1
00:00:40,960 --> 00:00:39,100
for three decades the NASA Ames vertical

2
00:00:43,030 --> 00:00:40,970
motion simulator has provided the

3
00:00:45,009 --> 00:00:43,040
shuttle program with engineering studies

4
00:00:48,910 --> 00:00:45,019
and pilot training for the shuttle

5
00:00:51,220 --> 00:00:48,920
landing and roll out phase since April

6
00:00:52,840 --> 00:00:51,230
1980 the VMS has been an important

7
00:00:57,819 --> 00:00:52,850
developmental tool for the shuttle

8
00:01:00,040 --> 00:00:57,829
program unlike most newer aircraft

9
00:01:02,139 --> 00:01:00,050
programs with extensive flight testing

10
00:01:03,880 --> 00:01:02,149
only five free flight landings were

11
00:01:05,620 --> 00:01:03,890
performed as part of the approach and

12
00:01:09,520 --> 00:01:05,630
landing tests for the first shuttle

13
00:01:14,560 --> 00:01:09,530

mission to date the shuttle program has

14
00:01:16,719 --> 00:01:14,570
130 successful mission landings due to

15
00:01:18,130 --> 00:01:16,729
the low number of flights the VMS has

16
00:01:22,410 --> 00:01:18,140
played a major role in what would

17
00:01:26,610 --> 00:01:25,020
VMs has been used as a testbed to

18
00:01:28,830 --> 00:01:26,620
determine the effects of various

19
00:01:36,980 --> 00:01:28,840
engineering and operational changes for

20
00:01:42,870 --> 00:01:40,560
the VMS is a unique high fidelity large

21
00:01:58,020 --> 00:01:42,880
amplitude six degree of freedom motion

22
00:02:00,389 --> 00:01:58,030
flight to meet the large motion envelope

23
00:02:02,400 --> 00:02:00,399
of the VMS simulates to touchdown and

24
00:02:08,190 --> 00:02:02,410
roll out motion cueing of the actual

25
00:02:14,430 --> 00:02:08,200
shuttle landing the system architecture

26
00:02:16,320 --> 00:02:14,440
in the VMS is flexible by design it

27
00:02:18,390 --> 00:02:16,330
allows integration of external software

28
00:02:21,870 --> 00:02:18,400
modules and unique vehicle specific

29
00:02:24,900 --> 00:02:21,880
hardware this has enabled the shuttle

30
00:02:27,780 --> 00:02:24,910
program to use the VMS to develop test

31
00:02:29,850 --> 00:02:27,790
and evaluate numerous changes that have

32
00:02:32,370 --> 00:02:29,860
improved safety and operation of the

33
00:02:37,420 --> 00:02:35,320
early use of the VMS investigate and

34
00:02:39,400 --> 00:02:37,430
address humming quality issues played a

35
00:02:44,680 --> 00:02:39,410
major role in the use of VMs for

36
00:02:46,480 --> 00:02:44,690
training the first VMs simulation

37
00:02:48,190 --> 00:02:46,490
investigated a pilot induced

38
00:02:49,900 --> 00:02:48,200

oscillations or Pio

39
00:03:00,880 --> 00:02:49,910
that the orbiter encountered during

40
00:03:03,850 --> 00:03:00,890
approach and landing tests prior to use

41
00:03:06,160 --> 00:03:03,860
of the VMS Ames flight simulator for

42
00:03:08,440 --> 00:03:06,170
advanced aircraft was used for the PIO

43
00:03:10,570 --> 00:03:08,450
testing but did not provide the vertical

44
00:03:16,960 --> 00:03:10,580
motion camera with enough fidelity to

45
00:03:19,180 --> 00:03:16,970
recreate the PIO when the VMS became

46
00:03:21,190 --> 00:03:19,190
operational in 1980 this test is

47
00:03:23,200 --> 00:03:21,200
repeated and the VMS was able to

48
00:03:28,450 --> 00:03:23,210
recreate the vertical cueing necessary

49
00:03:30,370 --> 00:03:28,460
to reproduce the PIO after that the VMS

50
00:03:32,260 --> 00:03:30,380
has been used extensively by the shuttle

51
00:03:37,510 --> 00:03:32,270
programs for engineering study as well

