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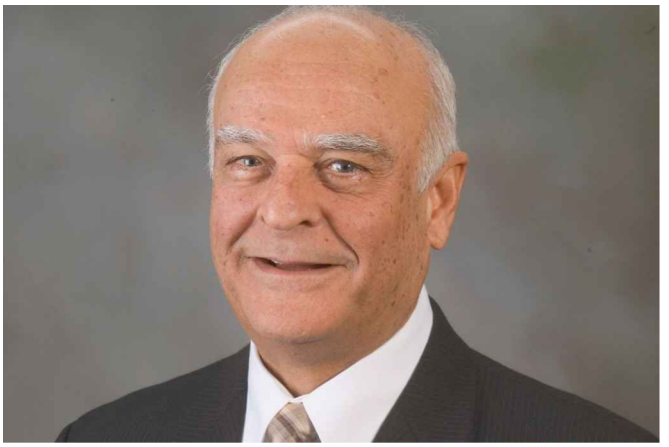
Obituary: Professor Ali H. Nayfeh 21 December 1933–27 March 2017



Ali Nayfeh

Ali Nayfeh, a University Distinguished Professor Emeritus of Virginia Tech's Department of Engineering Science and Mechanics, left us unexpectedly on March 27 at the age of 83. “A world without Ali is simply something I never imagined. He was immortal in my mind, a force of nature” wrote Jon Pratt, Chief of the Quantum Measurement Division of the Physical Measurement Laboratory at the National Institute of Standards and Technology (NIST). Jon's sentiments very closely match the mixture of sadness and disbelief by which the news of Ali Nayfeh's passing away was received by the scientific community at large.

Glancing over some figures quickly sheds light on the legend of Professor Ali Nayfeh. He authored over 1000 publications, including 12 books, 477 archival papers, 36 book chapters, 91 reports, 120 research grants, 639 presentations at national and international meetings and conferences, and received four patents. He gave 125 invited talks and seminars at universities across the US and abroad and organized over 30 international workshops and conferences. He was the founding editor of Nonlinear Dynamics (Springer, 1990–2017) and Journal of Vibration and Control (Sage, 1995–2014) [1]. Ali's work has been cited 43,364 times according to Google Scholar. He was awarded three honorary doctorates, from the Technical University of Munich, Germany, the Politechnika Szczecinska of Poland, and the Marine Technical University of St. Petersburg, Russia [1].

Of course, these numbers are simply a testament to an extraordinary life journey that started in the West Bank suburb of Shuwaikah/Tulkarm in occupied Palestine on December 21, 1933. The story of his life began with his parents who were poor villagers but so enlightened to spur his interest in achieving the highest level of education. As a young boy, he had to walk every day for miles from his little village to the nearest town to take classes. His love of mathematics and physics showed through his quick learning to the point that he became a math teacher at a very young age. Again stimulated by his persevering parents, he spent considerable time seeking a scholarship that would allow him to study in the US. It was in 1959 at the age of 26 he entered Stanford University as a freshman. His motivation and talent were so extraordinary that he graduated with a Ph.D. in Aeronautics and Astronautics in 1964. His advisor was Professor Milton Van Dyke. Professor Van Dyke's book Perturbation Methods in Fluid Mechanics (Parabolic Press) must have been a an inspiration for Ali's doctoral work doctoral work on using multiple scales for treating singular perturbation problems. In 2009 I was fortunate enough to attend a banquet at Stanford University sitting next to Professor Van Dyke, my academic grandfather.

After graduation, Ali immediately went to work in America's rapidly growing aerospace industry, first at Heliodyne between 1964 and 1968, then at the Aerotherm Corporation until 1971. In these jobs, he was challenged by problems in

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re-entry physics, orbital mechanics, flight mechanics, water waves, hydrodynamic stability, transpiration cooling, and waves in elastic media.

Ali then shifted his focus from the industrial world to the academic world, becoming a Professor at Virginia Tech in 1971. During his early years at Virginia Tech, he wrote his Wiley textbooks entitled “Perturbation Methods,” published in 1973, “Nonlinear Oscillations” (co-authored with Professor Dean T. Mook) published in 1979, and “Introduction to Perturbation Techniques,” published in 1981. These textbooks have been considered worldwide as premier reference texts on asymptotic methods and nonlinear vibrations over the past four decades and have been translated into Russian, Chinese, and other languages.

Over the course of his 37 years of teaching (Stability of Structures, Nonlinear Systems, Introduction to Perturbations, Perturbation Methods), Nayfeh advised 50 BS and MSc students, and 69 doctoral candidates to completion.

