

Aeronautical and Aerospace Engineering at the University of Florida

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ABSTRACT

In one sense aeronautical/aerospace engineering has come full circle at the University of Florida. An aeronautical option in the mechanical engineering department started in 1941. Aeronautical engineering became a separate department in 1946 with a faculty of three, leaving mechanical engineering with a faculty of five. After fifty-six years of parallel developments as separate academic departments, aerospace engineering and mechanical engineering reunited in 2002 to form the Department of Mechanical and Aerospace Engineering. At merger, the two departments were approximately the same size, and the new department has more than 50 faculty members, 700 undergraduate students and 250 fulltime graduate students.

Introduction

The growth and development of the aeronautical/aerospace engineering program at the University of Florida took place within a wider context. Global and national events of the period since 1941 are common knowledge, but regional and local events may not be. Information from the following sources is used throughout this paper without additional citation. Histories of Florida and of the University of Florida are given by Gannon (1) and Proctor and Langley (2), respectively. Various publications by the college and departments over the years provided more local history. Interesting information about the aeronautical/aerospace engineering program was also obtained from the University of Florida Archives including old university catalogs, office files of university presidents and college deans, and files of old photographs. More recent photographs were obtained from college and departmental files. Some of the following material is anecdotal and depends on the memory of those telling the stories.

Describing the aeronautical/aerospace program at the University of Florida is complicated by the various mergers, separations and name changes of the department within which the aero program has resided. Table 1 provides dates associated with the beginnings of the program and subsequent departmental changes.

Perhaps it is useful to view a measure of the size of the aerospace engineering program at the University of Florida before describing its development. A history of the annual number of graduates, shown in Figure 1, provides some indication of the teaching effort but only a hint of the research effort within the program. The numbers of graduate degrees in aerospace engineering are estimated after 1972 when there were several degree programs within the department.

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The Early Years

Although the University of Florida is a land-grant university and traces its founding to 1853, it was 1909-1910 when the current name and location in Gainesville were established. The College of Engineering was one of the four colleges formed at that time, offering curricula in civil, mechanical and electrical engineering. There were twenty-seven faculty members at the university including five in engineering, and 181 students enrolled including forty-seven in engineering. Elsewhere in the state, Henry Flagler was busy spending his Standard Oil fortune extending a railroad from Miami to Key West. This engineering marvel was completed in 1912. The Naval Aeronautical Center at Pensacola was established in 1914. During World War I, the university campus was used for military training programs. The war also focused on the need for an efficient transportation system and led to federal subsidization of state road construction. Air passenger service between Key West and Havana, Cuba was initiated in 1918 by Aeromarine.

Access by rail and automobile contributed to the Florida land boom of the 1920s. During the early part of the decade, roads improved to a degree that 2.5 million tourists visited Florida in 1925, most of them arriving by automobile. The Florida land boom was showing signs of strain by 1926 when a September hurricane that caused 400 deaths and left 50,000 homeless in south Florida, effectively ending the boom. An even more devastating hurricane in 1928 caused an estimated 2,000 deaths in the communities near Lake Okeechobee. The stock market crash of 1929 and the national depression followed in short order.

John Tigert was inaugurated president of the University of Florida in 1928, the year that graduate programs leading to a master's degree in chemical, civil, electrical and mechanical engineering were started. Severe spending restrictions were imposed at the university including prohibition of all travel, but a new football stadium seating 22,000 was completed in 1930. During 1933, the university had not been allowed to hire or replace employees, purchase equipment or authorize travel. There were sixteen faculty and 336 students in engineering that year.

Joseph Weil became Dean of Engineering at the University of Florida in 1936 and guided the growth of the college for the next 28 years. At the time Weil became dean, the primary business of the college was teaching, and research played a relatively minor role. Weil emphasized industrial and federally supported research as a means to develop the resources of the College.

Air-conditioning played an important role in the economic development of Florida where summer heat and humidity can be extreme. In 1929 Willis Carrier introduced the modern prototype air-conditioner. Over the next thirty years air-conditioning made its way from public transportation and urban buildings to private homes and vehicles, making Florida summers tolerable for millions of new residents. It is an interesting aside to note the role of a Floridian in the development of air-conditioning. John Gorrie, a physician in Apalachicola, was awarded a patent in 1851 for a machine that produced ice to cool sick rooms and hospitals.

Hard economic times ended with the military buildup for World War II. During the war years, college resources were directed to supporting the war effort in training and research. Fewer than 1,000 students remained on campus, but that was offset by several armed services training programs including the Civilian Pilot Training Program offered by the Civil Aeronautics Authority and administered by the College of Engineering. Shifts in engineering curricula were made to stress material having war significance. This included the mechanical engineering curricula placing more emphasis on aeronautics. The enhanced resources for research in the college of engineering were devoted almost entirely to the war effort and contributed to the development of the mortar type radio proximity fuse, radar, and weather tracking by radio, a forerunner of radar weather tracking.

A phenomenal enrollment boom occurred after World War II as veterans took advantage of the GI Bill. Fall enrollments climbed from 1,500 in 1945 to 6,300 in 1946 to 8,800 in 1947 to 10,200 in 1948. Staff size in engineering grew at a comparable rate. Facilities that had been declared inadequate for a prewar enrollment of 3,500 students were serving almost three times that number. War surplus buildings became the quick fix for student housing as well as classrooms and laboratories, and some remained on campus for many years. In 1947, the year of official transition of the University of Florida to a coeducational university, there was no medical school, no community college system, and no public university in the state south of Gainesville.

The University of Florida had its share of social conflict during the 15 years after the war. Integration was not accomplished at the University of Florida until it received a specific court order about four years after the 1954 United States Supreme Court decision that segregated school systems were unconstitutional. Once forced to do so, however, the university and community were integrated without violence. In the late 1950s, after Joe McCarthy had been censured by the United States Senate, a special Florida Senate committee was formed with Charley Johns as chairman to root out communists, homosexuals and other un-American elements from state universities. More than a dozen faculty members at the university were investigated and forced to resign.