52
00:03:42,110 --> 00:03:39,980
landing and roll ad is defined as the

53
00:03:43,850 --> 00:03:42,120
phase of flight from Mach point nine

54
00:03:49,180 --> 00:03:43,860
five to touch down where the shuttle

55
00:03:54,590 --> 00:03:51,830
this is a demanding task in many ways

56
00:03:56,360 --> 00:03:54,600
first the flight crew have been in

57
00:03:58,940 --> 00:03:56,370
microgravity conditions for some length

58
00:04:00,950 --> 00:03:58,950
of time and are adapting from extended

59
00:04:05,780 --> 00:04:00,960
weightlessness to Earth's gravity during

60
00:04:07,580 --> 00:04:05,790
approach and landing second the space

61
00:04:09,950 --> 00:04:07,590
shuttles flight control system is a

62
00:04:12,140 --> 00:04:09,960
three axis rate command system designed

63
00:04:15,910 --> 00:04:12,150

to deal with changing aerodynamics

64
00:04:20,449 --> 00:04:18,349
this requires years of training by

65
00:04:22,220 --> 00:04:20,459
pilots to perfect the precision small

66
00:04:26,020 --> 00:04:22,230
amplitude low gain input flying

67
00:04:28,580 --> 00:04:26,030
necessary to perform a safe landing

68
00:04:30,560 --> 00:04:28,590
lastly the space shuttles rapidly

69
00:04:32,390 --> 00:04:30,570
descending approach and landing profile

70
00:04:34,310 --> 00:04:32,400
is unpowered so it must be done

71
00:04:38,990 --> 00:04:34,320
correctly on the first attempt unlike

72
00:04:40,940 --> 00:04:39,000
any other aircraft for these reasons the

73
00:04:50,840 --> 00:04:40,950
training on the VMS simulator is

74
00:04:52,640 --> 00:04:50,850
critical to the astronauts to phase the

75
00:04:56,000 --> 00:04:52,650
fly from MOG point nine five two

76
00:04:58,820 --> 00:04:56,010
touchdown encompasses subsonic terminal

77
00:05:01,929 --> 00:04:58,830
area energy management or pain as well

78
00:05:05,659 --> 00:05:01,939
as perch and landing guidance

79
00:05:08,119 --> 00:05:05,669
team has four flight phases estern

80
00:05:12,169 --> 00:05:08,129
acquisition heading alignment and creep

81
00:05:15,649 --> 00:05:12,179
final approach and landing guidance has

82
00:05:18,649 --> 00:05:15,659
five seconds trajectories capture under

83
00:05:26,520 --> 00:05:18,659
glide slope shallow glide slope final

84
00:05:30,760 --> 00:05:29,080
orbiter landing simulators provide the

85
00:05:32,770 --> 00:05:30,770
relations of the heading alignment phase

86
00:05:40,600 --> 00:05:32,780
also referred to as a heading alignment

87
00:05:44,619 --> 00:05:42,550
Norberto will intercept the hitting the

88
00:05:46,450 --> 00:05:44,629

Lyman column and spiral down until it is

89
00:06:00,159 --> 00:05:46,460
lined up to begin the protein landing

90
00:06:02,469 --> 00:06:00,169
phase the approach and landing phase

91
00:06:04,540 --> 00:06:02,479
begins at ten thousand feet at a glide

92
00:06:13,140 --> 00:06:04,550
slope 20 degrees for a lightweight

93
00:06:18,220 --> 00:06:15,940
at approximately 2,000 feet the orbiter

94
00:06:22,720 --> 00:06:18,230
will begin to transition to at one point

95
00:06:28,720 --> 00:06:22,730
five degree glide slope until the final

96
00:06:31,540 --> 00:06:28,730
flare and touched in the main gear is

97
00:06:39,379 --> 00:06:31,550
targeted for 2500 feet down the runway

98
00:06:47,330 --> 00:06:41,540
shortly after touchdown of the main game

99
00:06:50,179 --> 00:06:47,340
the pilot with the polarize direction at

100
00:06:53,149 --> 00:06:50,189
a velocity of 185 knots the commander

101
00:06:57,950 --> 00:06:53,159
will de rotate at 1.5 degrees per second

102
