

**THIS SPECIAL ISSUE IS DEDICATED TO
PROF. LI TATSIEN
ON THE OCCASION OF HIS 70TH BIRTHDAY**



Academic Achievements of Professor Li Tatsien

Mathematician and Professor of Fudan University, China. Member of the Chinese Academy of Sciences. Fellow of the Third World Academy of Sciences (the Academy of Sciences for the Developing World). Foreign Member of the French Academy of Sciences. Member of the European Academy of Sciences. Male.

Born on November 10, 1937 in Nantong, Jiangsu Province, China. Graduated from the Department of Mathematics, Fudan University in 1957 and then has been serving on its teaching staff up to the present. His in-service graduate study at the university finished in 1966. Visiting scholar at Collège de France, Paris, France, from January 1979 to April 1981. Promoted to full professorship in 1980 and becoming Ph.D. Supervisor for pure mathematics and applied mathematics in 1981 and 1983 respectively. Appointed as Dean of Graduate School of Fudan University from 1991 to 1999.

At invitations Professor Li has visited over 16 countries and regions such as the United States, France, Italy, the United Kingdom, Japan and Germany etc. either on lecturing tours or as a visiting professor. He gave invited lectures at more than 50 international conferences, and served as a member or chairman on their scientific or organizing committees.

Professor Li has been appointed as a member, deputy chief-editor or chief-editor for over 14 domestic mathematical journals and 12 book series, and a member of the editorial board for about 20 international mathematical journals.

Professor Li is now the Co-Director of the Institut Sino-Francais de Mathmatiques Appliques (ISFMA) since 1998, the President of the China Society for Industrial and Applied Mathematics (CSIAM) since 2000, the Officer-at-large of the International Council for Industrial and Applied Mathematics (ICIAM) since 2003. He was the Vice-President of the Chinese Mathematical Society from 1996 to 2003, a member of the Conseil d'Enseignement of the Ecole Polytechnique from 1997 to 2003 and the Vice-President of the Shanghai Association for Science and Technology from 1996 to 2006.

Professor Li was elected as member of the Chinese Academy of Sciences in 1995, as fellow of the Third World Academy of Sciences in 1997, as foreign member of the French Academy of Sciences in 2005 and as member of the European Academy of Sciences in 2007.

Actively engaged in mathematical research and dedicated to a close combination of basic theory with practical applications, Professor Li has successfully achieved a large number of important results in his research:

1. Mainly motivated by the shock phenomenon in gas dynamics, he has established a complete theory on the local solvability for classical solutions and classical discontinuous solutions to the general quasilinear hyperbolic system in two independent variables (Li Tatsien, Yu Wenci. Boundary Value Problems for Quasilinear Hyperbolic Systems. Duke University Mathematics Series V,

1985).

(1). He initiated a systematic study on free boundary problems with shock waves and contact discontinuities regarded as instances of free boundaries for the quasilinear hyperbolic system. A unified framework is suggested and a simple necessary and sufficient algebraic condition is offered to solve various types of boundary value problems and free boundary problems for the general quasilinear hyperbolic system.

(2). Based on the model of centered rarefaction waves in gas dynamics, an effective way is proposed to overcome the difficulties brought about by multi-valued singularities and consequently an integrated theory is put forward for the centered wave solution to the general quasilinear hyperbolic system.

(3). As a result, a well-known result on the Riemann problem, given by P. D. Lax, is extended to the generalized Riemann problem for general quasilinear hyperbolic systems of conservation laws, thus the local structure of discontinuous solutions is thoroughly revealed.

2. He has made an essential contribution on global classical solutions and global classical discontinuous solutions to quasilinear hyperbolic systems (Li Tatsien. *Global Classical Solutions for Quasilinear Hyperbolic Systems*. *Recherches en Mathematiques Appliques* 32, Masson/John Wiley, 1994).

(1). By introducing the concept of “weak linear degeneracy” and the method of “normalized coordinates”, the existence of global classical solutions is successfully discussed and a sharp estimate is obtained for the upper and lower bounds of the life-span of classical solution for the Cauchy problem of the general quasilinear hyperbolic system with small and decaying initial data. This complete theory with applications in many important physical situations covers and essentially improves all the classic results previously obtained by F. John, L. Hörmander and Tai-Ping Liu under certain special hypotheses. A related open problem proposed by A. Majda in his monograph is then solved.

(2). Professor Li (with J. M. Greenberg) is the first to show the positive effect of the presence of boundary dissipation on the global regularity of the solution to the quasilinear hyperbolic system. This result promotes a series of successive work.

