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A Brief Biography of Professor L.C. Hsu (Lizhi Xu)

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L.C. Hsu, Advisor, Institute of Mathematics, Academia Sinica; Honorary Director, Institute of Applied Mathematics, Dalian University of Technology; Honorary Chairman, Department of Mathematics, Huazhong University of Science and Technology; Editor-in-Chief, Journal of Mathematical Research & Exposition; Editor-in Chief, Mathematical Methodology Series, [what publisher?]; and Learned Advisor, Liaoning University. Prof.Hsu devotes himself to the study of mathematics and has obtained many significant [and groundbreaking, noteworthy, etc.] results in the fields of asymptotic integration, unbounded function approximation, and higher dimensional boundary quadrature methods.

Prof.Hsu was born Quanyong Xu in Donglai Shazhou County, now Zhangjiagang City, Jiangsu Province, on September 23, 1920. His father, who worked as a carpenter, passed away when he was only ten years old. Afterwards, Prof.Hsu's family was support by income from his mother's work as a tailor. He graduated middle school first in his class and passed the exam for a full scholarship at the Luoshe County Normal High School. During this period, he not only received the highest grades, but also taught himself college mathematics by devouring such classic textbooks as "Higher Algebra" by Charles Smith. His future research was also inspired by the many biographies of mathematicians biography books that he read during this period.

At the beginning of WWII, when he was 14 years old, he traveled to the Southwest with his classmates. In 1938, after passing the entrance exam, he began attending the Normal Department of the Third National High School at Tongren, Guizhou Province. The hard life tempered his will. He studied assiduously, particularly in math. In 1940, with essentially the same educational level as a graduate of high schools, he passed the entrance exam of the Southwest Associated University (Kunming, China), which was formed from Peking, Tsing-Hua, and Nankai Universities. On his application for college, he changed his name to Lizhi Xu (L.C. Hsu).

Soon after he began college, however, Prof.Hsu had to suspend his schooling to teach in a high school in Chongqing due to difficulties [what difficulties?]. He went back to the Southwest Associated University one year later. Prof.Hsu enjoyed immensely his studies at the University, where he could attend stimulating lectures given by a number of famous professors, including Y. W. Chen, S. S. Chern, K. L. Chung, P. L. Hsu, L. K. Hua, T. H. Kiang, Y. S. Shen and S. H. Wang. He devoted himself enthusiastically to the study of mathematical classics, attended math seminars, worked on the most cutting-edge math research, and learned how to solve a math problem independently [this is really unnecessary]. During his college years, he published four papers in international math journals.

After graduating from the University, Prof.Hsu was recommended by Prof. L.K. Hua to become an assistant lecturer at the Mathematics Department. He was later appointed to an assistant lectureship in the Tsing-Hua University Math Department when, at the end of WWII, the three member colleges of the Southwest Associated University moved back to the North. It normally required an assistant lecturer six or seven years to be promoted to the instructor rank. However, Prof. Hsu took only three. During this period, he was absorbed in mathematical analysis, including working out problems from Whittaker-Watson's "A Course of Modern Analysis" and Polya-Szeg's "Aufgaben and Lehrsatze aus

der Analysis"; He also published a number of papers that are still being cited by other mathematicians.

As a British Council Scholar, Hsu received financial support to visit Aberdeen (Scotland) and Cambridge (England) in 1949-1951. His supervisors were the well-known British mathematicians E. M. Wright and F. Smithies. He returned to China in 1951, and was appointed an associate professor of mathematics by both Tsing-Hua University and the Beijing Normal University.

In 1952, in order to support the cultural construction in Northeastern China, Prof. Hsu volunteered to go to Changchun with Profs. Xianghao Wang, Zejian Jiang, etc. They founded the Math Department at the Northeastern People's University, which later changed its name to Jilin University, and Prof. Hsu was appointed the Vice Chairman of the department. Besides overseeing the departmental affairs, Prof. Hsu taught at least two courses each year. He also organized the Function Approximation Seminar series beginning in 1954 while training and mentoring a number of research scientists. Because of his teaching and his research results in asymptotic analysis and function approximation, Prof. Hsu was promoted to full professor in 1956. In the spring of the same year, he partook in a math conference in Moscow as a member of the Academia Sinica delegation, and this turned out to be his last trip abroad until 1981. After he returned from the conference, he established the computational mathematics field in China and organized the first national computation workshop with Soviet experts.

