History of the Helicopter

- The history of the fixed wing aircraft can be traced to Otto Lilienthal, Samuel Langley, and the first fully controlled flight of a piloted powered aircraft by Orville and Wilbur Wright in 1903.

See: http://www.eanem.umd.edu/AGRC/Aero/history.html
History of the Helicopter

• The history of the helicopter flight is less clear:

  • The ideas of vertical flight aircraft can be traced back to early Chinese tops, used about 400 BC

  • Leonardo da Vinci shows what is a basic human-carrying helicopter like machine. Dated to 1483
History of the Helicopter

• Difference must be made between early attempts to develop a working helicopter:

  • Inventive: The intuition was the major weapon used.

  • Scientific: Where the design was based in trained, systematic approach.

• Nearly all first approaches to the problem can be categorised was Inventive.
History of the Helicopter

- Six fundamental technical problems can be identified that limited early experiments with helicopters.

1. Understanding the basic aerodynamics of vertical flight:

2. The lack of a suitable powerplant (engine):

3. Minimizing structural weight and engine weight:

4. Counteracting rotor torque reaction:

5. Providing stability and properly controlling the machine:

6. Conquering the problem of high vibrations:
History of the Helicopter

- In England in 1796, Sir George Cayley constructed the first powered models of helicopters that were driven by elastic devices.

- Cayley (1809-10) published a three-part paper that was to lay down the foundations of modern aerodynamics.
History of the Helicopter

• In the 1880s, Thomas Alva Edison experimented with small helicopter models in the United States using Electric motors.

• He was one of the first to realize from his experiments the need for a large diameter rotor with low blade area to give good hovering efficiency.

• Edison's more scientific approach to the vertical flight problem proved that both high aerodynamic efficiency of the rotor and high power from an engine were required.
History of the Helicopter

In 1907, about four years after the Wright brothers' first successful powered flights in fixed-wing airplanes at Kitty Hawk in the United States, a French bicycle maker named Paul Cornu constructed a vertical flight machine that was reported to have carried a human off the ground for the first time.
History of the Helicopter

Video Paul Cornu

100 years into the History of the Helicopter

Min. 1.48 e 2.25

De YouTube
History of the Helicopter

• In 1904 French scientist and academician Charles Richet built a small, unpiloted helicopter. While the machine was unsuccessful, one of Richet's students was the future famous aviation pioneer, Louis Breguet

• Louis Breguet made meticulous tests of airfoil shapes, paralleling those of the Wright Brothers and understood the essential aerodynamic theory of the helicopter.
History of the Helicopter

Vídeo Louis Breguet

De YouTube
History of the Helicopter

In the early 1900s, Igor Ivanovitch Sikorsky began to design and build vertical-lift machines in Czarist Russia. By 1909, inspired by the work of Cornu and other French aviators, Sikorsky had built a nonpiloted coaxial helicopter prototype. This machine did not fly because of vibration problems and the lack of a powerful enough engine.
History of the Helicopter

- Boris Yur'ev proposed in 1912 an helicopter with very modern looking, single rotor and tail rotor configuration. The large diameter, high aspect ratio blades suggested some knowledge that this was the configuration for high aerodynamic efficiency.

- The aircraft lacked a powerful enough engine.

- Yur'ev was another one of several firsts to propose the concepts of cyclic pitch for rotor control.
History of the Helicopter

• About 1914, the Danish aviation pioneer Jen C. Ellehammer designed a coaxial rotor helicopter.

• A cyclic pitch mechanism was used to change the pitch of the rotating wings and to effect control, this being another early applications of the cyclic pitch concept.

• The aircraft made many short hops into the air but never made a properly controlled free flight. It was finally destroyed in a crash in 1916.
History of the Helicopter

- In the United States, Emile and Henry Berliner (a father and son) were interested in vertical flight aircraft.

- By the early 1920s the Berliners were flying an aircraft with side-by-side rotors with a conventional elevator and rudder assembly at the tail. Differential longitudinal tilt of the rotor shafts provided directional control. Lateral control was aided by cascades of wings located in the slipstream of the rotors.
History of the Helicopter

- During the early 1920s, Raul Pescara, was attempting to fly a coaxial helicopter with biplane-type rotors

- Work focused on the need for complete control of the machine, which was achieved through cyclic-pitch changes that could be obtained by warping the blades periodically as they rotated the first successful applications of cyclic pitch. Yaw was controlled by differential collective pitch.
History of the Helicopter

- Raoul Hafner early machines used a single-rotor configuration with a pair of wings located in the rotor downwash to provide an antitorque moment. For rotor control, Hafner's machine is notable in that it used a swashplate for blade pitch, which was a very early application of the final mechanism that was to become the standard means of providing pitch control on the modern helicopter.
History of the Helicopter

- The Spanish engineer Juan de la Cierva had built and flown another type of rotating-wing aircraft as early as 1923.

