

SYE 3803
Fundamentals of Avionics
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A Confluence of Ideas

- December 17, 1903, Kitty Hawk, NC
- Orville Wright at the controls
- First flight lasted 12 seconds at 6.8 mph for a distance of 120 feet
- $L = kSV^2C_L$



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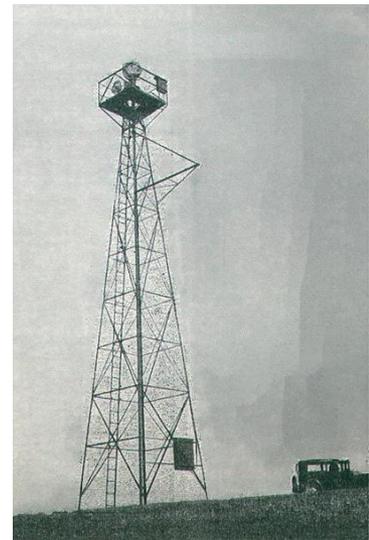


- December 12, 1901, St. Johns, Newfoundland
- Guglielmo Marconi and his assistant, Mr. Kemp, receive first trans-Atlantic radio transmission from a transmitting station in Poldhu, Cornwall, England 2200 miles away

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

History of Avionics

- During the 1920s most aircraft had no radio equipment, had to fly below 10,000 feet, and had to be flown mostly during daylight hours
- By the late 1920s the US Department of Commerce, Aeronautics Branch, had established a coast-to-coast network of airways using lights beacons
- Visibility obstructions were a problem



History of Avionics - continued

- Radio navigation was established to increase visibility due to various visibility-related events such as clouds, fog, and nighttime
- Radio direction finding (RDF) was developed wherein an aircraft was equipped with a directional antenna and radio receiver capable of being tuned to a non-directional radio beacon (NDB) positioned at a known location, which was marked on a map
 - Aircraft *home* to a station by flying a 0° heading (straight ahead); Using homing an aircraft can drift off the airway to/from the NDB due to crosswinds
 - Aircraft can *track* a particular course by accounting for the expected crosswind and the direction to/from the NDB
 - A radio-navigation system called the A-N range was developed to provide better *directional* information for aircraft. A-N ranges were constructed, approximately 200 miles apart, along the original light beacon airways



History of Avionics - continued

- In 1926 Daniel Guggenheim established a fund for the development and promotion of the fledgling aeronautics field. His funding was used to establish the “Full Flight Laboratory,” the primary goal of which was to create a means for all-weather flying.
 - On September 24, 1929 test pilot Lt. James “Jimmy” Doolittle and check pilot Lt. Benjamin Kelsey successfully demonstrated “blind flight” wherein Doolittle took off, flew a closed course, and landed solely by use of instruments while under a covered canopy



History of Avionics - continued

- In 1930 the first radio-equipped control tower was built and began operation in Cleveland, Ohio. However, few aircraft at the time had the necessary equipment to make use of the tower's navigational and communication services
- As scheduled airline services began to emerge a means to provide radio communications was required. Aeronautical Radio, Inc. was established for that purpose
- Commercial, military and civilian aircraft manufacturing and corresponding air traffic began to increase throughout the 30s until December 7, 1941
- When the US entered WWII virtually all aircraft-related activities were diverted to the war effort
- Radar Video: <http://tinyurl.com/llekfay>
- Radar Video: <http://tinyurl.com/lemwv86>
- Radar Video: <http://tinyurl.com/lc9b5qz>

History of Avionics - continued

- After WWII radar was used to track aircraft within the National Airspace System
- Navigation and weather radar systems were installed in civilian aircraft
- Soon advancements such as VHF Omnidirectional Range (VOR), VHF communications, instrument landing systems, and radar transponders were added to the growing list of avionic devices for civilian, transport, and military aircraft



VORTAC
Courtesy of Hans-Peter Scholz
[Commons.Wikimedia.org](https://commons.wikimedia.org)

History of Avionics - continued

- Prior to the shutdown of the airline transport industry at the beginning of WWII, air traffic control was accomplished by means of ground-based observers, aircrew calculations and radio communications to an Area Control Center.
- After the war radar systems were installed along the airways to provide aircraft position, thus eliminating the need for visual reports



30s vintage Air Control Center showing communication terminals and flight monitoring strips

History of Avionics - continued

- The first commercial turbojet aircraft, BAE Comet, entered service in 1952. Unfortunately several of these aircraft broke apart in flight due to cyclic fatigue from cabin pressurization and de-pressurization during flight operations
- The first flight of the Boeing 707 occurred in December 1957. The aircraft was equipped the latest avionics including distance measuring equipment (DME), autopilot, and airborne weather radar



Boeing 707 Cockpit
Courtesy of Alexander Z
Commons.Wikimedia.org

History of Avionics - continued

- In 1957 the space race, which was an important part of the cold war, began when the former U.S.S.R launched Sputnik 1 into orbit around the earth
- Sputnik 1 not only provided telemetry data, but also transmitted radio pulses at 20.005 and 40.002 MHz, which were used by scientist to analyze characteristics of the ionosphere
- Further developments in the space race culminated in the landing of a man on the moon. All of these developments required an ever increasing sophistication and miniaturization of electronic equipment for communications, life support, navigation, telemetry, and other vital systems used in the aerospace industry
- Accelerated advances in avionics has lead to such modern improvements as the glass cockpit, collision avoidance system, air traffic radar transponder, and GPS navigation