

9. April 2008, 18:15 Uhr

Ingrid DAUBECHIES

Princeton University

The Application as Architect for the Mathematical Framework

Traditionally, applied mathematicians have often been interested in problems stemming from physics or other natural sciences. In this framework, the standard paradigm is to carry out, and push as far as feasible, a detailed non-quantitative mathematical analysis of the phenomena at hand, even in cases where the computation of quantitative results is a goal from the start of the study. Typically, the transition to numerical computation happens only after the theoretical analysis.

The realization that this transition has to be done extremely carefully in order to lead to meaningful results, gave rise to the very rich mathematical field of numerical analysis. Nonetheless, there is often a separation between the two stages: the mathematical analysis of the problem at hand in a first step, followed by numerical analysis to determine good algorithms for numerical results in a second step.

The requirements of an engineering application, or of solving other problems designed by man (rather than nature) generate mathematical challenges that are equally interesting, in which the implementation modalities can play a role at earlier stages, driving not only the numerical analysis at the end, but playing an important role as well in the mathematical framing of the problem, at the start of the study.

Ingrid Daubechies will present several instances of this interplay between algorithms and analysis, borrowed from work done by the speaker herself as well as many others; examples are wavelets, analog-to-digital conversion and sparse expansions.

JOHANN RADON LECTURES

Nächster Termin: Mittwoch, 23. April 2008, 18:15 Uhr

Helmut NEUNZERT,

Fraunhofer-Institut Techno- und Wirtschaftsmathematik, Kaiserslautern

Mathematik für den Alltag - meist keine alltägliche Mathematik

Mathematik ist heute überall, auch in vielen Bereichen von Handwerk, Industrie und des Finanzwesens; denn Mathematik ist, als Grundlage mathematischen Modellierens und von "scientific computing", eine Schlüsseltechnologie. Simulation und Optimierung gehören zum Alltag von Industrie und Banken, aber auch in vielen Handwerksbetrieben - und sie beruhen eben auf Modellierung und Berechnung. Sie spielen z.B. beim Schleifen von Juwelen, beim Spinnen von Textilfasern, beim Klassifizieren von Leder, bei der Glasherstellung eine wichtige Rolle. Dass diese "Mathematik für den Alltag" keine alltägliche Mathematik ist - auch nicht alltäglich im Sinne moderner mathematischer Forschung -, sollen im Vortrag Beispiele aus den genannten Bereichen unter Beweis stellen.

JOHANN RADON LECTURES 2007/2008

Ingrid DAUBECHIES – biografischer Hintergrund

Ingrid Daubechies' primary area of research is harmonic analysis guided by problems that arise in science, engineering, and psychology. By learning about the concerns of scientists and engineers, Daubechies works to abstract the underlying mathematical problems and then solve them with analysis. She has worked extensively on problems related to signal analysis. One of her major areas of interest in this field is the wavelet transform.

Wavelets provide a mathematical representation of a complex signaling pattern from a series of simpler building blocks. To these one can add increasingly fine and increasingly localized detail, much in the same way a painter uses smaller brushes to achieve a greater degree of detail. Her work led her to construct a family of "compactly supported" wavelets known as the "Daubechies Wavelets". This has opened the door for a new system of image compression that allows for the efficient storage of an image without sacrificing detail. The JPEG2000 file format is one consequence of this work. Her book on the subject remains central to the body of work on wavelet theory.

She has also dealt with the mathematics behind the conversion from analog to digital signaling. Raw analog input, such as sound, lacks the exactness afforded to digital signals, and Ingrid Daubechies' research works to improve the degree of accuracy with which this conversion takes place. Recently she has spent time as well on developing new approaches to regularize various inverse problems with applications to geophysics, neuroscience, and finance.

Academic background

After completing her studies in Belgium at the Vrije Universiteit Brussel with a Ph.D. in physics, Ingrid Daubechies worked as a researcher at her alma mater. She moved to the U.S. in 1987 to work as MTS (member of technical staff) at AT&T Bell Labs. In 1991 Daubechies began teaching mathematics at Rutgers University, and three years later she made the move to Princeton to work in the Program in Applied and Computational Mathematics (PACM) as well as in the mathematics department. From 1997-2001 she served as the director of PACM.

Major and recent awards

- 2007 ICIAM Pioneer Prize
- 2005 Gold Medal (Gouden Penning) of the Flemish Royal Academy of Arts and Sciences
- 2000 Eduard Rhein Foundation Basic Research Award
- 2000 National Academy of Sciences Medal in Mathematics
- 1992 MacArthur Fellowship

Quelle: <http://www.pacm.princeton.edu/people/exec/Daubechies.shtml>

JOHANN RADON LECTURES

Veranstalter: Österreichische Akademie der Wissenschaften (ÖAW) gemeinsam mit der Industriellenvereinigung Wien

Veranstaltungsort: Österreichische Akademie der Wissenschaften, Festsaal
1010 Wien, Dr. Ignaz Seipel-Platz 2

Information: ÖAW/Büro für Öffentlichkeitsarbeit, Dr. Marianne Baumgart
T +43-1-51581-1219, marianne.baumgart@oeaw.ac.at, <http://www.oeaw.ac.at>