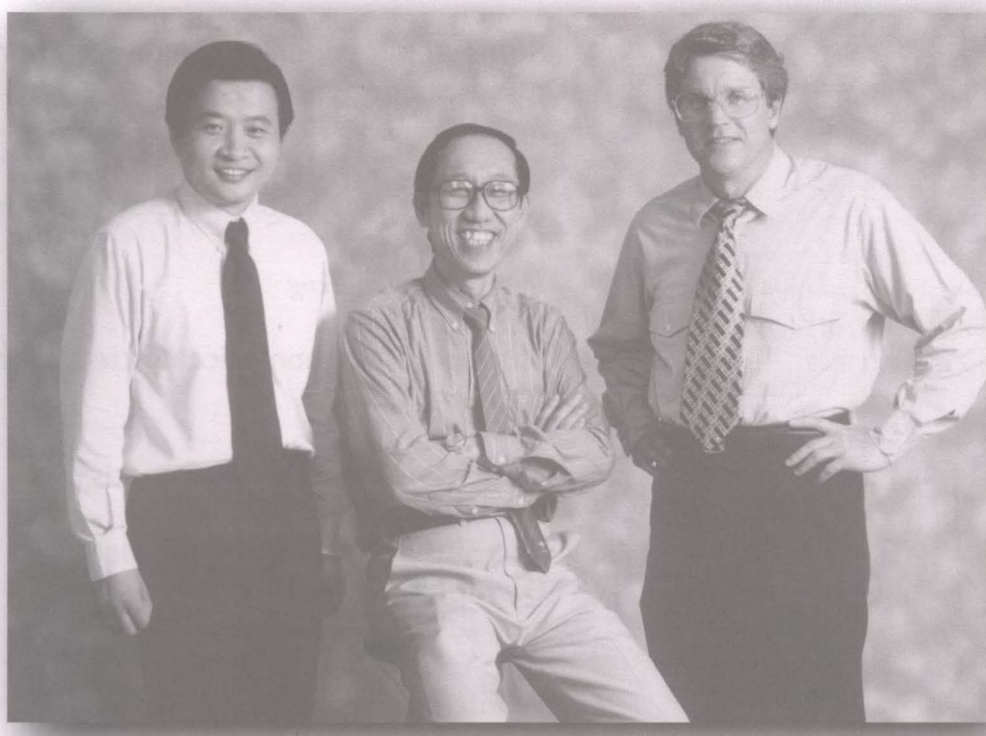
Society's Mathematicians win National Science Awards

It is a rare honour for a Society to report that its members, current president and past president no less, have for the second time been conferred the national recognition of professional and scientific excellence in research.

A National Science Ward 1998 was awarded to Prof Lee Seng Luan, A/Prof Wayne Michael Lawton and A/Prof Shen Zuowei of the Department of Mathematics, National University of Singapore for their fundamental research on wavelets.

A 1998 Young Scientist Award went to Dr Zhu Chengbo of the Department of Mathematics, National University of Singapore.



▲ *From left : Shen Zuowei, Lee Seng Luan, Wayne Lawton*

▲ *Zhu Chengbo*

Lee Seng Luan, Wayne Michael Lawton and Shen Zuowei of the Department of Mathematics, National University of Singapore, are members of the Wavelets Strategic Research Programme (WSRP). The WSRP is jointly funded by the National Science and Technology Board and the Ministry of Education.

The programme is called a strategic research programme, because wavelets is of strategic importance to the next generation technology. Therefore, it may be of strategic importance to the future technological development of Singapore. Because of its strategic importance we want to understand wavelets. It is important for us to understand wavelets in order to exploit it. Therefore we do research to understand it. Research in the WSRP ranges from basic research in mathematics to downstream applications in science and technology. Good technology grows out from good mathematics, good science and good engineering. On the other hand, mathematics often derived inspirations from science, engineering and technology. Lee, Lawton and Shen won the National Science Award for their work on fundamental mathematical research on wavelets.

What are wavelets and what are they used for? Let us first look at a brief history of the mathematical formulae that have "ruled" the mathematical world and "served" science and technology for the past 100 year, the Fourier transforms. Since its appearance in the early 18th century, Fourier transforms have become a very powerful and indispensable tool in science, engineering, and technology. The fast Fourier transform (FFT) and the discrete cosine transform (DCT) have been the underlying mathematical formulae and they constitute the standard in digital signal and telecommunications technology. They are used to store or transmit images and sound in compact disc, digital camera and high definition TV. Fourier transforms have served the world well for the past 100 years up to now. However, it has a number of drawbacks, which may not be tolerated in the next generation technology when precision and sophistication set in. It is unable to locate the content of a signal at specified intervals of time and frequency, and it cannot handle transient structures such as edges and singularities. A signal carries information like sound, images, stock market movements, etc., and signal processing is an important activity in modern society. New transforms are required to tackle these sophisticated problems, and this has open up a vast area of research in mathematics. Various ad hoc methods have been introduced, but it was not until the late eighties that a new mathematical structure began to evolve, leading to the birth of "wavelets." For the past 10 years it has grown very fast, and research competition has been fierce and intense.

Wavelets constitute a set of mathematical formulae that can be used to represent signals, much like musical notes are used to represent a composition of music. In wavelet representation, a signal is decomposed into various components from which information about the signal can be extracted, essential features retained and unimportant ones discarded. In this way a compact representation can be obtained for storage and/or transmission. The original signal can be reconstructed for playback if and when required. Endowed with these capabilities, wavelets have found widespread applications in many areas of signal processing technology, such as high-performance audio, image and video compression, which form the enabling technology for video conferencing, movie-on-demand, image browsing, distance teaching and learning, and internet retailing, medical image processing, vibration analysis and machine diagnosis. This has led to rapid mathematical development of the subject encompassing approximation theory, computational mathematics, computer aided geometric design, harmonic analysis, and operator theory.

Zhu Chengbo's area of research is representation theory of Lie groups. One of the most important and beautiful phenomenon in the representation theory of Lie groups is the duality correspondence between two commuting subgroups of the symplectic group in the Weil (or oscillator) representation. It offers hopes for classifying the representations of small groups. Classifying representations is one of the main problems in representation theory. Very little is known except for a few cases. Results of Chengbo's research gives a lot of information on the representations appearing in the duality correspondence.