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HAPPY BIRTHDAY, PROFESSOR FENG KANG!

September 9, 1990 was the 70th birthday of Prof. Feng Kang, outstanding mathematician, Member of Academia Sinica. We four Editorial Committees extend here our warmest congratulations to Professor Feng Kang.

Feng Kang was born in Nanjing, Jiang Su Province. When he was in Suzhou Middle School, he distinguished himself in all his studies and showed strong interest in mathematics and physics. Soon after the War of Resistance had broken out, he left the occupied area for the south. In 1939 he entered the Department of Electrical Engineering, Central University, Chongqing, taking all the required courses for the electrical engineering, physics and mathematics majors, and graduated from Physics Department in 1944, right after that he turned to mathematics. This background played a subtle role in his later career in science.

Since 1945 he had worked in the Departments of Physics and of Mathematics, Fudan University and Tsinghua University. In 1951, joined the newly founded Institute of Mathematics, Academia Sinica, before long, he was sent to Steklov Institute of Mathematics, Academy of Sciences of USSR, for advanced studies. During this period, he had the chance to study under S.S. Chern, L.K. Hua and L.S. Pontrjagin, eminent mathematicians but with different style.

In 1957–1978 Feng worked in Institute of Computing Technology, Academia Sinica. He was elected as a Member of Academia Sinica in 1980. Since 1978 he worked in Academia Sinica Computing Center, Director 1978–1986, Honorary Director 1987–. Chinese Computer Society, Vice Chairman 1978–1986. Chinese Society of Computational Mathematics, President 1985–1990, Honorary President 1990–. Member, Academic Award Commission, State Council, 1980–. He has been associated with various domestic and international universities, scientific institutions, societies and journals. In particular he is deputy editor in chief in Mathematics, Encyclopedia Sinica and editor in chief of the four principal Chinese journals on computational mathematics and scientific computing undersigned below.

Before 1957 Feng devoted to pure mathematics, mainly topological groups and theory of distributions. His earliest works (unpublished) were on generators of symplectic groups and topological proof of the fundamental theorem of quarterion algebra. His main interest is in almost periodic topological groups, initiated by von Neumann in 1934 in relation to unitary representations. Two extreme cases are important: maximal groups with an abundance of unitary representations and minimal groups, devoid of unitary representations. The characterization problem for maximal groups was solved in 1936 by Weil and Freudenthal. The theory for minimal groups was advanced further in 1940 by von Neumann and Wigner, but the characterization problem remained open. In 1950 Feng solved the problem for linear Lie groups, a significant result for representation theory and physical applications.

In theory of distributions, Feng worked out a duality theorem between discrete (delta functions and their derivatives) and continuous distributions. Upon suggestion of L.K. Hua, he founded a theory of generalized Mellin transforms, which has potential applications in partial differential equations and in analytical theory of numbers. His long article presenting the theory of distributions was influential for the development of that new discipline in china.

Since 1957 Feng's research interest turned to applied and computational mathematics, the fields in which Feng's most important contributions lie.

Based on the experience of his collective from late fifties to early sixties on solving large scale engineering computing problems ranging from airfoil flutter dynamics and especially

various stress analysis of dams and architectural designs, he originated, independently from the engineering community of Western countries, in a systematic way, the finite element method (or the difference method based on variational principle as was called then) together with its earliest mathematical foundation. This innovation in numerical solution of elliptic equations consists simply in variational principle plus triangulation, putting the discrete solutions together with the continuous ones in the same Sobolev function space—enormous advantages both in practical implementation and in theorectical analysis. It gained rapid developments and world-wide applications. The finite element method now has become classical and is universally recognized as a major progress in contemporary applied mathematics. Feng's merit in the independent origination of the finite element method under the isolated condition then in China was duly appreciated afterwards both at home and abroad.

In 1970's Feng extended the classical theory of elliptic equations to the so-called composite manifolds containing components with different dimensions. This laid a mathematical foundation for complex elastic structures and for the convergence of the correspondent finite element method. This direction is followed and further developed by Feng's students and other researchers in recent years.