Aeronautics first appears in the course listing of the Mechanical Engineering department at the University of Florida in 1928, the year that Robert Thompson, founding head of the Aeronautical Engineering department, entered the university as a freshman. Thompson earned his bachelor's degree in Mechanical Engineering in 1932 and joined the mechanical engineering faculty as a part-time instructor and operator in charge of the mechanical engineering laboratory while he worked on his master's degree.

In 1939, the Head of Mechanical Engineering Department, N. C. Ebaugh, wrote a brief report recommending that an aeronautical engineering degree not be developed at that time at the University of Florida. He pointed out that of the twelve degree programs in aeronautical engineering offered in the United States, six were endowed by the Daniel Guggenheim Foundation. Low enrollment in the aeronautics option of mechanical engineering (about twelve students per year) and the expense of expanding engineering facilities were cited as reasons for not offering a special degree in aeronautical engineering. Thompson was by then a full-time member of the faculty with the rank of assistant professor. He was involved about half-time with initiating a flight training program for the Civil Aeronautics Authority including serving as ground school instructor. Additionally, he was given responsibility for building up the aviation work in

the Department of Mechanical Engineering, and aeronautical engineering became an option in mechanical engineering in 1941. During the next few years, Thompson supervised the construction of a small (18-inch by 18-inch test section) low-speed wind tunnel, a six-component balance system (see Figure 2) and acquired a small smoke tunnel for flow visualization.

The Aeronautical Engineering department, with a separate degree Bachelor of Science in Aeronautical Engineering, was formed in 1946 with three faculty members including Robert Thompson as “Head Professor of Aeronautical Engineering”. The other two founding members of the faculty were Ford Prescott and Sam Goethe, both graduates of the mechanical engineering program at the University of Florida and listed as research engineers. The aeronautical engineering program started as a home-grown product. Thompson remained head of the new department for ten years, but Prescott appears on the faculty list for only the first year, and Goethe, for two years. The Bachelor of Aeronautical Engineering degree was accredited by the Engineer’s Council for Professional Development by 1949. A graduate program leading to a master’s degree was offered by the new department, and the first master’s degree in aeronautical engineering was awarded in 1950 to Charles Pearson who shows up on the faculty list during his graduate studies. In a list of thirty-two graduate theses for the College of Engineering in 1951, Thompson is named as the director for six. For the first five years of the department’s existence, the faculty consisted of Thompson and one or two interim members, often his graduate students.

Although aeronautical engineering was probably housed originally in the old Benton Hall and Benton Annex with the other engineering departments, it moved in 1950 to an airplane hangar that had been used during the war for training activities (3). The “hangar building” was shared with chemical engineering and was located west of the football stadium on the current site of the O’Connell Center sports dome (see Figure 3).

John Hoover joined the department in 1951 as an associate professor. Hoover earned a bachelor’s degree from Alabama Polytechnic Institute (Auburn University) and a master’s degree from Georgia Institute of Technology, both in aeronautical engineering. He was director of academics for the Southern Aviation School during the war years, worked for a couple of years in the aircraft industry and was an associate professor of aerospace engineering at the University of Alabama before joining the University of Florida. Hoover taught and advised students in the department for more than thirty years (Figure 4). Many of our alumni have fond memories of him and credit his influence as contributing to their personal and professional maturity. Hoover was also active in engineering professional societies, including the American Society for Engineering Education where he chaired the Aeronautical Division, and the Florida Engineering Society.

Thompson and Hoover, and sometimes one other interim instructor, shared the teaching and research duties for undergraduate and graduate courses in aeronautical engineering until 1955 when William (Bill) Miller joined the faculty as an associate professor. Miller had earned an MSAE degree from Massachusetts Institute of Technology and was a retired naval officer. By the time Thompson resigned in 1957, the department had granted 107 bachelor’s degrees and 9 master’s degrees. This averages to about the same number of undergraduates as cited by Ebaugh in his report in 1939 recommending against starting a new aeronautical engineering department. During the

two-year period ending in 1954, the six departments of the college of engineering awarded a total of 278 bachelor's degrees, 34 master's degrees and one PhD. Aeronautical engineering accounted for 13 bachelors degrees compared to 51 in mechanical engineering and 75 in electrical engineering.

In 1957, Raymond Doll was hired to replace Thompson as head of the department. Doll was an aeronautical engineer and retired naval officer. It seems reasonable to assume that he was responsible for the biennial report for the department submitted at the end of that academic year. It begins, "The Aeronautical Engineering Department is still inadequately housed in the Hanger Building and has only the barest minimum of laboratory facilities required for teaching future aeronautical engineers in this space age. The facilities on hand are not suitable for prosecuting research projects at any level". Doll appears to have a tendency toward plain speaking; he is on the faculty list for only one academic year. The fledgling department of Aerospace Engineering appeared not to be participating in the phenomenal post-war growth of the university and college.

The arrival of David Williams in 1957 marks the beginning of a transition from the early years to a viable research-oriented department. Williams received his PhD in physics at New York University in 1938, and his experience included working as a physicist for the National Advisory Committee for Aeronautics during the war years, a year as Associate Professor at the University of Michigan, followed by ten years as a research scientist at Battelle Memorial Institute in Columbus, Ohio where he contributed to the development of the xerography process. Williams' research interests ranged over many topics including hypersonic flow, orbital mechanics, crystal growth and composite materials, but his focus was on applied optics and spectrometry. He was also noted as an outstanding classroom teacher during his twenty-year career at the University of Florida (see Figure 5).

The department had hired several of its own students as interim instructors after they received their master's degree. Except for Thompson, they usually stayed only a year or two before moving on. In 1958, Allen Ross joined the faculty in such a position. Ross made his career at University of Florida, growing with the department over the next 30 years. He continued his graduate work part time, earned his PhD in 1971 and moved to the university's Graduate Engineering Center at Eglin Air Force Base in the panhandle of Florida. He quickly established a productive research program and continued to be active as a consultant after his retirement from the university in 1985.

Establishing a Viable Research Program

Although some of the major events of the 1960s and early 1970s, such as the civil rights movement, directly impacted the university, and some, such as the war in Vietnam, caused major disruptions of personal lives for some of our undergraduate students and recent alumni, only one branch of this turbulent river of history resonated with the aeronautical/aerospace engineering program at the University of Florida, the space program.

