1
00:00:06,550 --> 00:00:04,070
nanotechnology is a part of uh

2
00:00:09,430 --> 00:00:06,560
some of the uh tremendous amount of

3
00:00:11,430 --> 00:00:09,440
technological research that is ongoing

4
00:00:14,150 --> 00:00:11,440
aboard the international space station

5
00:00:16,230 --> 00:00:14,160
uh which serves as not only an orbital

6
00:00:18,070 --> 00:00:16,240
laboratory but as a test bed for

7
00:00:18,870 --> 00:00:18,080
technological research that will serve

8
00:00:20,950 --> 00:00:18,880
us

9
00:00:23,670 --> 00:00:20,960
in exploration of the planets in an

10
00:00:25,750 --> 00:00:23,680
asteroid and deep space in the years

11
00:00:27,429 --> 00:00:25,760
ahead one of the unique technology

12
00:00:29,830 --> 00:00:27,439
demonstration capabilities of the

13
00:00:32,069 --> 00:00:29,840

international space station also extends

14
00:00:34,470 --> 00:00:32,079
to the outside of the orbiting complex

15
00:00:37,030 --> 00:00:34,480
in the form of a robot the satellite

16
00:00:38,950 --> 00:00:37,040
servicing capabilities office at nasa's

17
00:00:41,590 --> 00:00:38,960
goddard space flight center in greenbelt

18
00:00:43,830 --> 00:00:41,600
maryland oversees the robotic refueling

19
00:00:46,790 --> 00:00:43,840
mission demonstrations on the station

20
00:00:48,229 --> 00:00:46,800
and jill mcguire the rrm project manager

21
00:00:50,549 --> 00:00:48,239
is joining us this morning on space

22
00:00:52,790 --> 00:00:50,559
station live to talk about it jill good

23
00:00:54,310 --> 00:00:52,800
morning and thanks for joining us today

24
00:00:55,670 --> 00:00:54,320
thank you very much for having me it's a

25
00:00:57,830 --> 00:00:55,680
pleasure to be here

26
00:00:59,510 --> 00:00:57,840
great to have you with us today jill the

27
00:01:02,709 --> 00:00:59,520
robotic refueling mission suite of

28
00:01:04,950 --> 00:01:02,719
experiments is not new but uh it is

29
00:01:06,230 --> 00:01:04,960
somewhat familiar to those of us who are

30
00:01:08,310 --> 00:01:06,240
paying attention

31
00:01:10,469 --> 00:01:08,320
give us a little glimpse about what uh

32
00:01:13,109 --> 00:01:10,479
the robotic refueling mission is and

33
00:01:14,950 --> 00:01:13,119
what it does on board so the robotic

34
00:01:17,910 --> 00:01:14,960
refueling mission is a payload about the

35
00:01:19,429 --> 00:01:17,920
size of one meter cube it's on iss on

36
00:01:21,190 --> 00:01:19,439
elc 4

37
00:01:23,429 --> 00:01:21,200
and it was

38
00:01:25,429 --> 00:01:23,439

it has various spacecraft interfaces on

39
00:01:27,830 --> 00:01:25,439
it that we've used to test out robotic

40
00:01:30,149 --> 00:01:27,840
manipulation techniques to demonstrate

41
00:01:32,310 --> 00:01:30,159
the feasibly the feasibility of using a

42
00:01:34,870 --> 00:01:32,320
robot to

43
00:01:35,910 --> 00:01:34,880
refuel repair and maintain satellites in

44
00:01:37,830 --> 00:01:35,920
space

45
00:01:40,230 --> 00:01:37,840
we've completed numerous demonstrations

46
00:01:42,389 --> 00:01:40,240
including wire cutting cap removal

47
00:01:44,310 --> 00:01:42,399
blanket manipulation and finally an end

48
00:01:45,830 --> 00:01:44,320
to end fuel transfer

49
00:01:49,749 --> 00:01:45,840
about a year ago

50
00:01:54,230 --> 00:01:52,149
we are looking forward to continuing

51
00:01:55,190 --> 00:01:54,240
that with rm2

52
00:01:58,149 --> 00:01:55,200
and that's what we're going to talk

53
00:02:01,749 --> 00:01:58,159
about today some of our new hardware has

54
00:02:05,749 --> 00:02:01,759
just been recently launched on atv5 so

55
00:02:07,910 --> 00:02:05,759
um the photo of rrm that is up on the

56
00:02:09,510 --> 00:02:07,920
screen in that you

57
00:02:12,070 --> 00:02:09,520
