1988: Head of Research Project Modelling and Discretization (Free University of Berlin).
1989–1994: Head of Research Project Regularization (Free University of Berlin).
1995–2003: Head of Research Project Convolutions (Free University of Berlin).
1994–1997: Leading member of NATO Collaborative Research Project Fractional Order Systems, with R. Rutman, University of Massachusetts Dartmouth.
1995: Guest professor at the University of Tokyo.
1996–2013: Visiting professor of the Department of Physics, University of Bologna for periods of 2–4 weeks (almost) every year.
Since October 1998: Professor emeritus at Free University of Berlin.
After emeritation: continued activity in teaching, scientific research and international collaboration, refereeing and reviewing, and editorial boards of journals.
Rudolf Gorenflo is member of several scientific associations.
Family status: married since August 1959, two sons, one daughter.

Francesco Mainardi

ISAAC: How It Became What It Is

H. Begehr, R.P. Gilbert, L. Rodino, M. Ruzhansky, and M.W. Wong

Abstract A history of ISAAC from its founding in 1996 until its 10th biennial International Congress in 2015.

Keywords History of ISAAC

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1 Foundation

"Let us found an international society for analysis!" announced R.P. Gilbert upon entering the office of H. Begehr, at the Free University of Berlin (FU), late in the morning as usual after a long night working on mathematics. This idea came to him in the beginning of the 1990s, almost 25 years ago. "What for?" replied Begehr, "Do you want to become the president of something?" But it was not just a mood. There

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was already the idea to call the society after Newton "ISAAC," the International Society for Analysis, its Applications and Computation.

In the 1970s R.P. Gilbert had been honored by an Alexander von Humboldt Award, at that time still restricted to US citizens, which had enabled him to extend his stay in Berlin for an additional semester at FU Berlin in 1974/1975. About 15 years later he used the AvH-reinvitation program for another visit at FU. Begehr and Gilbert were involved in writing a monograph [1] and the idea of an ISAAC was put aside for a while. During January 15–17, 1993, there was the conference on Complex Analysis and its Applications at the newly founded Hong Kong University of Science and Technology, organized by Chung Chun Yang. Here Gilbert brought up the idea about ISAAC at the conference and the response from colleagues was indeed supportive. In particular, C.C. Yang was enthusiastic. But his aim was different; in his view the main purpose behind the founding of the ISAAC was to promote and restore the prestige of complex analysis as an area in mathematical research. In this sense he was quite active at that time, e.g., with his book series in complex analysis with Gordon and Breach and with Kluwer. However, Gilbert had in mind a less focussed society which would "promote analysis, its applications, and its interaction with computation." This idea was adopted by the colleagues at the conference and was imbedded in ISAAC's constitution. The goal of ISAAC was to act as a society in the broad field of analysis and should never be dominated just by some particular subfield.

Three more years passed by before Gilbert had prepared to incorporate the society as a nonprofit organization in the state of Delaware. This registration had to be renewed every year for about US$30 and was terminated in 2005. The registration was important because otherwise a tax rate of 2% would have applied even to membership fees paid in the USA.

In 1996 activities of ISAAC began in ernest with Gilbert opening a bank account in Delaware and Begehr one in Berlin. C.C. Yang, the founding vice president, was asked to act as a treasurer for Asia. In April Gilbert had set up registration forms for memberships. They were sent out internationally and the founding members became registered. Indeed, this enabled Begehr sending US$1000 to Gilbert in that June for paying the cost of registration. Shangyou Zhang, a young colleague of Gilbert, set up a home page for ISAAC at the University of Delaware and consequently became the ISAAC corresponding secretary. A second website was established at the Freie Universität Berlin with a link to the main site in Delaware. And Yuri Hohlov opened a site in Moscow. He also managed to create the ISAAC logo, a drawing of the head of ISAAC Newton. Hohlov had put a list of ISAAC fellows on his site, which contained many mathematicians to whom Begehr had sent an invitation to join ISAAC. This publication was risky as none of the persons on the list were ever asked if they agree. By the way, only some were recruited at that time and had paid their dues. Nevertheless, the list survived somehow on the main website at Delaware now in the "List (all ISAAC related people)," containing more than 500 names; however their email addresses are not visible for the public but can be used to send messages. Probably it was never used again and has not been

updated. The Moscow page disappeared, however, as soon as Hohlov joined the Lenin Library in Moscow as an employee.