The launch of Sputnik I on October 14, 1957 focused the attention and competitive spirit of our country on space. The Air Force Missile Test Center at Cape Canaveral had been launching missiles since 1950. Echo, a satellite that one could see easily in orbit

was launched in 1960. John Glenn's flight into orbit on February 20, 1962 raised the level of interest even more. Facilities of large private companies such as Martin (Orlando), Pratt & Whitney (West Palm Beach), Lockheed (Dunedin), Boeing, Northrop and Douglas (Cocoa) were moving into Florida. Many of the brighter young people who were entering the university to study engineering wanted to participate in the excitement of the space program. This phase of rapid growth and development of aerospace engineering at University of Florida almost coincides with the Apollo program from 1963 to 1972 to land humans on the moon and bring them back safely to earth.

Guidelines for restructuring engineering education in the United States were also in place. In 1955, the "Report of the Committee on Evaluation of Engineering Education" (known as the Grinter Report) was published by the American Society for Engineering Education. It stated that the technical objective of engineering education includes "mastery of the fundamental scientific principles associated with any branch of engineering" and recommended that basic science (including mathematics, physics and chemistry) constitute about one-fourth of the undergraduate program. At that time, L. E. Grinter, chairman of the committee, was Dean of the Graduate School at the University of Florida. This report had significant influence on engineering programs nationwide and guided the transformation that was about to take place in aeronautical engineering at the University of Florida.

By the early 1960s, the college of engineering at the University of Florida had grown and developed to offer the bachelor's and master's degrees in nine fields of engineering and a PhD in six. Undergraduate engineering enrollment was about 2,000 and graduate enrollment, about 300. It was recognized by the university that to successfully compete for competent faculty there must be adequate space and support for research activities as well as adequate salaries. Federal dollars were matched by state funds to construct seven new buildings to house engineering departments. The need was so great for aeronautical engineering that a special "surge" building was built to house the department temporarily from 1964 until the new aerospace engineering building was completed in 1967.

Mark Clarkson was hired as chairman of the aeronautical engineering department in 1961. He earned a bachelor's degree in aeronautical engineering from the University of Minnesota in 1939. After working in the aircraft industry from graduation through the war years, he became a research engineer and mathematician at the Defense Research Laboratory at University of Texas and earned his PhD in mathematics from the University of Texas in 1952. After a year at University of Manchester in England on a postdoctoral research fellowship, he returned to work at Chance Vought Aircraft Corporation in Dallas, Texas. He was supervisor of the Aerophysics Group at Chance Vought when he left to head the aeronautical engineering department at the University of Florida. Clarkson's research interests were initially plasma diagnostics, but evolved through the years to extracting aerodynamic coefficients from test data to flow visualization by the time of his retirement in 1986 (see Figure 6). Clarkson arrived at University of Florida to join Hoover, Williams, Miller and Ross as the faculty of the aeronautical engineering program. It was finally time for rapid growth and development of this program at University of Florida.

It was probably inevitable that one of the first acts of the transformation was to change the name of the department and curriculum from aeronautical to aerospace engineering. Approval from the state board of regents was received about the time of John Glenn's

flight aboard Friendship 7. Substantial changes began during the next two years with the addition of two senior faculty members, Knox Millsaps and Bernard (Bernie) Leadon.

Clarkson liked to tell the story of how he had seen in a newspaper article that Millsaps was resigning as Chief Scientist and Executive Director of the Air Force Office of Scientific Research. Informal contacts indicated that Millsaps might be interested in joining the aerospace engineering faculty at the University of Florida. Before opening more formal negotiations, Clarkson called a contact in Washington to inquire if he should be aware of any circumstances about Millsaps' resignation. The reply was that although Millsaps had not been forced to resign these positions, the decision for him to leave had been mutual because, "Millsaps doesn't just call a spade a spade, he calls a spade a bloody shovel". Millsaps earned his PhD from the California Institute of Technology in 1943 in Applied Mathematics and Theoretical Physics. Three years earlier, he had received a BS degree from Auburn University in English literature; he reportedly chose Cal Tech for graduate school so that he could study drums under Sol Goodman. Before joining the University of Florida in 1963, Millsaps had also been on the faculty at Ohio State (aeronautical engineering), Auburn University (physics) and Massachusetts Institute of Technology (mechanical engineering). Millsaps primary love was classical problems in fluid mechanics and heat transfer, but his interests also included electric propulsion, mechanical vibrations and statistical theory of gases.

Leadon received his MS degree from the University of Minnesota in 1942 and worked during the war years at Cornell Aeronautical Laboratory. After the war, he returned to the university where he taught while working on his PhD, graduating in 1955. He was a senior staff scientist at General Dynamics Corporation for several years before joining the University of Florida in 1964. This is also the year the department finally moved out of the old hanger building that Doll had referred to in his 1958 report. Leadon's research interests were primarily in experimental fluid dynamics including shock phenomena, turbulent mixing, sensors and wind engineering (see Figure 7).

A graduate degree program leading to a PhD was initiated in 1964. In keeping with local tradition, bright students were recruited from the undergraduate program for graduate studies, and three were hired as part-time faculty during the latter stages of their studies. The first PhD was earned by Roland C. Anderson in 1965, with the guidance of Millsaps. Anderson remained on the faculty of the University of Florida until his retirement in 1990, and he was active professionally until his death in 1997. Kynric (Ken) Pell and Dennis Keefer both studied under Clarkson's supervision and received their degrees in 1967. Pell went to the University of Wyoming after graduation where he has served as Head of Mechanical Engineering and Dean of the College of Engineering. Keefer remained on the University of Florida faculty for a few years before moving to University of Tennessee Space Institute where he is the B .H. Goethert Professor of Engineering Sciences. Another student from this era took a slightly different route to the aerospace engineering faculty. After receiving his BS degree in aeronautical engineering at the University of Florida in 1960, James E. (Ed) Milton changed colleges to begin graduate studies in physics where he earned a PhD in 1966, then returned to aerospace engineering as a member of the faculty. He moved to the University of Florida Graduate Engineering and Research Center at Eglin Air Force Base in 1972 where he served as its director until his retirement in 1998.