In 1961, Prof. Hsu was invited to be a reviewer for the Mathematical Reviews. By that time, he had already published more than 50 papers and two monographs. His prolific work continued even after Cultural Revolution began several years later, when all classes stopped. In the beginning, Prof. Hsu did his research at home, but he was soon sent to the countryside. In his new home in Changling County, Jilin Province, after hard physical labor every day, Prof. Hsu still pursued his research and published several famous papers abroad. In September 1975, he went back to teach at Jilin University. He immediately began helping to reorganize research efforts in China, through such actions as starting a nonstandard analysis seminar that attracted mathematicians from around the country. At the beginning of 80's, Prof. Hsu became a Ph.D. advisor, one of the first in the nation, at the Jiling University.

In addition, starting in 1980, he became a professor at both the Dalian University of Technology (DUT, originally the Dalian Institute of Technology) and the Huazhong University of Science and Technology (HUST, originally the Huazhong Institute of Technology). He was also appointed the first director of the DUT Institute of Applied Mathematics, founded in 1981. At the same time he also served as the Chairman of the HUST Math Department. Meanwhile, with support from these two universities, Prof. Hsu founded the Journal of Mathematical Research and Exposition and became its first Editor-in-Chief. In 1984, Prof. Hsu became a Ph.D. advisor at the DUT. Since then, students have successfully completed their Ph.D. dissertations under him and received doctoral degrees, namely W. C. Chu (1987), H. H. Wan (1988), T. X. He (1988), J. Z. Di (1989), W. H. Song (1989)...

After China opened up once more, Prof. Hsu made several trips abroad to engage in academic exchange. He traveled to West Germany twice, to Hamburg in 1981 as a delegate participating in the International OR Symposium and Bonn in 1982 for the International

Symposium on Mathematical Programming. The second trip was financially supported by the German Foundation for the Promotion of Sciences.

Prof. Hsu has visited the U.S. three times since 1983 and worked for 18 months at Texas A&M University, where he was supported by the NSF for the academic year 1985-86. He was also a visiting professor in 1986-87. During this time, he also made three trips to Canada to visit universities and attend conferences.

On his visits in Europe and North America, Prof. Hsu was invited to give talks at a number of university math departments, including the ones at Aachen Technical University (Germany), West Virginia University (Morgantown), University of Pittsburgh (Pittsburgh), Stanford University, Texas A&M University (College Station, Texas), University of Texas at Austin (Austin, Texas), University of Regina (Regina, Canada), University of South Florida (Tempa, Florida), Ohio State University (Columbus, Ohio), and the Thomas J. Watson Research Center (New York). He was also invited to make presentations at several international symposiums.

Hsu has published 12 books and some 150 mathematical papers in well-known Chinese and foreign journals during 1945-1990. In what follows we would like to sketch very briefly some of his contributions in the fields: (1) Asymptotics, (2) Approximation theory, (3) Numerical analysis, (4) Combinatorics-inversion techniques, and (5) Mathematical methodology and related problems.

1. Asymptotics

During the period 1948 through 1951, Prof. Hsu published a number of papers which extended Laplace's asymptotic method to multiple integrals involving a large parameter. Some of these results have been afterwards generalized extensively again by G. Ascoli (1952), R. Riedel (1965) and others. Several of Hsu's asymptotic results have been quoted or reformulated in L. Berg's Asymptotische Darstellungen und Entwicklungen (Berlin, 1968), E. Riekstins' Asymptotic Expansions of Integrals, Vol. 2, Vol. 3 (in Russian), (Riga, 1977, 1981), and other books on asymptotics.