- This aircraft looked a lot like a hybrid between a fixed-wing airplane and a helicopter, with a set of conventional wings and a tail but with a rotor mounted on a vertical shaft above the fuselage.

- However, unlike a helicopter, this rotor was not powered directly and was completely free to turn on the shaft. It was found that when the rotor disk was inclined backward at a small angle of attack and as the machine was pulled forward by a propeller, the rotor was turned by the action of the airflow on the blades.
History of the Helicopter

• This aerodynamic phenomenon, called "autorotation," had been understood by Crocco and Yur'ev before 1910, but the idea of pulling the rotor horizontally through the air to generate lift was clearly that of de la Cierva. Juan de la Cierva called his rotating-wing aircraft an "Autogiro."
History of the Helicopter

Vídeo Juan de la Cierva

De YouTube
History of the Helicopter

• In 1930, Corradino d'Ascanio of Italy built a relatively successful coaxial helicopter, which flew under good control.

• With two, two-bladed, counterrotating rotors. The blades had hinges that allowed for flapping and a feathering capability to change blade pitch. Control was achieved by using auxiliary wings or servo-tabs on the trailing edges of the blades.

• D'Ascanio designed these servo-tabs so that they could be deflected cyclically by a system of cables and pulleys, thereby cyclically changing the lift on the blade as it swept around the rotor disk. For vertical flight, the tabs on all the blades moved collectively to increase the rotor thrust.
History of the Helicopter

- During the period 1930--1936, Louis Breguet and Rene Dorand develop a practical helicopter with a coaxial rotor configuration.
- Each rotor had two modern looking tapered blades that were mounted to the hub with flap and lag hinges.
- The blades were controlled in cyclic pitch using a swashplate design.
- Yaw control was achieved by differential torque on one rotor with respect to the other rotor. Horizontal and vertical tails were used for increased stability.
History of the Helicopter

Louis Breguet and Rene Dorand
History of the Helicopter

• Nicolas Florine: First flight on a “tamdem” Helicopter
History of the Helicopter

• During the period 1938-43, Antoine Flettner, had great success using a side-by-side intermeshing rotor configuration, which became known as a synchropter (first patented to Bourcart in 1903 and by Mees in 1910)

• In the synchropter design, the rotor shafts are close together but arranged so that they are at a significant outward angle with the overlapping rotors turning in opposite directions. A gearing system ensures the exact phasing of the rotors.
History of the Helicopter

• In 1939, Flettner's Fl-265 synchropter flew successfully and was the first helicopter to demonstrate transition into autorotation and then back again into powered flight.
History of the Helicopter

Video Antoine Flettner
(minute 2.20)

De YouTube
History of the Helicopter

• In 1935 Sikorsky was issued a patent, which showed a relatively modern looking single rotor/tail rotor helicopter design with flapping hinges and a form of cyclic pitch control.

• Although Sikorsky encountered many technical challenges, he tackled them systematically and carefully.
History of the Helicopter
History of the Helicopter

• With only the sideward thrusting tail rotor retained out of the original three auxiliary rotors, the longitudinal and lateral control was achieved by tilting the main rotor by means of cyclic-pitch inputs; the single tail rotor was used for antitorque and directional control purposes. This configuration was to become the standard for most modern helicopters.
History of the Helicopter

- Before long, Sikorsky had refined his first machines and by 1941 he had already started production of the R-4.

- In 1943 Sikorsky developed the R-5, which, although still only a two-seater helicopter, was much larger, more powerful, and more capable than the R-4. The R-5 was produced in substantial numbers although it had a limited payload and forward speed capability
History of the Helicopter

Sikorsky early models
History of the Helicopter

Vídeo Sikorsky

First Helicopter

R-4

De YouTube
History of the Helicopter

Advancing the technology

S55

S61

S54
History of the Helicopter

Video S-64

De YouTube
History of the Helicopter

Present day models

S92

UH-60

S70
History of the Helicopter

Bell Early models

Model 47

Bell UH1 Iroquois "Huey"
History of the Helicopter

Bell models

Model 205

Model AH-1
History of the Helicopter

Boeing Models

CH-47

AH-64
History of the Helicopter

Eurocopter

Puma

Alouette
History of the Helicopter

- Eurocopter
- NH-90
- Tiger
History of the Helicopter

Westland Lynx

EH-101
History of the Helicopter

Mil Helicopters

Mil Mi-26

Mil Mi-12
History of the Helicopter
History of the Helicopter

Other technology:
Tilt Rotor

Boeing-Vertol VZ-2

Hiller X-18
History of the Helicopter

Other technology: Tilt Rotor

Bell Augusta 609

Bell V22
History of the Helicopter

Boeing Bell V-22