2 ISAAC Publications, Proceedings

Gilbert prepared the 1st International ISAAC Congress at the University of Delaware (UD) early in 1996. This Congress took place from June 3 to 7, 1997. It was necessary to reduce registration fee for the congress, as well as the society membership fee, for attendees from countries with weak economies. Also it was decided that the Congress fee should contain some part of the ISAAC membership fee for the following 2 years. The congress was organized in parallel sessions, altogether more than 25, and plenary talks; see the ISAAC home page "mathissac.org" under "congresses". The congress fee of US$100 was moderate for the developed countries. Several publishers were present, not just for book presentations but with editors who were interested in obtaining book contracts with ISAAC and its members. In particular John Martindale from Kluwer was enthusiastic about the new society and was expressing his wish that ISAAC will soon compete with SIAM in magnitude and importance. He signed a contract with Gilbert about a book series "International Society for Analysis, Applications and Computation." Ten volumes have appeared between 1998 and 2003. In 1997 the market for scientific literature was still okay. Kluwer had guaranteed for US$500 each volume published in this series and for the first two volumes this amount was actually paid. Obviously Kluwer did not make money with the series and stopped paying. When Kluwer then merged with Springer after 2003 and the name Kluwer disappeared, the book market for proceedings had collapsed because of the restricted book budgets of university libraries. Springer had decided not to publish ISAAC's proceedings anymore and as a consequence had terminated the Kluwer ISAAC series. John Martindale continued to work for Springer. He managed, e.g., in 2006 to get the English translation of the first volume of the *Selected Works of S.L. Sobolev* published by Springer. The Russian original had appeared in 2003. But Martindale was not happy with the new company and had quit. A translation of the second Sobolev volume, published in Russian language in the same year 2006, has not appeared. However, Springer was not interested in further collected works, for examples, the translation of the 2009 in Russian language published Selected Works of S.M. Nikol'skii. Therefore some years later this publisher has changed its policy. Already in 2003 Birkhäuser, since 1985 part of Springer, has started its series "Trends in Mathematics" and in 2011 Springer itself has started its "Springer Proceedings in Mathematics," now "Springer Proceedings in Mathematics & Statistics," where proceedings volumes are published. In 2013 Birkhäuser has started the subseries "Research Perspectives" of the "Trends in Mathematics." Since the 2013 congress in Krakow the proceedings of ISAAC are published in these series, the plenary talks volumes in the Springer series, and the general proceedings volumes with Birkhäuser. The general Krakow proceedings volume is the second

book in this newly opened subseries. But the general proceedings volume gets smaller and smaller as more sections are publishing their own volumes in order to avoid length restrictions for manuscripts.

As a consequence to the situation with publishers H. Begehr had started to tight ISAAC's strings with World Scientific in Singapore. This company had published the main proceedings from 2001 in Berlin in a very reliable way with convincing results. The problem was the requirement of bulk orders. Joji Kajiwara had succeeded in finding financial resources for paying the printing costs for the two proceedings volumes from 1999 of together more than 1,600 pages.

By the way he did a marvelous job although he had to look after his sick spouse daily for years. On the occasion of his 70th birthday ISAAC has honored him with a "Distinguished ISAAC Service Award".

Joji Kajiwara Fukuoka 2015

It was presented to him at the 12th International Conference of Finite and Infinite Dimensional Complex Analysis and Applications in Tokyo in July 2004, one of a yearly held series of conferences, organized by mathematicians at first from the countries China, Japan, and Korea, to which later Thailand and Vietnam and recently India have joined in. This series was once initiated by Joji Kajiwara.

The Fukuoka proceedings volumes were the only ones of all ISAAC congresses where almost all contributions are published in total. Maybe it was just an accident that some contributions from the session "Analytic Extension Formulas and their Applications" were published together with the ones from a conference from 11 to 13 January, 2000, on "Applications of Analytic Extensions" at the Research Institute for Mathematical Sciences of the Kyoto University in an extra volume in the ISAAC Kluwer series 2001 under the title "Analytic Extension Formulas and their Applications" edited by Saburou Saitoh, Nakao Hayashi, and Masahiro Yamamoto.