Prof. Hsu obtained a class of complete asymptotic expansions for the differences of zero (Stirling numbers of the second kind), which has been used frequently by statisticians. This result was extended later by Leo Moser and Max Wyman (1958) and also successfully generalized to Stirling functions of the second kind by P.L. Butzer and M. Hauss (1990).

Prof. Hsu was much delighted with his early finding of a general asymptotic expansion formula for a wide class of oscillatory integrals in 1958. His formula with a remainder term was published as theorem 3 of the paper in Proc. Cambridge Phil. Soc., 59 (1963), 81-88.

2. Approximation theory

Prof. Hsu is the first author who offered a quantitative estimation for the first exponential formula of Hille, which is known as one of the most fundamental formulas in the theory of semi-groups of linear operators. This result has inspired some subsequent improvements and comprehensive generalizations given by Z. Ditzian (1969, 1970), D. Pfeifer (1984,1985), et al.

Prof. Hsu and his colleague R.H. Wang firstly formulated the method of growing multipliers (also called "method of multiplier enlargement") in a very general form so that various linear operators could be modified by introducing growing multipliers. This method can be used to approximate unbounded functions over unbounded domains.

3. Numerical Analysis

In 1964 Prof. Hsu obtained the well-known square root iteration method with global convergence by the aid of Hadamard's factorization theorem, which may be quoted here: For any entire function f(z) of order less than 2, f(z) is real if z is real, and f(z) has real zeros only. Denote

$$S(x) = (f'(x))^2 - f(x)f''(x)$$

and define

$$x_{k+1} = x_k \pm |f(x_k)|/\sqrt{S(x_k)}, \quad k = 0, 1, 2, \cdot$$

Then starting from any x_o such that $f(x_o) \neq 0$, the two sequences generated from above iteration process with fixed choices of the signs + and - do always converge monotonically to zeros of $f(z)$ nearest to xo from its right side and its left side respectively. In particular, the divergence of a sequence means that there is no zero of $f(z)$ on the right or left side of xo. This result was first reported at the computational mathematics seminar of Jilin University in 1964; However its publication was delayed until end of "Cultural Revolution." It was then published in the Notices Amer. Math. Soc., 20 (1973), A-577, 73T-B279, through the help of Everett Pitcher.

Prof. Hsu and his colleagues Y.S. Zhou, R.H. Wang, T.X. He, and J.X. Yang have made two main contributions on numerical integration methods. They developed a general process for the construction of lowering dimensional expansions. It has been shown that one can even construct boundary-type formulas with arbitrarily preassigned algebraic precisions. They also completed the constructive process that leads to two kinds of quadrature formulas with any preassigned compound precision for strongly oscillatory integrals.

4. Combinatorics-inversion techniques

Prof. Hsu has established some general pairs of Mbius inversion formulae that are useful for finding solutions of Volterra type integral equations, etc. These results are proved with the aid of Nonstandard Analysis.

Particular mention should be made of the joint paper by Hsu and his American friend H.W. Gould, in which some general inverse series were presented. It is known that Gould-Hsu's inversion pair and its rotated form have extensive application to combinatorial identities. Also, Prof. Hsu and his colleagues W.C. Chu and T.X. He gave a nice application of the inversion pair to the construction of certain rational interpolation process.

5. Mathematical methodology and related problems

Since 1980 Prof. Hsu has spent some time in methodological studies of mathematics. He published a book entitled Topics in Mathematics Methodology (1983, 1988) which has been widely used as a text or a reference book by various teachers' colleges and normal universities in China for training mathematical teachers. In particular, his early publication Methods of Mathematical Analysis and Selective Examples (1955, 1958) has been one of the most popular mathematical textbooks for years in China, and its new edition in 1983 (with joint author X.H. Wang) won the national prize for excellent textbooks in China.

Prof. Hsu also wrote a series of foundation-analytic papers concerning some foundational problems of mathematics, including metamathematical or philosophical analysis of various antinomies, Gdel's incompleteness theorem, etc., during the years 1981-1983.

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