It is well known that elliptic equations can be reduced to boundary integral equations. In this aspect Feng originated the so-called natural boundary reduction method, quite different from the conventional Fredholm's approach. He introduced hypersingular kernel (in Hadamard's distribution sense, pseudo-differential operator of order 1) to make the boundary reduction fully compatible with the variational principle over the domain and so to make the boundary finite elements also fully compatible with the domain finite elements. So the resulting integrated methodology (domain finite elements plus boundary elements) is highly flexible and good for large-scale problems with natural and compatible coupling between domains and boundaries. This is in fact a pioneering contribution to the so-called domain decomposition methods now under active development in relation to parallel computation. In particular, he obtained for Helmholtz equation the radiation condition at finite distance corresponding to the classical Sommerfeld radiation condition at infinity, a significant result both in theory and applications. This direction is followed by his students and other researchers, it deserves further exploration.

Since 1984 Feng's interest turned to dynamical problems. At 1984 International Symposium on Differential Geometry and Differential Equations he proposed in a way the Hamiltonian (or symplectic or canonical) algorithms for solving Hamiltonian equations together with mathematical foundation within the framework of symplectic geometry. As is well known, all real physical processes, classical, quantum, relativistic with finite or infinite number of degrees of freedom all included, can always be cast in suitable Hamiltonian form. However, inspite of the importance and ubiquity of Hamiltonian systems, the pertinent numerical methods for such systems were unfortunately and grossly neglected thus far. Works of Feng and his co-worker definitively show the following: (1) All conventional methods are generically non-symplectic, they all inevitably produce artificial dissipation and other kinds of distortions alien to Hamiltonian systems. (2) Infinite varieties of symplectic schemes can be systematically constructed, they are "clean" algorithms, free from all non-Hamiltonian pollutions. (3) The structural properties, including the conservation properties, of the discrete Hamiltonian algorithms are completely parallel to those of the continuous Hamiltonian systems. This ensures the high quality of the algorithms. (4) Computer experimentation confirms convincingly the overwhelming superiority of the symplectic methods over the conventional non-symplectic ones, especially in the aspects of structural, global stability properties and long-time tracking capabilities. Thus Feng's work initiates a new research field of numerical methods for Hamiltonion systems, promising of wide developments and applications.

In addition to his own research, Feng also takes on administrative work. He was an

initiator of China's research on computing technology, scientific computing and computational mathematics and made important contributions to the building up of China's research forces in these fields. For many years since 1957, with his characteristic enthusiasm, strong sense of duty and sound knowledge base he supervised the research first at the Mathematical Laboratory of Institute of Computing Technology and then at the Computing Center. Under his guidance his collective solved a large variety of large scale computing problems important for scientific research and economy on the one hand, and produced a series of excellent results in basic research in computational and applied mathematics on the other hand. He was also crucial in the founding of national society and journals on computational mathematics and scientific computing. In 1964, under his proposal, China's first national journal in this area, Applied Mathematics and Computational Mathematics started publication. Unfortunately however, it was forced to close right at the outbreak of "Cultural Revolution" in 1966. Around 1979, again by Feng's initiative, four national journals has been started successively. Mathematica Numerica Sinica (in Chinese), Numerical Methods and Computer Applications (in Chinese), Journal of Computational Mathematics (an international journal in English, published jointly with VSP, the Netherlands), Chinese Journal of Numerical Mathematics and Applications (an English translation journal of the first two, published by Allerton Press, USA). The successful growth of them is credited to Feng's guidance.

Feng Kang is a scientist with deep and independent way of thinking, with creative imaginativeness and with unusual knowledge background. His methodology in research is scientific as usually understood but with a highly personal style. At the inception, with his sound knowledge and deep understanding, he used to stand high to look at things globally and critically from many angles to get the correct overview. Then he used to think hard and with his insight he would be able to spot the most promising area, i.e. to get the "right" problem for attack. Then with his imaginativeness he would be able to conceive innovative idea as guideline which quite often appears to be unconventional but turns out to be right to the point. Then with his accomplished skillfulness and perseverance he would be able to overcome the technical difficulties one by one and ended up sometimes even with down-to-earth implementation and applications. Feng used to work in this way to initiate successfully and successively new directions and new fields of research. As a mathematician Feng is interested in both theorem proving and problem-solving. He advocates, in words and in deeds, the unity of theory and practice as well as the unity of the pure and applied mathematics.