From 1980 to 1984, Nayfeh took a leave of absence to establish an engineering college at Yarmouk University, 45 miles north of Amman, the capital of Jordan. During this time, he also served as dean of the college, and as vice-president for engineering affairs at the university.

During his extraordinarily active career, Nayfeh organized a number of conferences, including the Seventh International Symposium on Nonlinear Acoustics and 12 conferences on Nonlinear Vibrations, Stability, and Dynamics of Structures at Virginia Tech [3-5].

In 1995 Ali received the Pendray Aerospace Literature Award from the American Institute of Aeronautics and Astronautics for his seminal contributions to perturbation methods, nonlinear dynamics, acoustics, and boundary-layer transition. He received the J. P. Den Hartog Award in 1996 for a lifetime of contributions to the teaching and practice of vibration engineering, the Lyapunov Award in 2005 for lifelong contributions to nonlinear dynamics, and the first Tom Caughey Award in 2008 for significant contributions to the field of nonlinear dynamics through practice, research, teaching, and outstanding leadership, all three from the American Society of Mechanical Engineering. Also in 2008 he received the Academy Gold Medal of Honor from the Academy of Transdisciplinary Learning and Advanced Studies. In 2014 Ali received the Benjamin Franklin Medal in Mechanical Engineering from the Franklin Institute [2]— an award once won by the likes of Albert Einstein, Thomas Edison, Orville Wright, Marie and Pierre Curie— for developing novel methods to model complex engineering systems in structural dynamics, acoustics, fluid mechanics, and electromechanical systems. I was proud of presenting my research at the Symposium honoring Nayfeh at Villanova University organized by Professor C "Nat" Nataraj the day before the Franklin Award ceremony which I gladly attended. I remember distinctly how visibly touched Ali was by the recognition and magnificent award presentation. Because of his genuine humble nature, he felt felt slighlty uncomfortable in the Hollywood-style award ceremony.

In the same year, Nayfeh told the Arab Daily News from his home in Virginia that he was “very honored and proud to have received this award”, yet it did not mean he was retiring at all. In fact, he was asked by the University of Jordan to be “an advisor” to the faculty as well as the students of engineering and was given the same rank of “University Distinguished Professor” that he held at Virginia Tech. Ali accepted the Jordanian university offer on the condition of working there without pay. As to why he chose to move to Jordan and to a university with very limited research capabilities, he said that he wanted to contribute to the development of science in the Arab World. This is the story of the life of Ali Nayfeh, who leaves an immense legacy that reaches across different cultures and continents.

It is not easy to describe Nayfeh's contributions as well as his standing in the academic community because he was a very unconventional scientist and professor. He was a rare mixture of applied mathematician, physicist, mechanician, fluid dynamicist, and dynamicist. At the heart of his interest there was always motion or, more broadly speaking, time evolutions occurring at multiple (fast and slow) time scales and across a huge variety of physical systems. Like Leonardo da Vinci he truly believed that "motion is the cause of all life." That is because life is about change, and change is about complexity. To fully understand nonlinear systems, his work was very much devoted to models that played a crucial role in his theoretical and experimental research. He was always very in fast devising new models starting from existing models and was always very clear in grasping the inner features of the new models, examples of which are ships moving in rough seas, cranes lifting heavy payloads and undergoing unexpected nonlinear vibrations, aircraft flying at high speeds and spacecraft hurtling back to Earth through the friction of the atmosphere, and very small and silent microelectromechanical systems working as sensors or actuators. During the past several decades, perhaps no one has contributed more to our understanding of nonlinear dynamics than Ali. He developed new analytical methods for the solution of the nonlinear ordinary and partial differential equations that are at the heart of these phenomena. By pushing the use of multiple time scales in perturbation analysis, he went even further, revolutionizing the use of these techniques for practical design. His work is far more than merely theoretical. Its applications encompass devices, structures, and systems. He was the true founder of a new paradigm in higher education and engineering practice called Nonlinear Dynamics for design, which seeks to exploit advantageously nonlinear phenomena and principles to enlarge the design envelope and performance of engineering systems.

Instead of going further with my own views on Nayfeh's contributions, I prefer to leave room for some of the many colleagues who have described Nayfeh and his work through their own words.

Dean T. Mook, Harrison Professor Emeritus at Virginia Tech, wrote: “Professor Ali Hasan Nayfeh's achievements, lasting contributions and influence rank among the greatest in the studies of nonlinear dynamics. For decades he was a highly respected international leader making seminal theoretical and experimental advancements, instructing and mentoring, being of service to the international technical community, and participating globally in professional activities. His 80+ graduate students came from Asia, India, Europe, the Middle East, and the Americas. Today they hold professorships in