By 1965 the aerospace engineering faculty on the main campus had tripled in size to fifteen, but that included at least four graduate students who received their PhDs within the next year or two and accepted positions elsewhere. The department moved into its new building in 1967, and Millsaps left the University of Florida to accept a position as Head of Mechanical Engineering at Colorado State University in 1968. Faculty size was about ten as the boom times ended.

Job prospects for graduating aerospace engineers were grim in 1971 and undergraduate enrollment was plummeting. A report on engineering programs in Florida commissioned by the state board of regents precipitated a reorganization of the college in which the department of Aerospace Engineering was merged with the department of Engineering Science and Mechanics, with Lawrence (Larry) Malvern serving as interim chairman. Malvern earned his PhD from Brown University in 1949 and had been a Professor at Michigan State when he joined the Engineering Science and Mechanics department at the University of Florida in 1969. Malvern did pioneering work in plastic wave propagation analysis, and several generations of graduate students studied his text "Introduction to the Mechanics of a Continuous Medium". The merger increased the breadth and depth of the aerospace program, particularly in the area of structures, and provided increased potential for collaborative research among faculty members. The combined faculty size at merger was thirty one, and the engineering science and mechanics branch brought with it responsibility for teaching the service courses statics, dynamics and mechanics of materials. The name chosen for the new department was Engineering Science, Mechanics and Aerospace Engineering.

Disney World opened in Orlando in 1971, the HP 35 calculator was introduced in 1972 and by 1973 the slide rule had disappeared from campus.

Building a Foundation

Tourism became the foundation of Florida's economy, increasing from 5 million visitors in 1950 to 40 million in 1990. Retirees seeking milder winter climates sought affordable housing. By 1980, Florida had more mobile homes than any other state with over 12 percent of the population housed in 760,000 mobile homes and 25 percent of the population classified as elderly. More than 800,000 Cuban exiles have arrived in the United States since the fall of Bastista in 1959, most of them settling in Florida. The vast majority of this growth took place in areas of Florida south of Gainesville where the University of Florida is located.

In 1967, a Federal District Court ordered reapportionment in Florida, shifting political power in the state to the south. During the next decade, although per capita funding of higher education remained among the lowest in the nation, four new public universities were created south of the University of Florida in large population centers. Building a foundation of excellence at the University of Florida would require augmenting state funding by establishing a healthy endowment fund and successful competition on the national level for funded research. One wise investment the state legislature made in higher education was to provide matching funds for large private gifts to state universities.

During the next twenty-three years the department continued to build the foundation for a strong research and teaching program in aerospace engineering. Millsaps returned from Colorado State in 1973 to chair the newly formed department. A year later, an additional merger occurred with the Coastal and Oceanographic Engineering department. Extending the name list was beyond the tolerance of the faculty, and the name Engineering Sciences was chosen for the department. A couple of years later, Coastal and Oceanographic Engineering was restored as an independent department, but Engineering Sciences remained the name for the home department for the aerospace engineering program. Millsap's strategy to guide the department through its next phase of development was to leverage the winter weather and his personal contacts to bring well-known senior people who were nearing retirement age to the University of Florida and then to seek their help in recruiting competent young faculty. Millsaps' health began to fail in the early 1980s and he resigned as chairman in 1986, but continued to teach until his death in 1989. Martin (Marty) Eisenberg became chairman of the department in 1986. Eisenberg had been a member of the Engineering Science and Mechanics department before the merger in 1972. He earned his doctoral degree in mechanics of solids from Yale in 1967 after receiving a bachelor's degree in aeronautical engineering and a master's degree in aeronautics and astronautics from New York University. In 1987, the department's name was changed again, this time to Aerospace Engineering, Mechanics & Engineering Science.

Karl Pohlhausen had retired to Gainesville in 1967 to be near the Millsaps family. When he came to the United States in 1946 as a participant of Operation Paperclip, Pohlhausen was well known for his earlier work in fluid mechanics, particularly boundary-layer theory. He and Millsaps (see Figure 8) began their collaboration at Wright Field in 1948 and continued to work together at the University of Florida until Pohlhausen's death in 1980. Although their primary interest was forced and free heat convection in fluids, they made excursions into other fields such as the metabolism of glucose and the rail gun.

Raymond L. Bisplinghoff visited the University of Florida during winter semesters from 1978 until his death in 1985, teaching courses on aeroelasticity and presenting seminars on technical and national policy topics. Charles E. (Chuck) Taylor joined the faculty in 1981 to strengthen the area of optical stress analysis. He is currently Professor Emeritus and active in the Society of Experimental Mechanics. Hans von Ohain spent winter semesters on campus during the period from 1982 to 1985, providing undergraduates a special treat for their propulsion course, and reminding them that "inventions are the result of a playful mind". One of those taking his course was Millsaps son, Knox Millsaps, Jr., who is currently a professor at the Naval Postgraduate School. Daniel (Dan) Drucker joined the faculty in 1984, was active in teaching continuum mechanics in our graduate program and in research until his retirement in 1994, and was consulted often on both technical and engineering education topics by the faculty throughout the college and university until his death in 2001. Harry N. (Norm) Cotter, retired vice president for engineering at Pratt & Whitney Aircraft, was an adjunct professor from 1984 to 1992 and taught the undergraduate propulsion course several times. Chia-Shun (Gus) Yih joined the faculty in 1987, teaching the joys of fluid mechanics in our graduate program and continuing his research until his retirement in

1990. Those of this group in residence and other colleagues had lunch together on Fridays and referred to themselves as the “lunch bunch” (see Figure 9).

Research projects underway in the department during the 1970s, and 1980s of direct interest to the aerospace engineering community included the following examples. Damage and wave propagation in composite materials by ballistic impact were investigated by Lawrence Malvern, C. T. Sun, Robert Sierakowski and Allen Ross. Research on compression failure in composite plates and fracture toughness in stitched graphite/epoxy composites was conducted by Bhavani Sankar (see Figure 10). Bernard Leadon worked on the effect of boundary-layer separation on vehicle stability and control, and shock tubes. Ulric Kurzweg studied flow stability and time dependent heat transfer and received patents on a process for thermal pumping. Additional research topics of this period that attracted significant student participation include high-angle-of-attack aerodynamics, fluctuating wind pressures on tall buildings, turbine-blade cooling, combustion, vortex breakdown, computational fluid mechanics, turbulent jets in a cross flow and their effects on vertical take-off and landing aircraft, optical information processing, projectile aerodynamics, structural optimization, control of large space structures and sensor development.