Professor Feng Kang has already made many-sided distinguished contributions to science. However, he is never satisfied with what has been done and he has always an inner incentive for further exploration. Now inspite of his old age, he is still eager for scientific inquiry, still capable, both physically and mentally, to do creative research, still ready to offer something new and original. He is still a full-time working mathematician. In character Professor Feng is a man of integrity, indifferent in personal fame and interest. His unusual perseverance and selfless didication continue to inspire our younger generations. He is highly respected in our scientific community. We whole-heartedly wish him a good health and a long life, and much more achievements in his scientific endeavor.

The Editorial Committees of
Journal of Computational Mathematics
Mathematica Numerica Sinica
Journal on Numerical Methods and Computer Applications
Chinese Journal of Numerical Mathematics and Applications

LIST OF MAIN PUBLICATIONS

(* denotes publication in Chinese)

[1] Minimally almost periodic topological groups, Science Record (Academia Sinica), **3** : 2 (1950), 161–166.

[2] A topological proof of the fundamental theorem of algebra of quarternions, Tech. Rep., Physics Dept., Qinghua Univ., 1950.

[3]* On the theory of distributions, *Prog. in Math.*, **1** : 3 (1955), 405–590.

[4]* Duality relations in spaces of distributions, *Prog. in Math.*, **3** : 1 (1957), 201–208.

[5]* Mellin transform in distributions, I. General theory, *Acta Math. Sinica*, **7** : 2 (1957), 242–267.

[6]* Mellin transform in distributions, II. Convolutions and applications, Report to the Division of Math-Phys-Chem. Sciences, Academia Sinica, 1957, Awarded Academia Science Prize.

[7]* Computing Methods, Science Press, 1959.

[8]* Triangulation method for the numerical solution of integral equations in thin-wing aerodynamics, Tech. Rep., Institute of Computer Technology, Academia Sinica, 1962. (jointly with Zhang Luei et al.)

[9]* A numerical approach for a problem of hydrodynamic stability, Tech. Rep., Commission of Science and Technology, 1963. (jointly with Pan Zhisen)

[10]* Conservative difference scheme for nonlinear subsonic turbine flow, Tech. Rep., Institute of Computer Technology, Academia Sinica, 1963. (jointly with Jing Danhua)

[11]* Built-in treatment of singularities based on conservation laws in difference schemes for oil flow problem, Tech. Rep., Institute of Computer Technology, Academia Sinica, 1964.

[12]* Difference scehems based on variational principle, *Journal of Applied and Computational Mathematics*, **2** : 4 (1965), 237–261.

[13]* The finite element method, I. Method, *Mathematical Practice*, 4 (1974), 54–61.

[14]* The finite element method, II. Theory, ibid., 1 (1975), 42–54.

[15]* The finite element method, III. Applications, ibid., 2 (1975), 51–73.

[16]* A Survey of the finite element method, in "Finite ELement Methods and Applications", Institute of Computer Technology, Academia Sinica, 1976.

[17]* Methods of Numerical Computation, ed. Feng Kang, Industrial Press, Beijing, 1978.

[18]* Elliptic equations on composite manifold and composite elastic structures, *Mathematica Numerica Sinica*, **1** : 3 (1979), 199–208.

[19]* On The theory of discontinuous finite elements, *Math. Num. Sinica*, **1** : 4 (1979), 378–385.

[20]* Differential vs integral equations and finite vs infinite elements, *Math. Num. Sinica*, **2** : 1 (1980), 100–105.

[21]* Conservative difference method for neutron transport equation and eigenvalue problem, *Journal on Numerical Methods and Computer Applications*, **1** : 1 (1980), 26–33. (jointly with Zhen Ji-rong et al.)