can see that there are four different

58
00:02:13,430 --> 00:02:12,080
tools on board that the dexter robot the

59
00:02:16,949 --> 00:02:13,440
canadian

60
00:02:19,589 --> 00:02:16,959
robot uses to do these demonstrations

61
00:02:21,830 --> 00:02:19,599
and its rm is designed to be modular so

62
00:02:23,910 --> 00:02:21,840
that we can switch out those tools and

63
00:02:26,550 --> 00:02:23,920

we can switch out the task boards in

64
00:02:28,710 --> 00:02:26,560
order to do additional experiments which

65
00:02:31,990 --> 00:02:28,720
is what we're taking advantage of

66
00:02:36,790 --> 00:02:34,150
jill uh refueling or fuel transfer is

67
00:02:38,470 --> 00:02:36,800
not new to human space flight in fact uh

68
00:02:40,710 --> 00:02:38,480
as you mentioned the automated transfer

69
00:02:42,869 --> 00:02:40,720
vehicle that brought your new hardware

70
00:02:44,710 --> 00:02:42,879
up as well as the russian uh progress

71
00:02:48,150 --> 00:02:44,720
vehicle contains fuel that is uh

72
00:02:51,350 --> 00:02:48,160
transferred for a variety of purposes

73
00:02:53,670 --> 00:02:51,360
but there are still unknowns to this uh

74
00:02:56,390 --> 00:02:53,680
to this art uh in human spaceflight why

75
00:02:59,589 --> 00:02:56,400
is orbital refueling so complex

76
00:03:01,430 --> 00:02:59,599
well the reason it's complex is because

77
00:03:03,190 --> 00:03:01,440
the interface was not designed to be

78
00:03:06,070 --> 00:03:03,200
robotic friendly

79
00:03:08,390 --> 00:03:06,080
the a fuel valve on a satellite is

80
00:03:10,229 --> 00:03:08,400
closed out before launch with a series

81
00:03:11,030 --> 00:03:10,239
of caps and then those caps are wired

82
00:03:12,470 --> 00:03:11,040
shut

83
00:03:14,550 --> 00:03:12,480
because the

84
00:03:16,949 --> 00:03:14,560
fuel is so flammable they want to make

85
00:03:18,710 --> 00:03:16,959
sure that the interface is safe during

86
00:03:20,710 --> 00:03:18,720
launch and that those caps can't back

87
00:03:22,309 --> 00:03:20,720
off and that's great in a world where

88
00:03:25,190 --> 00:03:22,319

you never want to touch that interface

89
00:03:27,430 --> 00:03:25,200
again but in order to enable

90
00:03:29,990 --> 00:03:27,440
doing this with a robot we had to

91
00:03:32,229 --> 00:03:30,000
demonstrate that we could safely cut all

92
00:03:33,990 --> 00:03:32,239
those wires and remove all those caps

93
00:03:35,670 --> 00:03:34,000
and then open up that valve transfer

94
00:03:37,589 --> 00:03:35,680
fuel through it and then safely close

95
00:03:38,630 --> 00:03:37,599
the valve and show that it was sealed so

96
00:03:39,910 --> 00:03:38,640
none of that

97
00:03:41,830 --> 00:03:39,920
fuel is

98
00:03:44,470 --> 00:03:41,840
uh leaking out and that's what we were

99
00:03:46,869 --> 00:03:44,480
able to do successfully through by using

100
00:03:49,430 --> 00:03:46,879
a series of real innovative tools the

101
00:03:51,110 --> 00:03:49,440
key to our technology is that we design

102
00:03:52,789 --> 00:03:51,120
an innovative tool

103
00:03:55,429 --> 00:03:52,799
that can bridge the gap between a

104
00:03:57,990 --> 00:03:55,439
non-robot friendly interface and the

105
00:04:01,030 --> 00:03:58,000
robot itself and so the

106
00:04:03,509 --> 00:04:01,040
the technology is in the mechanisms and

107
00:04:05,429 --> 00:04:03,519
the innovation in the tool that can do

108
00:04:07,589 --> 00:04:05,439
that use that robot to do that

109
00:04:09,670 --> 00:04:07,599
manipulation

110
00:04:11,910 --> 00:04:09,680
now jill you know as well as i do that

111
00:04:13,830 --> 00:04:11,920
nothing in nasa comes without an elegant

112
00:04:16,229 --> 00:04:13,840
acronym and the next in this series of

113
00:04:18,949 --> 00:04:16,239