Pursuit of Excellence

Since the late 1980s, the department has shifted its strategy to hiring mostly junior and mid-career faculty. A number of them have become productive and professionally visible at the University of Florida or elsewhere. For example, six younger members of the departmental faculty have won National Science Foundation CAREER or Office of Naval Research Young Investigator awards.

Overall research funding for the department has experienced substantial growth, reaching a level of about \$3.5 million dollars for a faculty of about 25 just before the recent merger with mechanical engineering. Faculty and students form working groups to pursue topics of both research and undergraduate teaching interests. Research groups in aerospace engineering include computational fluid mechanics, gas dynamics, experimental combustion and propulsion, pressure and temperature sensitive paints, composite materials, dynamics and control, engineering optimization, and micro-electro-mechanical systems (MEMS). Most faculty members participate in joint projects, and regularly produce publications collaboratively. Our faculty and students are now regularly winning research and teaching awards in professional societies.

During the last several years, the group approach has also contributed noticeably to the University of Florida’s success in yielding nationally recognized activities. Brief descriptions of two research projects of the many underway are given as examples of current activity. In early 1996, shortly after Wei Shyy became the department chair, a few faculty members, including Rafi Haftka, David Jenkins, Wei Shyy, Norman Fitz-Coy and Bruce Carroll, wondered what “new” aerospace topics would make sense for the department to promote. The topic should be scientifically and technically interesting, and multidisciplinary. Haftka suggested micro air vehicles (MAV) which received an enthusiastic reaction from the group. A special-topics course was offered the same year by Jenkins, and collaborative activities began. Shyy suggested that the group focus on

the flexible-wing concept, and with Jenkins and some students, began to pursue studies in membrane wing aerodynamics. These efforts were before the term MAV became trendy in the technical community. Shortly after the University of Florida started its activities, experts such as Peter Lissaman, Rick Foch, and program managers such as Jim McMichael visited the University of Florida either to offer advice or to learn about our activities. An annual international flight competition began in 1997 with much publicity. Later, Peter Ifju and his students joined this effort. Ifju's interest in windsurfing and his talent in fabrication technologies have significantly advanced vehicle development (see Figure 11), and the University of Florida group has succeeded in winning flight competitions since 1999. The group has also produced scholarly works, and won grants and recognition within the MAV community.

The University of Florida's aerospace engineering faculty, leading a consortium of several universities, won a major project in the Reusable Launching Vehicle (RLV) area under a University Research, Engineering and Technology Institute (URETI) competition. The project has the potential of ten years support from NASA with an initial phase of fifteen million dollars already committed. The goal is to develop scientific foundations for key aspects related to a future RLV, including hypersonics, combined air-breathing and rocket cycles, multidisciplinary analysis and optimization, computational tool development, materials and life expectancy, vehicle health management, and educational outreach. URETI was the first broad-ranged, nationwide competition organized by NASA. More than ten faculty members from the University of Florida are active participants in the effort. Different aspects of our URETI activities have been covered recently in news media such as the New York Times, St. Petersburg Times and Christian Science Monitor.

On the teaching side, broad revisions to the curriculum, especially the undergraduate program, were implemented in the 1990s. The State of Florida requested that its public universities standardize the number of credits required for all bachelor's degrees. In response, the aerospace engineering program not only trimmed the semester-hour credits to 128, but has also gone through substantial revisions of the curriculum. Table 2 summarizes the curriculum structure early in the program (1948), at the time of the first merger (1972) and currently. While there are clear shifts in topics of emphasis through the years, there is an interesting consistency in the overall spirit, namely, a combination of mathematics, basic and engineering science, and the aerospace engineering discipline. Additionally, there have been changes in textbooks and teaching methods within topics, usually an increase in mathematical sophistication and increased use of numerical methods. A modern aerospace engineer needs a strong foundation in mathematics and science, breadth in other engineering disciplines and depth in a chosen specialty for technical competence. Additional studies in areas of "people skills" are increasingly important for multidisciplinary approaches to problem solving. Graduate studies are an important path to a suitable level of competence in aerospace engineering.

A number of graduates from the University of Florida's Aerospace Engineering degree programs have become strong contributors to their chosen professions. We offer a few examples of those who have also continued to contribute to the aerospace program at the University of Florida by visiting periodically to offer advice and encouragement. John D. Anderson, Jr. (BSAE 1959) has established a distinguished career as an aerospace educator and researcher. He is now curator of the National Air & Space Museum.

Anderson gave the Distinguished Alumni Lecture at the golden anniversary celebration of the Aerospace Engineering, Mechanics & Engineering Science department in 1996. Could his first technical paper have been “Rocket Fuels”, published in the May 1959 issue of the student publication, Florida Engineer? William Powers (BSAE 1963) became a professor of aerospace engineering at the University of Michigan before joining Ford Motor Company where he held several positions including vice president for research before his retirement in 2001. He established an endowed professorship in aerospace engineering at the University of Florida, and earned distinction as a member of National Academy of Engineering, as well as a senior spokesman for the automotive and aerospace professions. Donald Daniel (BSAE 1964, MS 1965, PhD 1973) became Executive Director and Chief Scientist of the Air Force Research Lab, then Deputy Assistant Secretary for the Air Force, the highest ranked career civil servant in the US Air Force, before retiring in 2002. William Sellers, III (BSAE 1973, MS 1975) and Robert Garcia (BSAE, 1986) have become branch leaders at NASA Langley Research Center and Marshall Space Flight Center, respectively. Darryl Van Dorn (BSAE 1962) became the Director of NASA and Commercial Delta Programs for McDonnell Douglas, overseeing activities of Delta rocket launch services for a host of customers. Carl Meece (BSAE 1969) became Director of Pratt & Whitney’s Turbine Component Center, responsible for all aspects of the air-breathing engine’s turbine technology for the company.