(3). The study of the global classical solution is extended from the Cauchy problem and mixed initial boundary value problems with fixed boundaries to problems with moving boundaries and free boundaries, which are more important and much more difficult. A systematic theory is set up for the first time and a large class of nontrivial global classical discontinuous solutions is constructed for the problems including shock waves and (or) contact discontinuities.

(4). The singularity caused by eigenvectors as a new concept is proposed and the mechanism of the formation of singularities is deeply studied.

3. He has proposed a complete result and a unified framework on the global existence and the life-span of classical solutions to fully nonlinear wave equations (Li Tatsien, Chen Yunwei. *Global Classical Solutions for Nonlinear Evolution Equations*. Pitman Monographs and Surveys in Pure and Applied Mathematics 45, Longman Scientific & Technical, 1992).

To study the global existence and the life-span of classical solutions to fully nonlinear wave equations, Professor Li proposes a simple and unified framework—the global iteration method. With the help of some fine estimates on the solution to the linear wave equation, a complete result is derived on the global existence and the life-span of the classical solution for any space dimension $n(\geq 1)$ and for any integer order $p(\geq 2)$ of the nonlinear right-hand side. All the previous results established with various methods by F. John, L. Hörmander, S. Klainerman and D. Christodoulou etc. under special hypotheses are covered and improved so successfully that the problem can be virtually regarded as perfectly resolved.

4. He has given an efficient mathematical model and method on the resistivity well-logging with applications in petroleum exploitation (Li Tatsien et al. *Applications of the Finite Element Method in Resistivity Well-Logging* (in Chinese). Oil Industry Press, 1980; Li Tatsien et al. *Boundary Value Problems with Equivalued Surface and Resistivity Well-Logging*. Pitman Research Notes in Mathematics Series 382, Longman, 1998).

Based on a series of physical and mechanical models and especially on the resistivity well-logging in petroleum exploitation, Professor Li has described a new type of boundary value problem, namely, the boundary value problem with equivalued surface, and established an integrated theory.

With the practical problem of resistivity well-logging by the patched electrode as the background, the idea and theory on the homogenization of boundary conditions is introduced and developed, resulting in a great reduction of computation complexity.

A unified mathematical model illustrated by boundary value problems with equivalued surface is formed and highly efficient numerical scheme is designed for various types of resistivity well-loggings. Moreover, a convenient treatment of the corresponding problem concerning the patched electrode is suggested by applying the above-mentioned theory on homogenization of boundary conditions. This result which provides a basic theoretical and numerical framework becomes now a classic in the area of resistivity well-loggings. The instrument of mirospheric focusing well-logging made according to this framework has been actually employed by more than 10 domestic oil fields for more than 20 years up to now, bringing about better

geological interpretation and considerable economic benefits.

5. He has obtained a complete theory with applications on the exact controllability and exact observability for 1-D quasilinear hyperbolic systems.

By establishing the theory on the semi-global C^1 solution to quasilinear hyperbolic systems, Prof. Li has solved the problem of exact controllability and exact observability for 1-D quasilinear hyperbolic systems with general nonlinear boundary conditions. This result gives a complete theory on the exact controllability and exact observability in the quite open situation—the quasilinear case. Successful applications are given to 1-D quasilinear wave equations and to unsteady flows in a tree-like network of open canals.

As an invited speaker, Professor Li has given a plenary lecture on this subject for ICIAM 2007 (July 16-20, 2007, Zürich).

Significant results are also obtained on the theory and applications of quasilinear hyperbolic-parabolic coupled systems, on the optimal control of distributed systems, on the mathematical modeling and methods of spontaneous potential well-loggings etc.

Professor Li has published more than 200 papers and 16 monographs and textbooks, among which 4 monographs are printed in English in U.S.A., U.K. and France respectively.

He has received domestic prizes and awards, including: Shanghai Top Science and Technology Award, Hua Loo-Keng Prize of Mathematics, one Second Prize and one Third Prize of National Natural Sciences from the State, one First Prize of Scientific and Technological Progress from the State Education Commission, and one First Prize of Scientific and Technological Progress from Shanghai Municipality. Two of his works are awarded as Excellent University Textbooks from the State. One Exceptional Shanghai Award for Teaching Achievements in Higher Education and one First National Award for Teaching Achievements in Higher Education. Moreover, he has received the Science and Technology Progress Award of Ho Leug Ho Lee Foundation.

Hong Jiaying , Zhou Yi

List of Publications of Li Tatsien (Li Daqian, Lee Datsin)

Books and Monographs

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- [6] Li Tatsien. Collection of Papers on Geometry, Analysis and Mathematical Physics, In Honor of Professor Gu Chaohao. World Scientific, 1997.
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