

Citation

For outstanding and pioneering contributions to the theory and applications of wavelets



Dr. Ingrid Daubechies

Position and Organization :

James B. Duke Professor of Mathematics, Duke University

Doctorate : Ph.D. (Vrije Universiteit Brussel, 1980)

Date of Birth : August 17, 1954

Brief Biography :

- 1975 Bachelor's degree in Physics, Vrije Universiteit Brussel (VUB)
- 1980 Ph.D. in Theoretical Physics, VUB
- 1975 Research Assistant, Dept. for Theoretical Physics, VUB
- 1984 Research Prof., Dept. for Theoretical Physics, VUB
- 1987 Technical Staff Member, Mathematics Research Center, AT&T Bell Laboratories
- 1991 Prof., Mathematics Dept., Rutgers Univ.
- 1994 Prof., Mathematics Dept. and Program in Applied and Computational Mathematics, Princeton Univ.
- 2004 William R. Kenan, Jr. Prof., Princeton Univ.
- 2011 James B. Duke Prof., Mathematics Dept., Duke Univ.
- 2011 President, International Mathematical Union

Main Awards and Honors :

- 1984 Louis Empain Prize for Physics
- 1992 Fellow, MacArthur Foundation
- 1993 Member, American Academy of Arts and Sciences
- 1994 American Mathematical Society (AMS) Steele Prize for Exposition
- 1997 AMS Ruth Lyttle Satter Prize
- 1998 International Society for Optical Engineering Recognition of Outstanding Achievement
- 1998 IEEE Information Theory Society Golden Jubilee Award for Technological Innovation
- 1998 Fellow, IEEE
- 1998 Member, National Academy of Sciences (NAS)
- 2000 NAS Medal in Mathematics
- 2000 Eduard Rhein Foundation Basic Research Award
- 2006 Emmy Noether Lecturer
- 2010 Guggenheim Fellow
- 2011 Benjamin Franklin Medal for Electrical Engineering
- 2011 Jack S. Kilby Medal of the IEEE Signal Processing Society
- 2011 AMS Steele Prize for Seminal Research

Main Achievements :

Dr. Ingrid Daubechies is currently James B. Duke Professor of Mathematics at Duke University; from 1994 until the end of 2010, she was a professor in the Mathematics Department and in the Program in Applied and Computational Mathematics at Princeton University. Her contributions consist of both theoretical research, especially on wavelets, and the application and expansion of this work into a wide array of fields, including engineering (signal processing, image processing, data compression), functional magnetic resonance imaging (fMRI), exploration for underground resources such as oil, matching human fingerprints, and time-series analysis of economic data. One of her most outstanding contributions is in the field of image processing, where her computational techniques and wavelet bases she constructed have been incorporated into the JPEG 2000 standard for image compression.

Dr. Daubechies was born in Belgium in 1954. She earned a Bachelor's degree in physics and, in 1980, a PhD in theoretical physics for research in quantum mechanics, both from Vrije Universiteit Brussel (VUB). She received the Louis Empain Prize for Physics, which is awarded to a Belgian scientist once every five years for scientific contributions completed before the age of 29, and in the same year she was promoted, at an unusually early age, to the rank of Research Professor with tenure at VUB.

She started working on the topic of wavelets in 1985. In 1987 she moved to the USA and joined the technical staff of the Mathematics Research Center at AT&T Bell Laboratories in New Jersey; while there, she worked mainly on signal processing.

Where classical Fourier analysis generally uses trigonometric function waves such as sine and cosine waves to express functions, the computational tool known as a "wavelet transform" represents functions and data by the incremental use of a series of small waves (hence the term "wavelet").

In 1987, Dr. Daubechies developed a new theory of compactly supported wavelets, now known as Daubechies wavelets ("compact support" is the quality that a wavelet exhibits if it takes non-zero values only over a finite interval), and also introduced a new class of Daubechies' wavelets with the added property of orthonormality in a paper titled "Orthonormal Bases of Compactly Supported Wavelets." In a later paper, she introduced a wavelet-based technique to represent two-dimensional images. In 1993, the FBI made use of the latter to store and match their database of 200 million fingerprints, achieving a savings of 93 percent in the memory space required to store the information. Due to advantages such as the fact that they are not compromised by corruptions in the acquisition or transmission of small amounts of data, wavelets have found applications in a wide range of fields. In medicine, they are utilized in electrocardiograms (EKGs), electroencephalograms (EEGs), and MRIs; in engineering, their uses include analyzing the air flow around the wing of an airplane or the path of electrically charged gases in a nuclear reactor. In resource exploration, they are employed to analyze the composition of underground layers and detect oil, coal, or salt. Filmmakers use them in animation, and they are also utilized to remove static from recordings of music.

In 1994, Dr. Daubechies was appointed full professor in the Mathematics Department and Program in Applied and Computational Mathematics at Princeton, the first woman to obtain this position. Her recent and current work has contributed greatly to the further study of wavelets and time-frequency analysis and the extension of their applications to new areas.

Dr. Daubechies' achievements have been honored with many awards, as listed above. Especially noteworthy are the John D. and Catherine T. MacArthur Fellowship (1992), the US National Academy of Sciences Medal in Mathematics (2000), the Benjamin Franklin Medal for Electrical Engineering (2011), and the Jack S. Killby Medal of the IEEE Signal Processing Society (2011). In addition, she holds honorary doctorates and is a member of national academies in several countries. She is currently the President of the International Mathematical Union (2011-2014 term), the first woman to serve in that capacity.

For outstanding and pioneering contributions to the theory and applications of wavelets, Dr. Ingrid Daubechies is hereby awarded the Okawa Prize.