



1
00:00:26,990 --> 00:00:25,130
Ames Research Center has played and will

2
00:00:29,600 --> 00:00:27,000
continue to play an important role in

3
00:00:31,370 --> 00:00:29,610
returning the space shuttle flight games

4
00:00:33,740 --> 00:00:31,380
has contributed to safety of the shuttle

5
00:00:36,200 --> 00:00:33,750
in several ways computing simulations

6
00:00:38,210 --> 00:00:36,210
and lab tests generated new data for

7
00:00:39,770 --> 00:00:38,220
preparing the shuttle and new facilities

8
00:00:43,460 --> 00:00:39,780
here will provide operational support

9
00:00:45,530 --> 00:00:43,470
during missions during every launch a

10
00:00:48,049 --> 00:00:45,540
certain amount of debris falls away in

11
00:00:49,400 --> 00:00:48,059
order to understand this phenomena we

12
00:00:52,189 --> 00:00:49,410
needed to simulate the event without

13
00:00:54,350 --> 00:00:52,199

actually flying a shuttle a technique

14

00:00:56,899 --> 00:00:54,360

called computational fluid dynamics or

15

00:00:58,910 --> 00:00:56,909

cfD is a method of using computers to

16

00:01:01,310 --> 00:00:58,920

simulate airflow over the shuttle wing

17

00:01:03,410 --> 00:01:01,320

during launch and reentry it requires

18

00:01:07,240 --> 00:01:03,420

millions of calculations but it can

19

00:01:11,810 --> 00:01:09,800

we've been working very closely with a

20

00:01:14,090 --> 00:01:11,820

number of engineers at Johnson for a

21

00:01:16,010 --> 00:01:14,100

quite a number of years in developing

22

00:01:17,840 --> 00:01:16,020

our computational fluid dynamics tools

23

00:01:21,380 --> 00:01:17,850

we've helped supply them with

24

00:01:24,830 --> 00:01:21,390

computational capability to analyze the

25

00:01:27,109 --> 00:01:24,840

sense of the redesigned external tank as

26

00:01:28,999 --> 00:01:27,119

well as to understand the debris

27

00:01:30,590 --> 00:01:29,009

environment that the vehicle has to go

28

00:01:34,850 --> 00:01:30,600

through as it's flying through the air

29

00:01:37,279 --> 00:01:34,860

even very small pieces of debris when

30

00:01:40,309 --> 00:01:37,289

they're traveling extremely fast and

31

00:01:42,620 --> 00:01:40,319

still in part significant impact to the

32

00:01:44,419 --> 00:01:42,630

vehicle and these are things that we

33

00:01:46,490 --> 00:01:44,429

have to look out for that we're still at

34

00:01:48,080 --> 00:01:46,500

risk for but that we have a very good

35

00:01:52,010 --> 00:01:48,090

understanding of what that risk is and

36

00:01:53,690 --> 00:01:52,020

we can try to avoid it the super

37

00:01:56,210 --> 00:01:53,700

computing facility here at Ames is

38

00:01:57,620 --> 00:01:56,220

absolutely unique and it's the fastest

39

00:02:01,010 --> 00:01:57,630

operational supercomputer in the world

40

00:02:03,949 --> 00:02:01,020

and its really allowed us to analyze our

41

00:02:05,719 --> 00:02:03,959

data compute our cases and just do

42

00:02:08,059 --> 00:02:05,729

things that we never would have been

43

00:02:10,009 --> 00:02:08,069

able to do without this facility in

44

00:02:12,020 --> 00:02:10,019

addition to the Columbia supercomputer

45

00:02:14,090 --> 00:02:12,030

Ames has several test facilities that

46

00:02:17,180 --> 00:02:14,100

are necessary to validate the cfd

47

00:02:19,330 --> 00:02:17,190

simulations with real-world data one is

48

00:02:21,850 --> 00:02:19,340

the ballistic range

49

00:02:23,800 --> 00:02:21,860

the CFD folks thought they are

50

00:02:25,750 --> 00:02:23,810