robotic refueling mission demonstrations

114
00:04:22,069 --> 00:04:18,959
is called viper for visual inspection

115
00:04:24,550 --> 00:04:22,079
posable invertebrate robot tell us a

116
00:04:27,670 --> 00:04:24,560
little bit about viper so viper is our

117
00:04:30,390 --> 00:04:27,680
next robotic tool that we um that is

118
00:04:33,350 --> 00:04:30,400
just launched on atv5

119
00:04:35,670 --> 00:04:33,360
and it is a really cool tool it has

120
00:04:38,230 --> 00:04:35,680
three different camera systems on board

121
00:04:39,510 --> 00:04:38,240
the goal is that we are trying to take

122
00:04:41,189 --> 00:04:39,520
um

123
00:04:43,030 --> 00:04:41,199
we want to be able to inspect the work

124
00:04:46,070 --> 00:04:43,040
site prior to

125
00:04:48,230 --> 00:04:46,080
doing any of the manipulation that we i

126
00:04:50,710 --> 00:04:48,240
just was speaking about so

127
00:04:52,230 --> 00:04:50,720
the camera systems that are on viper one

128
00:04:54,870 --> 00:04:52,240
is a

129
00:04:55,749 --> 00:04:54,880
camera on a boroscope where it can go

130
00:04:58,230 --> 00:04:55,759
about

131
00:05:00,390 --> 00:04:58,240
30 it's got it's on a 34 inch length and

132
00:05:03,350 --> 00:05:00,400
the last two and a half inches of it can

133
00:05:05,270 --> 00:05:03,360
be manipulated in 90 90 degrees in four

134
00:05:06,710 --> 00:05:05,280
opposing directions so the robot

135
00:05:11,270 --> 00:05:06,720
operators on the ground can actually

136
00:05:14,469 --> 00:05:11,280
command the end of the camera or the the

137
00:05:16,390 --> 00:05:14,479
little snake and see and look around in

138
00:05:18,310 --> 00:05:16,400

different directions so that's one

139
00:05:21,189 --> 00:05:18,320
camera that camera is actually the

140
00:05:23,510 --> 00:05:21,199
smallest camera that has flown in space

141
00:05:26,629 --> 00:05:23,520
by nasa it's 1.2

142
00:05:29,510 --> 00:05:26,639
millimeters and it is

143
00:05:32,230 --> 00:05:29,520
about the size of a dime if there's one

144
00:05:35,029 --> 00:05:32,240
picture that'll we provided that shows

145
00:05:35,990 --> 00:05:35,039
just how small it is in comparison to a

146
00:05:38,870 --> 00:05:36,000
dime

147
00:05:40,790 --> 00:05:38,880
and it does have a led array around it

148
00:05:41,990 --> 00:05:40,800
and it can see about a half of a

149
00:05:45,670 --> 00:05:42,000
millimeter

150
00:05:47,350 --> 00:05:45,680
about two inches away so it's not the um

151
00:05:49,189 --> 00:05:47,360
high resolution or high definition

152
00:05:51,430 --> 00:05:49,199
cameras that are you know we were used

153
00:05:53,189 --> 00:05:51,440
to seeing down on the ground but

154
00:05:54,710 --> 00:05:53,199
it was developed for the

155
00:05:57,270 --> 00:05:54,720
medical industry

156
00:05:59,430 --> 00:05:57,280
and so it can you know it has good

157
00:06:01,830 --> 00:05:59,440
enough to see very close up for what we

158
00:06:03,510 --> 00:06:01,840
want to see the other real nice camera

159
00:06:05,670 --> 00:06:03,520
system that's on there is what we call

160
00:06:07,110 --> 00:06:05,680
the motorized zoom lens and it's a

161
00:06:11,029 --> 00:06:07,120
custom

162
00:06:13,270 --> 00:06:11,039
camera that we built that has a 8 to 24

163
00:06:16,230 --> 00:06:13,280

millimeter optical zoom lens and we

164
00:06:20,629 --> 00:06:18,870
mechanism so that it can

165
00:06:22,629 --> 00:06:20,639
with using just again

166
00:06:23,830 --> 00:06:22,639
very small technology we're flying half

167
00:06:25,830 --> 00:06:23,840
inch stepper motors these are the

168
00:06:29,110 --> 00:06:25,840
smallest motors um to our knowledge that

169
00:06:31,670 --> 00:06:29,120
have ever flown in space and it can see