Merger with Mechanical Engineering

With encouragement by the new dean of the college, Pramod Khargonekar, faculty members of the Aerospace Engineering, Mechanics and Engineering Science department, and of the Mechanical Engineering department agreed to merge, creating the department of Mechanical and Aerospace Engineering. The two departments were of comparable size, and Shyy became chairman of the new department when it was formed in 2002. This merger reunited the programs of aeronautical/aerospace engineering and mechanical engineering after a separation of 54 years. Currently the Mechanical and Aerospace Engineering department has more than 50 faculty members, 700 undergraduate students and 250 full-time graduate students.

The rationale for this action came from the following realization: Aerospace Engineering has focused on an interest in all aspects related to flight including fluids mechanics, structural mechanics, and dynamics and control, while Engineering Science/Mechanics has historically been a home for nontraditional and developing curricula in engineering, most recently, biomechanics. Mechanical Engineering is broad in its scope, encompassing all aspects related to vehicles, machinery, thermal and fluid engineering, and energy. Faculty and students from both departments regularly interact with each other, and often publish scholarly works in the same journals. Intellectually, rapid advances in science and technology have significantly broadened the scope of engineering in all disciplines while blurring the boundaries between them. Pragmatically, available financial resources limit the ability to expand and modernize the teaching and research missions.

Wide ranging actions began immediately after the merger, including building renovation, new faculty searches, unified graduate course requirements and Ph.D. qualifying exams. The goal, simply stated, is to maximize faculty and student interactions and to minimize administrative barriers.

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Table 1. Departmental mergers and “firsts”

1928	First course in aeronautics offered in the mechanical engineering department.
1941	Option in aeronautical engineering offered in mechanical engineering.
1946	Aeronautical Engineering department founded.
1948	First graduating class in aeronautical engineering.
1950	First master’s degree in aeronautical engineering.
1961	Department name changed to Aerospace Engineering.
1965	First PhD in aerospace engineering.
1972	Merged with Engineering Science and Mechanics department to form the Engineering Science, Mechanics and Aerospace Engineering department.
1974	Merged with Coastal and Oceanographic Engineering department to form the Engineering Sciences department.
1976	Coastal and Oceanographic Engineering restored as separate department.
1987	Changed name to Aerospace Engineering, Mechanics & Engineering Science department.
2002	Merged with Mechanical Engineering department to form the Mechanical and Aerospace Engineering department.

Table 2. Sample aeronautical/aerospace engineering curricula

Topic	1948	1973*	2003
English including composition	8	6	6
Humanities and social science	16	14	15
Math through differential & integral calculus	16	13 $\frac{1}{3}$	12
Additional engineering math including num. meth.	0	8 $\frac{2}{3}$	10
Chemistry with lab	8	5 $\frac{1}{3}$	4
Physics with lab	8	8	8
Science elective	0	2 $\frac{2}{3}$	3
Physical education or military science	4	2	0
Elective	6	6 $\frac{2}{3}$	0
Computer programming	0	1 $\frac{1}{3}$	2
Intro. to engineering	0	$\frac{2}{3}$	0
Engineering drawing → computer-aided graphics	4	2	3
Elementary design	3	0	0
Mechanisms & kinematics	3	0	0
Statics, dynamics & mechanics of materials	9	6 $\frac{2}{3}$	9
Thermodynamics	3	3 $\frac{1}{3}$	3
Electrical engineering	6	3 $\frac{1}{3}$	4
Materials behavior & selection	3	2	3
Engineering lab courses	9	2	5
Manufacturing operations	6	0	1
Specifications & industrial safety	3	0	0
Elements of aeronautics & astronautics	0	2	0
Fluid mechanics	0	2 $\frac{2}{3}$	3
Aerodynamics	6	12	3
Aerodynamics	0	0	3
Structures	6	9 $\frac{1}{3}$	3
Stability & control of aircraft	0	0	3
Propulsion	5	3 $\frac{1}{3}$	3
Control systems	0	0	3
Electives restricted to approved technical or aerospace courses	5	12 $\frac{2}{3}$	12
Professional development	2	$\frac{2}{3}$	1
airplane design → aerospace design	6	4	6
Total semester hours	145	134 $\frac{2}{3}$	128

* Quarter system being used this year, credits converted to semester hours.

→ Denotes change in nomenclature between 1946 and 1973, but topics seem comparable.