constructed a pretty good code it will

51
00:02:28,330 --> 00:02:25,760
really predict the motion of the shuttle

52
00:02:30,220 --> 00:02:28,340
form fragments but they wanted to check

53
00:02:33,009 --> 00:02:30,230
it so they said look you guys in the

54
00:02:35,290 --> 00:02:33,019
range you fire maybe 2025 projectiles

55
00:02:38,160 --> 00:02:35,300
see how they actually fly and we'll see

56
00:02:41,170 --> 00:02:38,170
if we can predict them with the CFD code

57
00:02:44,080 --> 00:02:41,180
what we're firing is a small disk like

58
00:02:46,210 --> 00:02:44,090
projectile it's about 1.4 inches in

59
00:02:48,430 --> 00:02:46,220
diameter for these particular tests were

60
00:02:51,039 --> 00:02:48,440
firing at about Mach 3 or about one

61
00:02:53,589 --> 00:02:51,049
kilometer or a second another way of

62
00:02:55,420 --> 00:02:53,599
validating CFD results involve building

63
00:02:57,640 --> 00:02:55,430

a small model of the shuttle three

64

00:02:59,380 --> 00:02:57,650

percent of its actual size and equipping

65

00:03:01,420 --> 00:02:59,390

it with hundreds of miniature sensors

66

00:03:03,490 --> 00:03:01,430

this allowed us to look at design

67

00:03:05,350 --> 00:03:03,500

modifications on the fuel tanks fairings

68

00:03:08,250 --> 00:03:05,360

and other areas of shuttle that might

69

00:03:12,460 --> 00:03:10,960

we were looking at doing some fairly

70

00:03:14,830 --> 00:03:12,470

detailed measurements on a three percent

71

00:03:16,540 --> 00:03:14,840

scale model of the shuttle in its ascent

72

00:03:19,390 --> 00:03:16,550

configuration with the external tank and

73

00:03:21,160 --> 00:03:19,400

SRB is attached tests in the 70s were

74

00:03:22,090 --> 00:03:21,170

done as part of the design process they

75

00:03:23,740 --> 00:03:22,100

really didn't understand the

76
00:03:26,140 --> 00:03:23,750
aerodynamics of the vehicle until they

77
00:03:28,840 --> 00:03:26,150
did the wind tunnel tests and those

78
00:03:31,570 --> 00:03:28,850
tests were primarily concerned with the

79
00:03:33,370 --> 00:03:31,580
performance some loads measurements but

80
00:03:35,350 --> 00:03:33,380
certainly not the detail that we need to

81
00:03:36,580 --> 00:03:35,360
look at now to make sure that the

82
00:03:38,860 --> 00:03:36,590
vehicle is safe to fly and the

83
00:03:40,600 --> 00:03:38,870
modifications that are being made will

84
00:03:42,820 --> 00:03:40,610
be safe there's new measurement

85
00:03:46,570 --> 00:03:42,830
techniques in particular pressure

86
00:03:48,640 --> 00:03:46,580
sensitive paint gives a complete map of

87
00:03:51,010 --> 00:03:48,650
the pressure over the entire geometry

88
00:03:52,750 --> 00:03:51,020

new types of measurements using optical

89

00:03:54,580 --> 00:03:52,760

techniques have made measurements

90

00:03:56,590 --> 00:03:54,590

possible that we couldn't do back in the

91

00:03:58,270 --> 00:03:56,600

70s so it really is much richer

92

00:04:00,130 --> 00:03:58,280

database now that we're able to generate

93

00:04:02,190 --> 00:04:00,140

for the for the shuttle those

94

00:04:04,350 --> 00:04:02,200

measurements helped validate our

95

00:04:07,090 --> 00:04:04,360

calculations and show that the

96

00:04:11,330 --> 00:04:07,100

computational work matches the real

97

00:04:15,140 --> 00:04:13,610

the agency had to develop a few repair

98

00:04:17,750 --> 00:04:15,150

materials and techniques for treating

99

00:04:19,550 --> 00:04:17,760

damage to the shuttles wings one of the

100