From the Delaware 1st ISAAC congress, four sections have published their papers in extra volumes outside the ISAAC Kluwer series; see the ISAAC home

23rd International Conference on Finite or Infinite Dimensional Complex Analysis and Applications Kyushu Sangyo University, Fukuoka, Japan, 24.–28. 08., 2015

page mathisaac.org. For the 3rd congress in Berlin an extra volume with the plenary lectures and some main talks from sessions had appeared in the ISAAC Kluwer series. All the other contributions made up two volumes of about 1500 pages published with World Scientific in Singapore. At the 4th congress in Toronto, Man Wah Wong had founded his special interest group under the ISAAC umbrella on pseudo-differential operators and a book series "Pseudo-Differential Operators, Theory and Applications" published with Springer-Birkhäuser. The contributions to the ISAAC congresses within the sessions on pseudo-differential operators are since 2003 published in the Birkhäuser series "Operator Theory: Advances and Applications." Until the 7th congress in London World Scientific has published the main parts of the contributed talks. At the Krakow congress in 2013 representatives from Springer were present and new relations to this publisher were tied. Since then the proceedings are split into two parts. While the plenary talks are published in the series "Springer Proceedings in Mathematics & Statistics," the contributed talks of most of the sessions are appearing in a volume from the Birkhäuser series "Trends in Mathematics, Research Perspectives." After the 10th congress in Macao, ISAAC and Springer signed a contract on publishing monographs and proceedings volumes under the logo of ISAAC (see Appendix). This is the second contract about ISAAC publications as the SAAC book series with World Scientific, see http://www.worldscientific.com/series/saac, is also effective since 2003. Only the main

proceedings of the 8th ISAAC congress 2011 in Moscow were published without World Scientific and Springer for monetary reasons. They have appeared in three volumes published by the Peoples' Friendship University of Russia in Moscow.

A list of ISAAC publications is available at the home page mathisaac.org; see also the links there to the SIGs' home pages.

3 Members

The first ISAAC members were according to an email from Begehr to Gilbert from May 9, 1997: H. Begehr, M. Essen, R. Gorenflo, M. Kracht, S. Louhivaara, H. Malonek, W. Watzlawek, E. Wegert as life members (they had paid DM (German Marks) 250) and as annual members (the fee was DM 40) in 1995 K. Guerlebeck, P. Kravanja, M. Reissig, St. Ruscheweyh, J. Schnitzer and in 1996 Yu. Hohlov and M. Reissig. Not yet listed here are R.P. Gilbert and C.C. Yang. They both were supposed to recruit members in America and in Asia, respectively. At the end of 2015 ISAAC had 204 life members registered from 49 counties. The largest groups are from Japan (22), Russia (19), Italy (16), USA (13), China (12), Germany (10), and Kazakhstan (10). Seven members are from each Georgia and Serbia, 6 from Austria, also 6 from India, and 6 from Uzbekistan, 5 from Canada, 5 from UK, and 5 from Turkey, 4 as well from Belgium, from France and from Romania. Four countries have 3 ISAAC members: Armenia, Portugal, Sweden, and Tajikistan. The countries Algeria, Belarus, Cuba, Finland, Malaysia, Poland, Switzerland, Ukraine, and Vietnam are represented each by 2 members, and Argentina, Australia, Brazil, Egypt, Guadeloupe (France), Iran, Israel, Korea, Kyrgystan, Macedonia, Mexico, Moldova, Saudi Arabia, South Africa, Spain, Taiwan, United Arab Emirates, and Venezuela have one citizen in ISAAC. Among the "paid" members no continuation of membership fee is yet cultivated. Among the few members, however, is one institutional member from Portugal, the Center for Functional Analysis, Linear Structures and Applications in Lisbon. It has joined ISAAC in 2009 and is since then an ISAAC member. And recently in spring 2016 Springer International Publishing AG has become the second institutional ISAAC member.