170
00:06:34,390 --> 00:06:31,680
it can zoom in from two feet away it can

171
00:06:37,029 --> 00:06:34,400
resolve like again a half a millimeter

172
00:06:39,430 --> 00:06:37,039
about thinner than a credit card so

173
00:06:41,830 --> 00:06:39,440
um between the use of those two camera

174
00:06:44,790 --> 00:06:41,840
systems and the third camera is just

175
00:06:47,270 --> 00:06:44,800
like our standard rm cameras where the

176
00:06:49,430 --> 00:06:47,280
robot operator uses it to focus on the

177
00:06:51,350 --> 00:06:49,440
tip and see what they want so they can

178
00:06:54,469 --> 00:06:51,360
get a nice orthogonal view when they're

179
00:06:56,070 --> 00:06:54,479
doing the um manipulation so that third

180
00:06:57,589 --> 00:06:56,080
camera is the heritage just like we've

181
00:06:59,510 --> 00:06:57,599
flown on our other four tools but the

182
00:07:00,309 --> 00:06:59,520
two new cameras are the one that's on

183
00:07:18,870 --> 00:07:00,319
the

184
00:07:20,629 --> 00:07:18,880
ground controllers or both and what is

185
00:07:21,510 --> 00:07:20,639
the schedule now that the hardware is on

186
00:07:22,550 --> 00:07:21,520
orbit

187
00:07:25,029 --> 00:07:22,560
well

188
00:07:27,830 --> 00:07:25,039

you know of course uh space station

189
00:07:29,589 --> 00:07:27,840
robotic scheduling is you know tied into

190
00:07:31,350 --> 00:07:29,599
multiple logistics with visiting

191
00:07:32,629 --> 00:07:31,360
vehicles and

192
00:07:34,070 --> 00:07:32,639
our hardware has to be transferred

193
00:07:36,550 --> 00:07:34,080
outside of the gem through the gem

194
00:07:39,189 --> 00:07:36,560
airlock so

195
00:07:41,430 --> 00:07:39,199
so the folks are stationed are working

196
00:07:43,510 --> 00:07:41,440
to schedule it hopefully we've been told

197
00:07:45,990 --> 00:07:43,520
next spring unless a window opens up

198
00:07:47,670 --> 00:07:46,000
earlier this fall we're ready when they

199
00:07:50,230 --> 00:07:47,680
are and we're just waiting for the

200
00:07:52,710 --> 00:07:50,240
logistics and all the stars to align

201
00:07:54,790 --> 00:07:52,720
so that they can do um they can start

202
00:07:56,790 --> 00:07:54,800
the the transfer operations

203
00:07:58,790 --> 00:07:56,800
because we have three pieces of hardware

204
00:08:01,749 --> 00:07:58,800
to transfer out the new viper tool plus

205
00:08:03,990 --> 00:08:01,759
two new task boards that we are flying

206
00:08:06,710 --> 00:08:04,000
um they're gonna it looks like the plan

207
00:08:08,710 --> 00:08:06,720
will be to do a transfer operation in

208
00:08:10,629 --> 00:08:08,720
one segment and then

209
00:08:13,110 --> 00:08:10,639
come back after everything has been

210
00:08:15,510 --> 00:08:13,120
mounted on rrm and start the robotic

211
00:08:18,309 --> 00:08:15,520
operations at a later date so we're

212
00:08:20,710 --> 00:08:18,319
hoping again for the fall time frame for

213
00:08:23,029 --> 00:08:20,720

the transfer but it may not be till

214
00:08:25,189 --> 00:08:23,039
spring when we can start the whole

215
00:08:27,350 --> 00:08:25,199
series of operations

216
00:08:29,270 --> 00:08:27,360
that's fascinating jill and we certainly

217
00:08:32,310 --> 00:08:29,280
will be there along with you and your

218
00:08:34,630 --> 00:08:32,320
team as uh viper uh takes the next step

219
00:08:36,630 --> 00:08:34,640
in the uh robotic refueling mission jill

220
00:08:38,149 --> 00:08:36,640
mcguire the

221
00:08:39,750 --> 00:08:38,159
project manager for the robotic

222
00:08:41,269 --> 00:08:39,760
refueling mission from the goddard space

223
00:08:43,269 --> 00:08:41,279
flight center in greenbelt maryland

224
00:08:44,949 --> 00:08:43,279
joining us today thanks a lot jill and