00:04:22,790 --> 00:04:19,560

critical test facilities at Ames is

101
00:04:24,620 --> 00:04:22,800
called an arc jet this is a closed wind

102
00:04:26,000 --> 00:04:24,630
tunnel that generates air speeds and

103
00:04:28,610 --> 00:04:26,010
heating similar to what the shuttle

104
00:04:30,439 --> 00:04:28,620
encounters during reentry the agency was

105
00:04:31,909 --> 00:04:30,449
concerned that a debris strike would

106
00:04:34,159 --> 00:04:31,919
punch a hole in the wing leading edge

107
00:04:36,590 --> 00:04:34,169
and so they came up with a concept of a

108
00:04:38,960 --> 00:04:36,600
plug this is a typical plug

109
00:04:41,000 --> 00:04:38,970
configuration it's designed with some

110
00:04:43,400 --> 00:04:41,010
curvature to fit over the curvature of

111
00:04:45,080 --> 00:04:43,410
the wing leading edge early in the test

112
00:04:47,150 --> 00:04:45,090
program a lot of the plugs were failing

113
00:04:49,219 --> 00:04:47,160

and we learn lessons from those failures

114

00:04:51,950 --> 00:04:49,229

we knew we had to change the materials

115

00:04:55,850 --> 00:04:51,960

we had to change the shape and the

116

00:04:57,440 --> 00:04:55,860

angles to really try to adjust this plug

117

00:05:00,200 --> 00:04:57,450

so that it will stands the entry

118

00:05:02,420 --> 00:05:00,210

conditions this data was passed on to

119

00:05:04,190 --> 00:05:02,430

another group of CFD engineers who

120

00:05:06,200 --> 00:05:04,200

focused on analyzing the effects of

121

00:05:08,270 --> 00:05:06,210

atmospheric heating on specific types of

122

00:05:11,960 --> 00:05:08,280

tile damage and the repairs that might

123

00:05:14,480 --> 00:05:11,970

be made to them one is the analysis of

124

00:05:17,420 --> 00:05:14,490

damage and the other is the analysis of

125

00:05:20,029 --> 00:05:17,430

repair the object of CFD is to analyze

126
00:05:23,000 --> 00:05:20,039
both and determine whether both are in

127
00:05:25,310 --> 00:05:23,010
fact good candidates for entry or not

128
00:05:28,879 --> 00:05:25,320
you need on the order of a hundred

129
00:05:31,640 --> 00:05:28,889
solutions in under 24 hours in order to

130
00:05:34,129 --> 00:05:31,650
put enough credible data on the table to

131
00:05:36,350 --> 00:05:34,139
make a decision we had the ability to do

132
00:05:38,810 --> 00:05:36,360
CFD but it took us three weeks to

133
00:05:41,029 --> 00:05:38,820
generate even one solution during the

134
00:05:42,500 --> 00:05:41,039
return flight program we've moved the

135
00:05:44,839 --> 00:05:42,510
capabilities to the Columbia

136
00:05:49,800 --> 00:05:44,849
supercomputer we can now turn around a

137
00:05:53,700 --> 00:05:51,780
after every landing it's extremely

138
00:05:56,010 --> 00:05:53,710

important to closely examine all the

139

00:05:57,750 --> 00:05:56,020

shuttle services for damage in the past

140

00:06:00,690 --> 00:05:57,760

this has been extremely tedious and a

141

00:06:02,100 --> 00:06:00,700

time-consuming chore done manually one

142

00:06:03,960 --> 00:06:02,110

of our research has developed a device

143

00:06:06,360 --> 00:06:03,970

that could speed up the task and create

144

00:06:08,310 --> 00:06:06,370

a much higher degree of accuracy we

145

00:06:11,370 --> 00:06:08,320

developed a handheld laser scanning

146

00:06:12,570 --> 00:06:11,380

device that helps the technicians it

147

00:06:14,640 --> 00:06:12,580

speeds up their measurements

148

00:06:16,230 --> 00:06:14,650

tremendously and it makes the

149

00:06:19,890 --> 00:06:16,240

