Complex Numbers, Quaternions and Vector Products

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This talk explores the historical development of complex numbers, tracing their origin from solving cubic equations rather than the commonly assumed quadratic equations. Key milestones in their evolution are highlighted, drawing comparisons between complex numbers and two-dimensional vectors. Notably, complex numbers exhibit a unique ability to efficiently perform rotations of two-dimensional vectors.

The inquiry extends to the possibility of extending complex numbers to three dimensions, revealing that this extension materializes not in three but four dimensions, giving rise to quaternions. Quaternions, akin to complex numbers, prove adept at facilitating rotations of three-dimensional vectors around any axis. Furthermore, the multiplication of quaternions serves as a foundational influence on the dot and cross products in modern three-dimensional vector analysis.

In conclusion, the presentation introduces a geometric algebra that harmonizes complex numbers and quaternions, offering a framework for their generalization to higher dimensions.

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Kuang-Chong Wu received his B.S. degree in civil engineering from National Taiwan University in 1979, M.S. degree in structural engineering from Lehigh University, U. S. A., in 1981 and Ph.D. degree in mechanics from Cornell University, U. S. A., in 1985. He was a post-doctoral research associate at Cornell until the end of 1985. Dr. Wu returned to Taiwan in 1986 as an associate professor in the Institute of Applied Mechanics of National Taiwan University. He was promoted to full professor in 1991 and distinguished professor in 2006. He was the deputy director of the Institute in 1992, the director of the Institute from 1994 to 1997, and the director of Nano-Electro-Mechanical-Sytems Research Center from 2005 to 2006. He served as the executive vice president of the National Applied Research Laboratories, a non-profit organization sponsored by the National Science Council of Taiwan, from 2006 to 2012, and 2017 to 2020. He was the president of the National Applied Research Laboratories from 2020 to 2021. Dr. Wu's research interests include fracture mechanics, micro-mechanics, elastic wave propagation, and anisotropic elasticity.