Four mathematicians have been decorated as Honorary ISAAC Members. Victor Burenkov had initiated to honor Sergei Mikhailovich Nikol'skii, see [2], Academician of the Russian Academy of Sciences; at the 3rd congress in Berlin, Nikol'skii was at the age of 96, one of the plenary speakers there. At the York University in Toronto, Lee Lorch (see [3]) was—also suggested by Victor Burenkov—elected as Honorary Member. Oleg Vladimirovich Besov [4], former student and coauthor of S.M. Nikol'skii and also Academician at the Russian Academy of Sciences, became Honorary ISAAC Member at the Catania ISAAC congress in 2005. He was the first plenary speaker there and again V. Burenkov had suggested him. Lo Yang, Academician at the Chinese Academy of Sciences, was elected Honorary ISAAC Member at the 10th ISAAC Congress at the University of Macau in Macao 2015, see [5].

4   ISAAC Budget

Because international money transfer was and still is expensive, the idea at the beginning was to have local treasurers, collecting fees and only from time to time transfer bigger amounts. Due to the economical situation C.C. Yang did not collect any membership fees. Gilbert collected money in North America; Begehr had opened an ISAAC bank account in Berlin. The only financial resources of ISAAC are the membership and the congress participation fees. Already between 1995 and 1997 Begehr had collected DM (German Marks) 285 for paid membership fees and DM 2000 for life membership fees. For the registration of ISAAC as nonprofit scientific society in Delaware DM 1556.30 was transferred to Gilbert in 1997. Further in the first years ISAAC had in 1998 collected DM 1390 for conference fees and between the 2001 and 2003 congresses about Euro 610 and US$140 from so-called paid members and about Euro 1960 and US$1400 from life members.

But because of the monthly due bank charges, DM 109.50 until autumn of 1997, and only rare use, the account was terminated in October 1997. Since then Begehr uses his private bank account also for ISAAC. The account in Newark, Delaware, with Gilbert was dissolved in December 2006. The collected amount was used from Man Wah Wong to finance his ISAAC workshop on pseudo-differential operators from 11 to 16 December 2006 at the Fields Institute in Toronto. But Zhang still held an account for paying fees through credit cards. He had arranged for this possibility in connection with the 3rd congress in Berlin after this was demanded mainly from USA participants. In 2011 he did transfer the entire amount to Begehr and closed the account in the US on 11.11. 2011. This was just after Gilbert had retired from the University of Delaware. The main part of this amount was collected from congress fees paid via credit cards since 2001. During 2005 and 2009 Wong has collected some membership fees. This money was spent together with contributions from the Berlin account to finance the conference on "Homogenization, Inverse Problems and Applied Analysis" at the University of Central Florida in Orlando, Florida, from January 13 to 15, 2007, organized by Miao-jung Ou from the University of Delaware in honor of Gilbert on the occasion of his 75th birthday.

At its 2015 meeting in Macao, the board decided to open a bank account again for ISAAC. But this became difficult in the meantime. Banks are very careful nowadays with opening new bank accounts because of problems with money washing. Before ISAAC is not registered again as a (nonprofit) scientific society, there is no chance for an own society account. In recent years, however ISAAC's financial situation has improved. The 3rd (Berlin), the 7th (London), and the 10th (Macao) congresses were the only ones ISAAC was able to collect funds from. Recently many non-ISAAC members from SIGs are joining ISAAC as life members and thus increasing the ISAAC property.

The basis for the property of ISAAC was laid at the Berlin congress. This congress was financially supported mainly by the German Research Foundation (DFG), the Berlin Government, and the Free University of Berlin. Unfortunately there was an economical crisis before the congress which had forced the local

75th Birthday Party of R.P. Gilbert Orlando, Florida, 2007

government to stop spending from the budget. As a consequence, when finally, 1 week before the congress, the amount of over DM 100,000 (about Euro 50,000) was transferred, this was too late to guarantee financial support to participants from the former Soviet Union as they had not enough time to apply for visa. Most of the support from the city had to be returned but some part could be saved for the society for paying bulk orders of the proceedings etc.

