
control_
NASA 802

1
00:00:00,000 --> 00:00:03,436
>>Flashing across California desert skies, the airplanes you see

2
00:00:03,436 --> 00:00:07,540
here are writing new chapters in the story
of man made flight....there she goes!

3
00:00:07,540 --> 00:00:12,078
>>This is my first opportunity
to greet you as deputy administrator

4
00:00:12,078 --> 00:00:15,749
of the National Aeronautics
and Space Administration.

5
00:00:16,082 --> 00:00:18,718
>>Together, you and I must make our new agency

6
00:00:18,718 --> 00:00:20,053
>>A most unusual place

7
00:00:20,086 --> 00:00:22,922
>>An organization that can challenge
conventional wisdom.

8
00:00:22,922 --> 00:00:26,526
>>We can engineer anything we can write the requirements for.

9
00:00:26,526 --> 00:00:27,927
>>We're going to make your idea work.

10
00:00:27,927 --> 00:00:30,497
This particular idea is quite disruptive.

11
00:00:31,164 --> 00:00:35,435
>>A typical flight, of course, starts
under the wing of the B-52 mothership.

12

00:00:35,602 --> 00:00:41,041
>>This sleek, high speed machine
would have made Rube Goldberg proud.

13
00:00:41,174 --> 00:00:44,044
>>The manner in which we fly
reentry from space,

14
00:00:44,044 --> 00:00:48,048
on the space shuttle was
pioneered on the X-15.

15
00:00:48,048 --> 00:00:53,653
>>The X-31 pretty much wrote the book on thurst vectoring, along with its sister program, the F-18 HARV.

16
00:00:53,653 --> 00:00:55,822
>>An observation of an occulation is

17
00:00:55,822 --> 00:00:58,792
one of the more challenging
missions that SOFIA can do.

18
00:00:59,592 --> 00:01:18,778
[Music/Background sound]

19
00:01:19,612 --> 00:01:23,983
>>Right now, we are looking
at the dawn of a new era of aviation.

20
00:01:27,020 --> 00:01:31,357
[Music/Background sound]

21
00:01:37,931 --> 00:01:39,799
>>Most early inventors thought that flight control

22
00:01:39,799 --> 00:01:42,702
could be achieved by a pilot
simply shifting his weight back and forth.

23

00:01:42,869 --> 00:01:45,872
The Wrights, on the other hand,
knew that controlling the plane would be key

24
00:01:45,872 --> 00:01:47,607
to successful flight.

25
00:01:47,974 --> 00:01:50,944
[Music/Background sound]

26
00:01:54,147 --> 00:01:57,617
>>Release brakes...throttle to afterburner...watch exhaust temperature...

27
00:01:57,884 --> 00:02:01,187
...watch nozzle position...check engine pressure ratio now...

28
00:02:01,554 --> 00:02:04,657
And all this time
steer down the runway, first

29
00:02:04,657 --> 00:02:08,294
nose wheel steer, then rudder; lift nose wheel at just

30
00:02:08,294 --> 00:02:11,397
the proper speed to fly off
in the least ground roll.

31
00:02:11,531 --> 00:02:15,635
>>Today, man copes
with a highly complex environment...

32
00:02:15,969 --> 00:02:19,239
...with physical abilities no better than he
has ever had.

33
00:02:19,239 --> 00:02:20,473
>>Greater demands on the air

34
00:02:20,473 --> 00:02:24,911

crew call for ever closer
relationships between man and machine.

35
00:02:25,845 --> 00:02:29,249
>>Until now, all flyers have used the force of their muscles,

36
00:02:29,415 --> 00:02:33,186
multiplied by gears and motors,
to adjust wing and tail surfaces.

37
00:02:33,520 --> 00:02:36,055
>>Your landing gear and flaps
are operated hydraulically.

38
00:02:36,189 --> 00:02:38,758
>>It's about forty-five pounds of force to get that stick to move...

39
00:02:39,826 --> 00:02:41,861
...It's a very athletic endeavor.

40
00:02:41,861 --> 00:02:43,663
[Music/Background sound]

41
00:02:43,663 --> 00:02:47,734
>>An advanced flight control system
called the Digital Fly-By-Wire System

42
00:02:47,734 --> 00:02:51,771
has been installed by the Flight Research
Center in a modified F-8 jet aircraft.

43
00:02:52,005 --> 00:02:55,575
>>The pilot of this experimental aircraft
need only indicate

44
00:02:55,575 --> 00:02:59,345
the desired flight path to a computer,
which then calculates

45

00:02:59,546 --> 00:03:03,183
and actually executes the control changes
needed to stay on course.

46
00:03:03,917 --> 00:03:06,586
>>The heart of the control
system is a digital computer

47
00:03:06,920 --> 00:03:10,423
and an inertial measuring unit
that were developed for the flight control

48
00:03:10,423 --> 00:03:12,292
system of the Apollo lunar module.