[22]* Mathematical Theory of Elastic Structures, Monograph on Pure and Applied Math., Science Press, Beijing, 1981. (jointly with Shi Zhong-ci.)

[23] Canonical boundary reduction and finite element method, Proc. of Symposium of Finite Element Methods, org. by Chinese Mechanical Engineering Society (Hefei, 1981), 330–352, Science Press, Beijing, Gordon and Breach, Ins., New York, 1982.

[24] Canonical integral equations of elliptic boundary value problems and their numerical solutions, Proc. of China-France Symposium on Finite Element Methods, 1982, Beijing, ed. Feng Kang and J–L. Lions, Science Press, Beijing, Gordon and Breach, Inc., New York, 1983. (jointly with Yu De-hao.)

[25] Finite and boundary element methods, Keynote Address, International Conference on Finite Element Methods in Engineering, 1982, Shanghai, org. by The Architectural Society of China.
[26] Finite element method and natural boundary reduction, Proc. of the International Congress of Mathematicians, 1983, Warszawa, 1439–1453.
[27] Asymptotic radiation conditions for reduced wave equation, *Journal of Computational Mathematics,* **2** : 2 (1984), 130–138.
[28] Inverse problems in mathematical physics, Report to the Division of Math.-Phys. Science, Academia Sinica, 1984.
[29] On difference schemes and symplectic geometry, Proc. of the 1984 Beijing Symposium on Differential Geometry and Differential Equations–Computation of Partial Differential Equations, ed. Feng Kang, Science Press, Beijing 1985, 42–58.
[30] Difference schemes for Hamiltonian formalism and symplectic geometry, *JCM,* **4** : 3 (1986), 279–289.
[31] Symplectic geometry and numerical methods in fluid dynamics, Proc. of the 10'th International Conference on Numerical Methods in Fluid Dynamics, Beijing, 1986, Lecture Notes in Physics, V.264, 1–7, ed. F.G. Zhuang and Y.L. Zhu, Springer Verlag.
[32] Canonical difference schemes for Hamiltonian canonical differential equations, Proc. of International Workshop on Applied Differential Equations, June 1985, Beijing, 59–73, World Scientific , Singapore, 1986.
[33] The symplectic methods for the computation of Hamiltonian equations, Proc. of 1st Chinese Conf. on Numerical Methods of PDF's, March 1986, Shanghai, Lecture Notes in Mathematics, No. 1297, 1–37, ed. Zhu You-lan and Gu Ben-yu, Springer, Berlin, 1987. (Jointly with Qin Meng-zhao)
[34] On the approximation of linear H-systems, *JCM,* **6**:1 (1988), 88–97.
[35] Construction of canonical difference schemes for Hamiltonian formalism via generating functions, *JCM,* **7**:1 (1989), 71–96. (Jointly with Wu Hua-mo et al.)
[36] The Hamiltonian way for computing Hamiltonian dynamics, Book of Abstracts, VENICE-1/ Symposium on applied and industrial mathematics, October 2–6, 1989, Island of San Servolo, Italy, 8–11.
[37] Sympletic difference schemes for the linear Hamiltonian canonical systems, *JCM,* **8**:4 (1990), 371–380. (Jointly with Wu Hua-mo et al.)
[38] A note on conservation laws of symplectic difference schemes for Hamiltonian systems, *JCM,* **9**:3 (1991), 229–237 . (jointly with Wang Dao-liu)
[39] Symplectic computing og geodesic flows on closed surfaces and Kepler motion, preprint 1990. (Jointly with Tan Yi-fa)
[40] Explicit symplectic schemes for Hamiltonian systems, preprint 1990.
[41] Hamiltonian principle and generating functions in the context of fractural Darboux transformations, preprint 1990.
[42] Hamiltonian algorithm for Hamiltonian systems and a comparative numerical study, to appear in *Comput. Phys. Commun,* 1990. (Jointly with Qin Meng-zhao)