In 2005 ISAAC had besides the cash in Begehr's FU account Euro 22,240 furnished by the Berlin congress. Part of this amount was spent for bulk orders in 2009 for the Berlin (about US$9000) and the Ankara (about US$5000) proceedings to World Scientific. In 2009 from the London congress about Euro 11,000 remained after having paid the World Scientific bulk order. From the Macao congress about Euro 4000 was transferred early in 2016 by Tao Qian to the society. He has been able to financially support many more participants of the congress than it was possible in the events before 2015.

But all the congresses were organized independently of the ISAAC budget. Only for the Toronto and the Catania congresses in 2003 and 2005 some financial engagement of the society for plenary speakers and some young participants was required. Up to the 2nd congress in Fukuoka and the 10th in Macao all ISAAC awards for young researchers were financed by ISAAC. C.C.Yang had suggested to start the ISAAC Awards for young scientists of age below 40. He had managed to finance 10 awardees at the Fukuoka congress. In Berlin again 10 young mathematicians were decorated. The price was equipped with a certificate, DM 800 supported by Berlin Mathematical Society, Daimler Chrysler, Motorola, and Siemens, and additionally some books provided by Elsevier, Kluwer, Springer, and

World Scientific. Afterwards, the number of awards was reduced to one at most two. At the Macao congress besides one award some Special Mention of Young Scientist, just a certificate for outstanding research work, were given to five candidates. The other congress very successful also from a financial point of view was the London congress. It got financial support from the London Mathematical Society, the IMU, the Engineering and Physics Research Council, the Oxford Centre in Collaborational and Applied Mathematics, the Oxford Centre for Nonlinear Partial Differential Equations, the Bath Institute for Computer Systems, and the Imperial College London (Strategic Fund and Department of Mathematics).

Remarkable is also the funding of the Fukuoka congress from the Commemorative Association for the Japan World Exposition (1970). It served to equip any proceedings contributor who had registered at the congress with a whole set of two proceedings volumes of more than 1600 pages. From the Berlin congress on it became usual that participants had the choice to order the proceedings volume during the registration process. When this habit was given up without notice at the Krakow congress, this caused some irritation.

5 Constitution

For getting ISAAC registered in Delaware, Gilbert had to create a constitution. It has served for several years, but was not very much observed in the first years. Already in the constitution the idea of special interest groups (SIGs) within the ISAAC society was established. In 2003 Man Wah Wong has founded the first SIG on pseudo-differential operators. Because of a discussion in the ISAAC board about representatives of several, in the meantime built, active special interest groups (SIGs) without elections in the board, before and during the 2009 London ISAAC congress, Michael Ruzhansky and Begehr, on request of the board, have adjusted the constitution somehow to what was practiced. The ISAAC community has accepted the new constitution by an electronic voting and it was amended in 2013 just before the 9th congress in Krakow. One regulation in the new constitution proved to be very effective in the sequel. Some of the SIGs had quite some large numbers of members, but only a few of whom were registered ISAAC members. Large enough SIGs are allowed to delegate a representative in the board. But non-ISAAC members in a SIG are only counted once as a SIG member. Afterwards they have to join ISAAC or are not counted again. This rule was applied for the first time in 2015. And because several SIGs wanted to keep their representative in the board, ISAAC enjoyed more new life members than ever within a short period between the 10th International ISAAC Congress in Macao and the following board election at the beginning of 2016.

The constitution is available at the ISAAC home page mathisaac.org.

6 Officers and Board, ISAAC Congresses

Gilbert had served as the founding president until the 3rd International ISAAC Congress in 2001 in Berlin. At the 2nd congress 1999 in Fukuoka organized by Joji Kajiwara the first ISAAC board meeting took place (see the Appendix). According to the minutes of this meeting, besides Gilbert and Begehr, Erwin Brüning, Louis Fishman, Ismael Herrera, Ilpo Laine, Saburo Saitoh, Boris Vainberg, Man Wah Wong, and Yongshi Xu took part. Already at the first Congress in Newark, Delaware not only the site of the next but also the next two congresses were determined as Fukuoka Institute of Technology, Japan, and FU Berlin, Germany, with Kajiwara and Begehr, respectively, as local organizer.