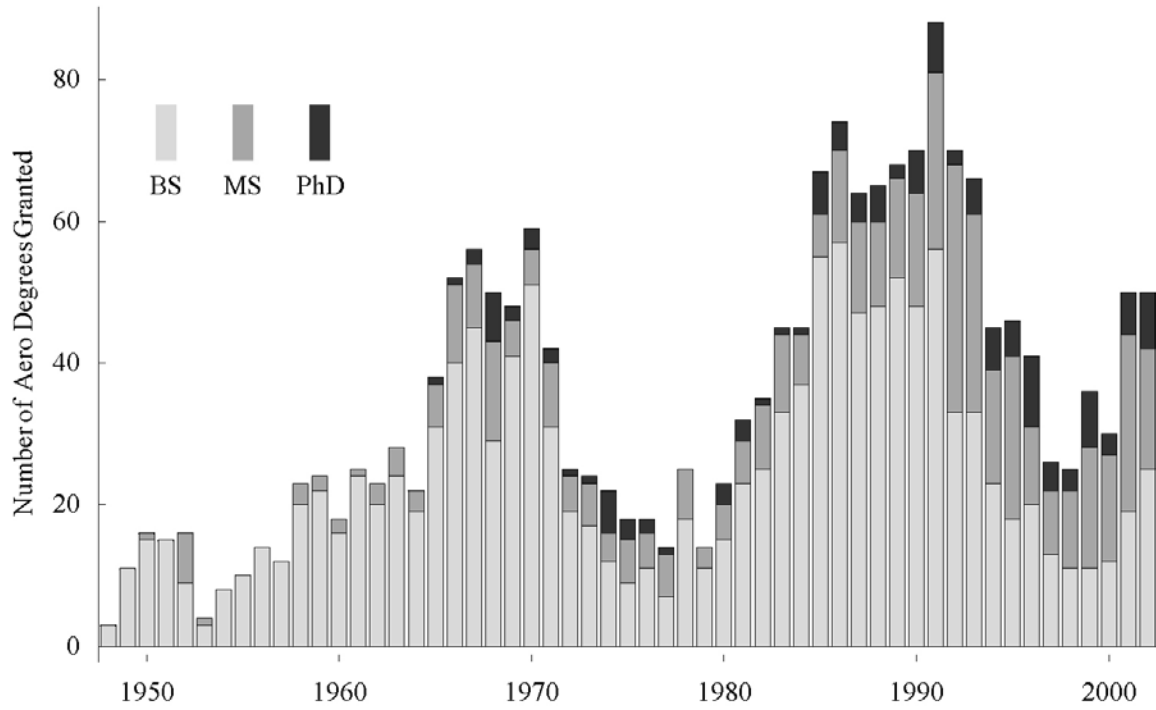


Figure 1. History of the number of graduates in aeronautical/aerospace engineering from the University of Florida

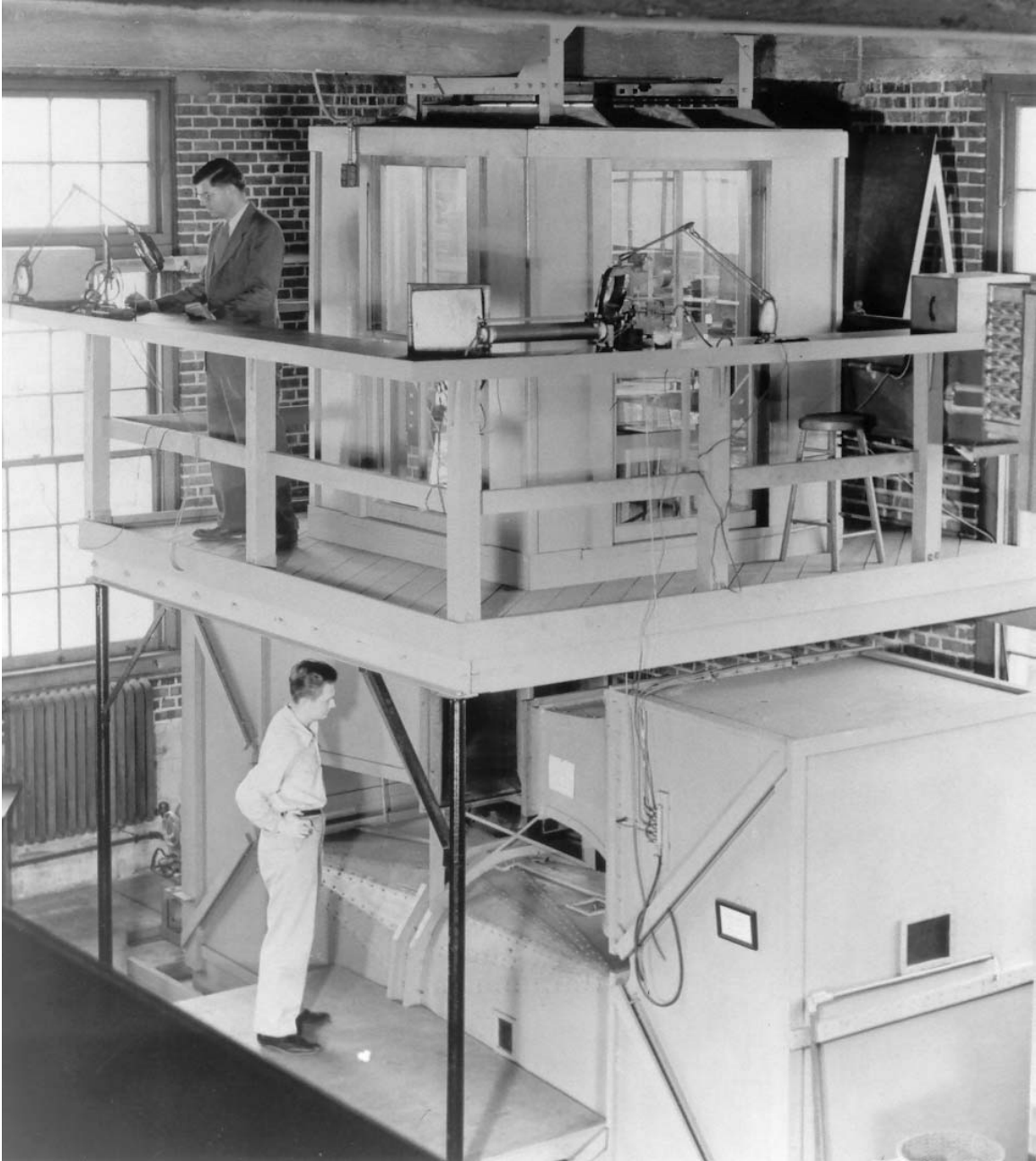


Figure 2. Low-speed wind tunnel and balance system with R. A. Thompson on upper deck.



Figure 3. Looking over the football stadium and press boxes toward temporary buildings, the old ROTC building and the hangar building.

