Karl L. E. Nickel (1924 – 2009)*

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DIE INTERVALLSCHACHTELUNGEN

Es konvergieren Intervall-
Schachtelungen überall.
Nach wen'gen Termen
sieht man schon:
den Fehler
kleiner
Epsi-
lon
ε

Professor Dr. Karl Nickel, one of the founding fathers of interval computations in Germany, died on January 1, 2009, a couple of weeks before his 85th birthday[1].

Karl Nickel, professor emeritus of mathematics at the Albert-Ludwigs-Universität in Freiburg, Germany, was born in 1924 in Tübingen. As with most young people of his age, he had to fight in the war. After being released as a prisoner-of-war, he enrolled at the famous Göttingen University. Following study at Göttingen and Tübingen, he received his Diploma in Mathematics (equivalent to a Master's Degree) in 1948. He worked at the Universities of Tübingen and Stuttgart and earned the degree of Doctor in Mathematics (equivalent to a PhD) in 1949. He was employed in aircraft design in Cordoba, Argentina, between 1951–55 and worked at the Universities of Brunswick and Karlsruhe between 1955–62. As early as 1958 he gave a course in a programming language, a novelty at that time; cf. [18]. He joined the Faculty of Mathematics at the University of Karlsruhe as a full professor for numerical mathematics and mainframe computing in 1962 and served there for several years as director of the Institute of Applied Mathematics. There he was the first director both of the Institute of Practical Mathematics and of the Institute for Computer Science, which he founded. Through these activities he played a prominent role in the rise of computer science and in the establishment of education in this subject at Karlsruhe. In 1976 he moved to the University of Freiburg, where he served

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[1]The following text is an extended version of an article which appeared in *Reliable Computing* **5** (1999), pp. 205–206, on the occasion of Professor Nickel's 75th birthday.

as director of the Institute of Applied Mathematics for many years until his retirement in 1989.

Professor Nickel began his academic career with papers on the solution of aerodynamic problems and his fundamental works on boundary layer theory. With his early paper "Über die Notwendigkeit einer Fehlerschranken-Arithmetik für Rechenautomaten", *Numer. Math.* **9** (1966), pp. 69–79, he became the first researcher in Germany to work on interval computations. He wrote over 40 papers on interval mathematics and related problems, focussing on one of the first programming languages which supported interval computations (Triplex-ALGOL 60) [2, 4], on enclosing zeros of polynomials [1, 5, 6], the Newton method [8, 14], the centred form [15], numerical integration with error bounds [3], the summation method of Kahan-Babuška [7], the Prae-Euler summation method [17], stability and convergence of numerical and monotone algorithms [9, 11, 12], and the lattice-theoretical foundation of interval analysis [10]. He also contributed to the guaranteed numerical solution of ordinary differential equations, e.g., [13], and to the solution of systems of linear interval equations, e.g., [16].

Professor Nickel founded the "Interval Library" at the University of Karlsruhe which was continued at the University of Freiburg and grew to over 2000 contributions from interval mathematics and related fields [2]. This library represents a comprehensive archive of the interval computation literature from the beginning of the subject to about 1988. Prof. Nickel also was the founder and editor of the first interval-related journal "Freiburger Intervall-Berichte" which was published between 1978–87. He organised three international conferences on interval mathematics: one at the University of Karlsruhe in 1975 [19] and two at the University of Freiburg in 1980 [21] and 1985 [22]. He was also the founder and chairman of the GAMM committee for interval mathematics.

Through these activities Professor Nickel contributed enormously to the propagation of the ideas of interval mathematics. He was an enthusiastic teacher, being an advisor to 26 doctoral dissertations and 97 masters' theses. He was a member of the "Deutsche Akademie der Naturforscher Leopoldina" and of the Academy of Creative Endeavours (Akademija Twortschestwa) of the former USSR as well as an honorary professor of Liaoning University in Shenyang / Liaoning, China.

Over the years, Professor Nickel never lost his interest in aeronautics. Since the early 1980's he expended much effort on the design of ultralight airplanes. With his PhD student M. Wohlfahrt he wrote a book on tailless airplanes [24]; not only did he design planes, he was also an enthusiastic motor glider pilot.

During his life he wrote poems. They appeared under the pseudonym KLEN in *Palmström als Programmierer* [20] in the tradition of the *Galgenlieder* (Gallows Songs), *Palmström*, *Palma Kunkel*, *Der Ginganz* by the German poet Christian Morgenstern (1871–1914). Under this pseudonym he also collected *Schüttelsprüche* [25] and wrote an introduction to the construction of

[2] These archives are now with the Bergische Universität Wuppertal under the responsibility of Professor Dr. Walter Krämer (`kraemer@math.uni-wuppertal.de`).