49
00:03:12,292 --> 00:03:13,893
[Jet flying]

50
00:03:13,893 --> 00:03:17,597
>>Use of this kind of control system
could make air travel of the future

51
00:03:17,597 --> 00:03:22,902
smoother and safer by reducing aircraft
vibration caused by turbulent air

52
00:03:23,136 --> 00:03:26,940
through automatic response
from the computer to the aircraft controls.

53
00:03:26,940 --> 00:03:29,909
[Music/Background sound]

54
00:03:36,382 --> 00:03:40,086
>>We used an F-111 for integrated engine control.

55
00:03:41,721 --> 00:03:43,256
[Jet landing]

56

00:03:43,256 --> 00:03:46,226
[Music/Background sound]

57
00:03:47,927 --> 00:03:51,331
>>Further, mechanization
hopes to make more optimum blending

58
00:03:51,331 --> 00:03:53,800
of airframe and propulsion system control.

59
00:03:53,800 --> 00:03:56,603
>>A computer-controlled flight system, along with

60
00:03:56,603 --> 00:04:02,075
some new control surfaces, allow
this modified F-16 to maneuver laterally...

61
00:04:03,443 --> 00:04:05,812
...change altitude
without pointing its nose...

62
00:04:06,946 --> 00:04:09,349
...and perform other
unconventional maneuvers.

63
00:04:09,916 --> 00:04:12,285
>>The DEEC system is full-authority

64
00:04:12,285 --> 00:04:16,089
digital electronic control. The fastest
calculation loop in the control

65
00:04:16,089 --> 00:04:18,424
is 24 milliseconds.

66
00:04:18,658 --> 00:04:21,361
[Music/Background sounds]

67
00:04:21,361 --> 00:04:23,029

>>At Dryden we have been working

68
00:04:23,029 --> 00:04:25,031
integrated controls here
over a number of years,

69
00:04:25,031 --> 00:04:28,101
so we decided to see if we could extend
our integrated control

70
00:04:28,101 --> 00:04:31,170
approach to let the engines do
all of the flight control.

71
00:04:31,304 --> 00:04:35,775
>>When Gordon Fullerton lands an F-15 and
he hasn't touched the control surfaces,

72
00:04:35,775 --> 00:04:39,178
all the people who said it was impossible
suddenly don't have a lot to say anymore.

73
00:04:39,646 --> 00:04:43,650
>>This will be invaluable on military
and commercial aircraft of the future.

74
00:04:43,683 --> 00:04:47,020
>>You could bring it in
not for just a survivable crash landing,

75
00:04:47,020 --> 00:04:49,989
but a precise normal landing,
which is what we did,

76
00:04:49,989 --> 00:04:53,192
with absolutely no motion
of any external flight controls,

77
00:04:53,359 --> 00:04:55,728
purely by modulation of the engine thrust.

78
00:04:55,728 --> 00:04:57,530
>>Using neural networks to identify

79
00:04:57,530 --> 00:05:01,467
aircraft stability parameters
and to optimize control performance

80
00:05:01,467 --> 00:05:05,738
during test flights will reduce
development and program costs.

81
00:05:05,738 --> 00:05:10,243
>>A neural network is a computer program
comprised of a series of examples.

82
00:05:10,243 --> 00:05:13,846
And in our particular case,
these examples are previous flight data.

83
00:05:13,880 --> 00:05:16,983
>>Power-by-wire actuators only draw power
when the aircraft is maneuvering.

84
00:05:17,016 --> 00:05:20,353
So that saves a great deal of energy,
which in aircraft translates to fuel.

85
00:05:20,420 --> 00:05:24,691
>>This new software allowed the aircraft's
flight control computer to minimize drag

86
00:05:24,924 --> 00:05:28,561
by automatically determining the best
setting for thrust-vectoring nozzles

87
00:05:28,561 --> 00:05:30,263
and aerodynamic controls.

88

00:05:30,263 --> 00:05:35,001
Thrust-vectoring is the ability to direct
an aircraft's thrust for directional control,

89
00:05:35,335 --> 00:05:38,404
rather than relying on
conventional control surfaces alone.

90
00:05:39,038 --> 00:05:43,209
The Intelligent Flight Control experiment,
to be tested in early 1999,

91
00:05:43,409 --> 00:05:47,513
seeks to enable aircraft control systems
to adapt to unforeseen changes

92
00:05:47,513 --> 00:05:49,215
in aircraft operating conditions.

93
00:05:49,215 --> 00:05:51,751
[Music/Background sound]

94
00:05:51,751 --> 00:05:53,353
>>In addition to advanced controls

95
00:05:53,353 --> 00:05:57,123
research, the FAST system
allows for simulating system failures.

96
00:05:57,223 --> 00:06:00,626
>>Data from NASA's Integrated Resilient
Aircraft Controls,

97
00:06:01,060 --> 00:06:05,365
or IRAC, project will be used to design
and develop aviation systems

98
00:06:05,631 --> 00:06:09,369
better enabled to safely fly
and land damaged aircraft.

99
00:06:09,435 --> 00:06:10,737
>>One promising technology

100
00:06:10,737 --> 00:06:13,940
that may make it possible to improve
both aircraft safety and performance