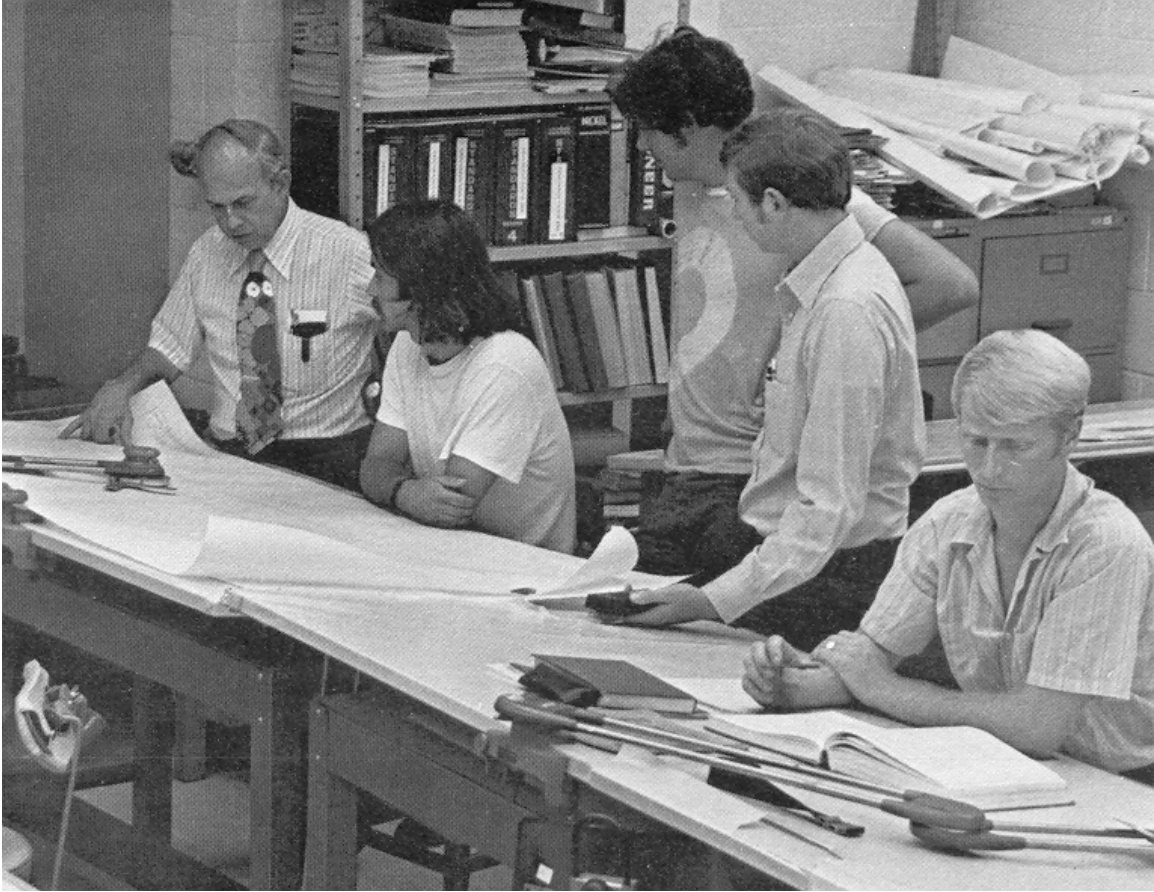


Figure 4. John Hoover with students in design class.



Figure 5. Dave Williams in the early 1970s



Figure 6. Mark Clarkson with undergraduate Paul (Dean) Johnson in the lab in the mid 1980s.



Figure 7. Bernie Leadon and student constructing a wind tunnel for studying wind loads on buildings.



Figure 8. Karl Pohlhausen and Knox Millsaps, early 1970s



Figure 9. Lunch bunch one day in 1982 – Knox Millsaps, Chuck Taylor, Joe Hammack, Stan Ulam (mathematics), Prabhat Hajela and Hans von Ohain; Knox Millsaps, Jr. in front.

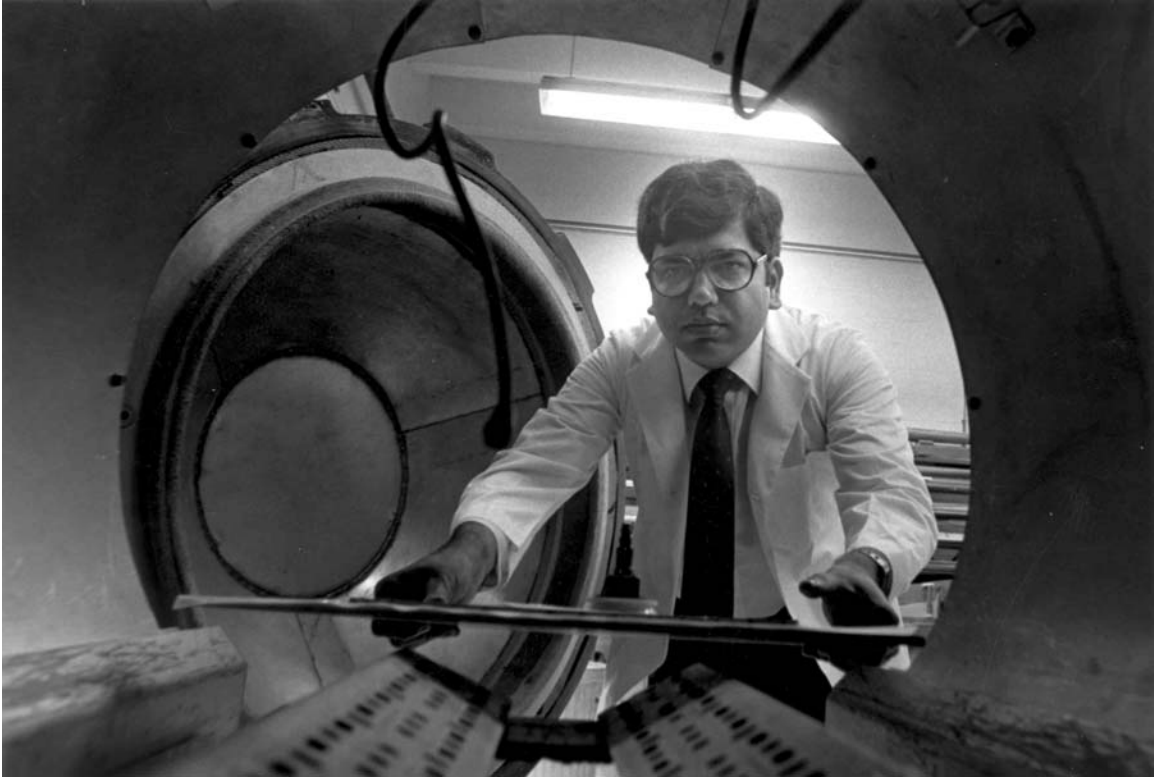


Figure 10. Bhavani Sankar curing fiber composites in an autoclave in the late 1980s



Figure 11a. David Jenkins ready to take control of MAV after Peter Ifju launches it.



Figure 11 b. Close-up of MAV.