Schüttelreime [23], a kind of (often humorous) rhyming.

The poem on the convergence of nested interval sequences at the beginning of this obituary and the one given below are taken from [20], pp. 16 and 46.

DAS STUMMSCHE KONSOL

Stumm erfindet ein Konsol,
das gleich zweifach Werte zeigt,
sich zur ob'ren Grenz' sowohl,
als auch zum Infimum neigt.

Rundungsfehler oder Daten-,
Fehler bei der Konversion
aufgefangen ('s gibt kein Raten),
auch die Abbrechfehler schon.

Denn bei dem Konsol von Stumm
mit dem Doppelzahlenpaar
(ihm ist: "Näherung" zu dumm)
ist's Ergebnis wirklich wahr.

Jürgen Garloff

Selected publications by Karl Nickel:

Papers and reports:

[1] Die numerische Berechnung der Wurzeln eines Polynoms, *Numer. Math.* **9** (1966), pp. 80–98.

[2] The algorithmic language Triplex-ALGOL-60, *Numer. Math.* **11** (1968), pp. 175–180 (jointly with N. Apostolatos, R. Krawczyk, U. Kulisch, B. Lortz, and H.-W. Wippermann).

[3] Quadraturverfahren mit Fehlerschranken, *Computing* **3** (1968), pp. 47–64.

[4] Triplex-Algol with applications, in: Hansen, E. (ed), *Topics in Interval Analysis*, Oxford University Press, 1969, pp. 10–24.

[5] Zeros of polynomials and other topics, in: Hansen, E. (ed), *Topics in Interval Analysis*, Oxford University Press, 1969, pp. 25–34.

[6] Fehlerschranken zu Näherungswerten von Polynomwurzeln, *Computing* **6** (1970), pp. 9–27.

[7] Das Kahan-Babuškasche Summierungsverfahren in Triplex-ALGOL 60, *Z. Angew. Math. Mech.* **50** (1970), pp. 369–373.

[8] *On the Newton Method in Interval Analysis*, MRC Tech. Summary Rep. #1136, University of Wisconsin, Madison, 1971.

[9] Termination criterion and numerical convergence, *SIAM J. Numer. Anal.* **9** (1972), pp. 277–283 (jointly with K. Ritter).

[10] Verbandstheoretische Grundlagen der Intervall-Mathematik, in [19], pp. 251–262.

[11] Über die Stabilität und Konvergenz numerischer Algorithmen, *Computing* **15** (1975), part I: pp. 291–309, part II: pp. 311–328.

[12] Stability and convergence of monotonic algorithms, *J. Math. Anal. Appl.* **54** (1976), pp. 157–172.

[13] The construction of a priori bounds for the solution of a two point boundary value problem with finite elements I, *Computing* **23** (1979), pp. 247–265.

[14] A globally convergent ball Newton method, *SIAM J. Numer. Anal.* **18** (1981), pp. 988–1003.

[15] Die zentrische Form in der Intervallarithmetik, ihre quadratische Konvergenz und ihre Inklusionsisotonie, *Computing* **28** (1982), pp.117–137 (jointly with R. Krawczyk).

[16] Die Auflösbarkeit linearer Kreisscheiben- und Intervall-Gleichungssysteme, *Linear Algebra and Appl.* **44** (1982), pp. 19–40.

[17] Das Prae-Eulersche Limitierungsverfahren, *Z. Angew. Math. Mech.* **63** (1983), pp. 465–478.

Books:

[18] *ALGOL-Praktikum. Eine Einführung in das Programmieren*, G. Braun Verlag, Karlsruhe, 1964 (2nd ed.: 1971).

[19] *Interval Mathematics*, ed, Lect. Notes Comp. Sci., Vol. 29, Springer Verlag, Berlin, Heidelberg, 1975.

[20] *Palmström als Programmierer*, Carl Hanser Verlag, Munich, Vienna, 1977.

[21] *Interval Mathematics 1980*, ed, Academic Press, New York, London, Toronto, 1980.

[22] *Interval Mathematics 1985*, ed, Lect. Notes Comp. Sci., Vol. 212, Springer Verlag, Berlin, Heidelberg, 1986.

[23] *Schüttelreime selbst gemacht*, Verlag Lax, Hildesheim, 1987.

[24] *Schwanzlose Flugzeuge*, Birkhäuser Verlag, Basel, Boston, Berlin, 1990; English translation: *Tailless Aircraft in Theory and Practice*, American Institute of Aeronautics and Astronautics (AIAA), Washington, DC, and Edward Arnold, UK (jointly with M. Wohlfahrt).

[25] *Schüttelsprüche, Eine Anthologie*, Verlag Lax, Hildesheim, 1995.