00:07:00,350 --> 00:06:57,960
until the nose gear touches down braking

103
00:07:05,450 --> 00:07:00,360
starts after the orbiter has decelerated

104
00:07:07,730 --> 00:07:05,460
below 120 knots the pilot would jettison

105
00:07:20,689 --> 00:07:07,740
the chute at 60 knots as the commander

106
00:07:24,749 --> 00:07:23,189
approximately 27 updates have been

107
00:07:26,879 --> 00:07:24,759
incorporated into the shuttle flight

108
00:07:29,629 --> 00:07:26,889
software and hardware systems over the

109
00:07:31,969 --> 00:07:29,639
past 30 years

110
00:07:33,860 --> 00:07:31,979
the VMS has been used to conduct more

111
00:07:36,020 --> 00:07:33,870
than 80 engineering studies that have

112
00:07:39,340 --> 00:07:36,030
led to more than 20 shuttle flight role

113
00:07:43,990 --> 00:07:41,710

the most recent engineered study was the

114
00:07:47,450 --> 00:07:44,000
crew evaluation of the modified braking

115
00:07:51,320 --> 00:07:49,550
it resulted in a flat road change to the

116
00:08:02,189 --> 00:07:51,330
braking procedures on the Edwards Air

117
00:08:07,890 --> 00:08:04,469
some significant models incorporated

118
00:08:09,929 --> 00:08:07,900
into the VMS include studying various

119
00:08:14,149 --> 00:08:09,939
drag chute sizes to see which would be

120
00:08:18,510 --> 00:08:16,320
evaluating crosswinds for all weights

121
00:08:22,769 --> 00:08:18,520
which resulted in helping define the

122
00:08:28,110 --> 00:08:22,779
orbiters limits studying the heads-up

123
00:08:33,839 --> 00:08:30,510
studying the mane and nose gear drag

124
00:08:38,279 --> 00:08:33,849
tire compression side energy side loads

125
00:08:39,750 --> 00:08:38,289
and normal loads investigating the

126
00:08:41,730 --> 00:08:39,760
carbon carbon bright energies

127
00:08:45,550 --> 00:08:41,740
encountered during worst case tell

128
00:08:50,650 --> 00:08:48,519
evaluating three equivalent airspeed for

129
00:08:52,840 --> 00:08:50,660
use in a redundant beep trimmed software

130
00:08:55,119 --> 00:08:52,850
modification allowing minimum

131
00:09:01,540 --> 00:08:55,129
degradation of D rotation handling

132
00:09:06,260 --> 00:09:04,550
the continuous reviews of VMs simulation

133
00:09:07,850 --> 00:09:06,270
results have led to systematic

134
00:09:12,050 --> 00:09:07,860
improvements the shuttles landing and

135
00:09:14,240 --> 00:09:12,060
rollout simulation these improvements

136
00:09:16,160 --> 00:09:14,250
have led to better training results and

137
00:09:20,690 --> 00:09:16,170
improved safety and operation of the

138
00:09:22,880 --> 00:09:20,700

orbiter the and even rollout training on

139
00:09:26,440 --> 00:09:22,890
the VMS has been an integral part of the

140
00:09:30,480 --> 00:09:28,720
simulation scenarios are developed for

141
00:09:33,009 --> 00:09:30,490
various environmental conditions

142
00:09:34,870 --> 00:09:33,019
emergency landings as well as system

143
00:09:41,200 --> 00:09:34,880
failures including blown tires and shoe

144
00:09:50,100 --> 00:09:43,330
every pilot who has flown the shuttle

145
00:09:54,960 --> 00:09:53,010
more than 65,000 landing and rollout

146
00:10:00,180 --> 00:09:54,970
training and engineering runs have been

147
00:10:02,610 --> 00:10:00,190
completed other than on the actual

148
00:10:04,560 --> 00:10:02,620
orbiter the BMS is the only place where

149
00:10:09,480 --> 00:10:04,570
a shuttle pilot can feel what it's like

150
00:10:12,000 --> 00:10:09,490
to land the vehicle experience shuttle

151
00:10:14,160 --> 00:10:12,010
commanders have stated that the VMS is