At the 3rd congress the democratic structure, manifested in the constitution, was finally practiced. The open board meeting was preceded by a Member Meeting attended by many congress participants who even were not ISAAC members (see the Attachment). However they could not participate in the voting. Gilbert had stepped down as president and had nominated Begehr as first elected president for the period of 2 years. After his election Begehr suggested Gilbert as an honorary president. The board was in favor. But neither a vice president nor a new secretary was nominated. C.C. Yang continued as the vice president and Begehr served also as secretary. For the board meeting in Berlin Gilbert and Begehr just had appointed some colleagues independently of their membership to ISAAC but they were appealed to become ISAAC members. Attendances on this meeting can be viewed in the respective list of the minutes of the board meeting of the 3rd ISAAC congress in Berlin (see Attachment).

Board members were Grigor Barsegian, Carlos Berenstein, Alain Bourgeat, Erwin Brüning, Victor Burenkov, William Cherry, Christian Constanda, George Csordas, Julii Dubinski, Abduhamid Dzhuraev, Maths Essen, Antonio Fasano, Louis Fishman, Klaus Hackl, Ismael Herrera, Adi Ben Israel, Joji Kajiwara, Ilpo Laine, Irina Lasiecka, Wei Lin, Fon-Che Liu, Rolando Magnanini, Takafumi Murai, Ivan Netuka, John Ryan, Saburou Saitoh, Promarz Tamrazov, Domingo Tarzia, Boris Vainberg, Armand Wirgin, Man Wah Wong, and Yongzhi Xu.

At this meeting it was decided to split the proceedings into two parts, one with just the plenary and some main talks from the sessions published by Kluwer in the ISAAC series and others published by World Scientific.

For the election of a board Zhang had set up an electronic voting system on the ISAAC website. This lead to the first democratically elected ISAAC Board consisting of Heinrich Begehr (President), Alain Bourgeat, Victor Burenkov, Julii Dubinskii, Robert Gilbert (Honorary President), Joji Kajiwara, Ilpo Laine, Michael Reissig, John Ryan, Saburou Saitoh, and Man Wah Wong.

ISAAC still had very few members. The main task in the following years was to recruit members. Only with a certain number of members the society would start to develop itself. Life members, just paying a certain amount only once at the beginning of membership was attractive as well for the members as for the society. At first the fee was US$200 later after beginning of 2010 Euro 300. Such an amount

Congress Photo by A. Begehr Berlin 2001

is not very much for people in countries with a strong economy; but the society could collect a bigger amount at a moment while the budget still was very low. For many candidates however, this amount was not affordable because of the economy in their countries. Many of those colleagues were interested in ISAAC and their fees were waived or reduced. After a few years ISAAC counted over 100 life members while the regular annual, as "paid" members listed, ones never were more than 20 at the same time.

In 2003 the 4th congress was held at York University in Toronto, organized by Man Wah Wong. This 4th ISAAC congress was hit by SARS. Because of this disease many scientists refused to participate. While in the preceding Berlin congress there almost 40 sessions, in Toronto there were just 15 sessions. In the minutes of the Toronto board meeting ISAAC is reported to have, besides 1 honorary member, 54 life members, 44 of which had joined after 2001, and 16 paid members. Begehr was reelected as president. At the board meeting were present Begehr, Victor Burenkov, Gilbert, Ilpo Laine, Michael Reissig, Saburou Saitoh, M.W. Wong, and C.C. Yang.

The board election after the 2003 congress took place in two separate ballots. As well three vice presidents were elected, Erwin Brüning for Africa, Man Wah Wong for America, and C.C. Yang for Asia, and Victor Burenkov, Massimo Lanza de Cristoforis, Ilpo Laine, Michael Reissig, John Ryan, Saburo Saitoh, and Masahiro Yamamoto as board members. Additionally, Gilbert as the Honorary President belonged to the board. This board elected the next president at the congress in Catania in 2005. By the regulation of the constitution the president may only once be reelected. ISAAC should develop as an international society dominated neither by some person nor by a group. Man Wah Wong was elected and served for the next 4 years. The reelection of presidents became a habit in the following years.

New vice presidents were determined by electronic election, namely Victor Burenkov replacing M.W. Wong, Saburo Saitoh, and Erwin Brüning. Begehr and Zhang were confirmed as secretary and treasurer and as webmaster and secretary, respectively. Besides the officers members of the board were for the board 2006