



Angelo Musca

ANGELO MIELE

1922–2016

Elected in 1994

“For contributions to flight mechanics and control.”

BY YILDIZ BAYAZITOGU
SUBMITTED BY THE NAE HOME SECRETARY

My colleagues at Rice University and I were deeply saddened to hear about the passing of ANGELO MIELE, A.J. Foyt Professor Emeritus of Aerospace and Mathematical Sciences and professor emeritus of mechanical engineering, on March 19, 2016, at the age of 93. He was an outstanding scientist, educator, and academic mentor who influenced the next generation of aerospace engineers and scientists.

His legacy and his pioneering contributions to the scientific community in both the development and application of methods for the optimization of aerospace vehicle trajectories and aerodynamic shapes will endure forever. His extraordinary research spanned flight mechanics and control, astrodynamics, applied aerodynamics, optimization theory, and numerical methods.

He was born August 21, 1922, in Formia, Italy, to Salvatore and Elena (née Marino) Miele. He had several stories about his childhood and life in Italy. Everyone who knows him will recall the story that when he was in elementary school in Formia, his teacher told him that he would grow up to become a professor and engineer. He completed his formal education at the University of Rome, where he received doctoral degrees in civil engineering (1944) and aeronautical engineering (1946).

He moved to Argentina in 1947, where he was an aircraft design project engineer at the Military Aircraft Company in Córdoba and later a lecturer at the School of Military Aviation and School of Aerospace Engineering of the Argentinian Air Force and at the University of Córdoba.

He arrived in the United States in 1952. First he taught at the Polytechnic Institute of Brooklyn, New York, as an assistant professor for 3 years, then he joined the faculty at Purdue University in 1955 as an associate professor. At Purdue he worked on optimal trajectories for aerospace vehicles, and in 1958 was promoted to full professor at age 36.

His work included optimal thrust programs for rocket-powered aircraft, such as takeoff and landing of an aircraft in wind shear, optimal cruise of turbojet-powered aircraft and of a hypervelocity glider, and an optimal burning program. While at Purdue he published "General Variational Theory of the Flight Paths of Rocket-Powered Aircraft, Missiles and Satellite Carriers" (*Astronautica Acta* 4(4), January 1958), a highly cited paper on a general variational theory of flight paths of missiles, satellite carriers, and other spacecraft.

In 1959 he was hired at Boeing Scientific Research Laboratories in Seattle as director of astrodynamics and flight mechanics. His research led him to develop the "Theorem of Image Trajectories in the Earth-Moon Space" (presented in 1960 at the XI International Astronautical Congress, Stockholm), one of his most frequently cited and influential contributions to the aerospace community. NASA used his work and his findings on symmetrical free-return trajectories in the missions from Apollo 1 to Apollo 11. Also while at Boeing he published the seminal textbook *Flight Mechanics, Volume 1: Theory of Flight Paths* (Addison-Wesley, 1962).

He became interested in optimal aerodynamic shapes in the supersonic, hypersonic, and free-molecular flow regimes (i.e., shapes minimizing the drag or maximizing the lift-to-drag ratio under a variety of geometric and aerodynamic constraints, such as both longitudinal and optimum transversal contour of a body at hypersonic speeds). Among his contributions, his application of Green's theorem to solve variational

problems of a linear type is well known; this method was used to solve problems related to the flight of jet-powered aircraft.

He also worked on the exposition of the application of variational methods to the optimization of aerospace vehicle trajectories (1958) and the theorem of image trajectories (1960) in the restricted three-body problem. This theorem enabled a user to calculate an Earth-Moon trajectory and led to free-return trajectories.

He moved to Rice University in 1964 as a professor of aerospace sciences and mathematical sciences. In 1988 he was named the A.J. Foyt Professor of Engineering, a title he retained until he retired in 1993, when he was designated emeritus and continued teaching and working with his students.

From 1967 to 1983 he concentrated on numerical methods for solving optimal control problems, developing several well-known families of algorithms, including the sequential gradient-restoration algorithm. From 1983 to 1993 his focus was on the engineering applications of numerical optimization, and he studied wave identification, aero-assisted orbital plane change, flight in wind shear, and wind identification and detection.

Miele was an outstanding teacher and very proud of the privilege of being an educator. When he attended the 14th International Workshop on Dynamics and Control in Russia, dedicated to him on the occasion of his 85th birthday in 2007, in an interview by *Rice News* he said, "I became emeritus professor in 1993, but I still teach classes and I'm still working on algorithms to solve optimal control problems of interest in atmospheric flight and space flight."

He was recognized for his seminal work with a number of awards and honors, including the Louis E. Levy Medal in 1974 from the Franklin Institute in Philadelphia, the Dirk Brouwer Award from the American Astronautical Society in 1979, and in 1982 both the Mechanics & Control of Flight Award and the G. Edward Pendray Aerospace Literature Award from the American Institute of Aeronautics and Astronautics. In 1989 he shared the O. Hugo Schuck Award from the American Automatic Control Council, and in 1992 he was awarded an

honorary doctor of science degree from the Technion–Israel Institute of Technology.

In addition to the NAE, he was elected to the International Academy of Astronautics, a foreign member of the Russian Academy of Sciences, and a corresponding member of the National Academy of Engineering of Argentina. He was also a fellow of the American Astronautical Society (1980) and American Institute of Aeronautics and Astronautics (1981). He was editor and associate editor of several journals and editor in chief of the *Journal of Optimization Theory and Applications*.

Miele spent most of his adult life in the United States and became a citizen in July 1985. But he visited Italy at every opportunity and kept his connections with Italian researchers. Following his wishes, his ashes were returned to his birthplace.

He did not have children and is survived by his wife Gymme (née Odom), who lives in Houston. The two travelled all over the world together. He has nieces and nephews in Italy.

Angelo was an outstanding scientist and successful educator and mentor in the areas of flight mechanics, astrodynamics, applied aerodynamics, and optimization theory. At Rice, knowing him made a positive impact on my professional life. I was fortunate to work with such a great man and gentleman, and I treasured his fatherly advice to me when I needed it. He also had a great sense of humor. After a long day at Rice, he would say, “Go home and cook macaroni for your husband and children.”