measurements more accurate and more

150

00:06:21,810 --> 00:06:19,900

reliable so you put the unit over the

151
00:06:24,570 --> 00:06:21,820
tile and you press a button and it takes

152
00:06:26,100 --> 00:06:24,580
a scan in about two seconds they will

153
00:06:28,800 --> 00:06:26,110
know as soon as they take the

154
00:06:31,469 --> 00:06:28,810
measurement if there is a problem with

155
00:06:33,960 --> 00:06:31,479
that tile that needs to be repaired so

156
00:06:35,879 --> 00:06:33,970
it takes a lot of the human tedious work

157
00:06:37,920 --> 00:06:35,889
out of it and therefore I think it

158
00:06:43,020 --> 00:06:37,930
increases the safety because it

159
00:06:47,559 --> 00:06:45,490
some of the ongoing support the names is

160
00:06:51,800 --> 00:06:47,569
given to the space program has been

161
00:06:56,030 --> 00:06:53,600
the vertical motion simulator is

162
00:06:57,620 --> 00:06:56,040
actually a simulation of the space

163
00:07:00,620 --> 00:06:57,630

shuttle coming in through landing and

164

00:07:03,470 --> 00:07:00,630

roll out the simulator out here at NASA

165

00:07:05,690 --> 00:07:03,480

Ames Research Center is a fantastic

166

00:07:07,190 --> 00:07:05,700

simulator for us to not just practice

167

00:07:09,590 --> 00:07:07,200

normal landings but to also practice

168

00:07:11,030 --> 00:07:09,600

emergency landings any type of failure

169

00:07:13,640 --> 00:07:11,040

that could possibly happen to the Space

170

00:07:17,020 --> 00:07:13,650

Shuttle on touchdown things like blown

171

00:07:19,670 --> 00:07:17,030

tires or you know brakes not working

172

00:07:22,340 --> 00:07:19,680

nose wheel steering a nice kid hi

173

00:07:24,710 --> 00:07:22,350

crosswinds it's a high fidelity sim and

174

00:07:27,080 --> 00:07:24,720

Glenn tastic training another great

175

00:07:28,310 --> 00:07:27,090

thing about the sim is in the visuals it

176

00:07:29,719 --> 00:07:28,320

could put runways from all over the

177

00:07:31,790 --> 00:07:29,729

world so we train all of our backup

178

00:07:33,620 --> 00:07:31,800

landing sites we have two runways in

179

00:07:35,240 --> 00:07:33,630

Spain and one of France we can also land

180

00:07:38,840 --> 00:07:35,250

at Edwards Air Force Base in Southern

181

00:07:40,430 --> 00:07:38,850

California white sands and New Mexico we

182

00:07:41,659 --> 00:07:40,440

don't really have the resources to take

183

00:07:43,640 --> 00:07:41,669

an airplane out there and look at all

184

00:07:44,719 --> 00:07:43,650

those airfields so it's really efficient

185

00:07:48,609 --> 00:07:44,729

for us to come out here and see in the

186

00:07:54,319 --> 00:07:52,059

they're very few off-the-shelf solutions

187

00:07:56,929 --> 00:07:54,329

really comes down to building space

188

00:07:58,489 --> 00:07:56,939

flight hardware you need to use a lot of

189

00:08:00,489 --> 00:07:58,499

different disciplines and you need

190

00:08:03,019 --> 00:08:00,499

insights from a lot of different people

191

00:08:05,689 --> 00:08:03,029

I think we've been invaluable to the

192

00:08:07,699 --> 00:08:05,699

program as a center and so it's been

193

00:08:11,479 --> 00:08:07,709

very gratifying to help help the program

194

00:08:14,749 --> 00:08:11,489

move forward NASA Ames is committed to

195

00:08:17,419 --> 00:08:14,759

astronaut safety and mission success all

196

00:08:19,549 --> 00:08:17,429

of these contributions add up to

197

00:08:21,949 --> 00:08:19,559

something we're very proud of returning