1
00:00:04,390 --> 00:00:02,629
space station is testing a robot

2
00:00:05,910 --> 00:00:04,400
mechanic that one day might be

3
00:00:07,990 --> 00:00:05,920
dispatched to perform simple repair

4
00:00:09,910 --> 00:00:08,000
tasks on orbiting satellites it's called

5
00:00:11,509 --> 00:00:09,920
rrm lori meigs with the station's

6
00:00:13,350 --> 00:00:11,519
payload operations integration center in

7
00:00:14,870 --> 00:00:13,360
huntsville spoke with scientists from

8
00:00:16,710 --> 00:00:14,880
nasa's goddard space flight center

9
00:00:19,269 --> 00:00:16,720
working on this technology demonstration

10
00:00:21,910 --> 00:00:19,279
on this robotic refueling mission

11
00:00:24,070 --> 00:00:21,920
just like if you were to go put fuel in

12
00:00:26,390 --> 00:00:24,080
your car you have to open up your gas

13
00:00:28,710 --> 00:00:26,400

cap put in the fueling valve transfer

14
00:00:31,589 --> 00:00:28,720
the fuel close it up and go same thing

15
00:00:33,990 --> 00:00:31,599
on a satellite satellite fuel valves are

16
00:00:37,190 --> 00:00:34,000
closed out with a series of caps and

17
00:00:38,790 --> 00:00:37,200
wires for ground safety so

18
00:00:40,470 --> 00:00:38,800
in order to put more fuel into a

19
00:00:42,950 --> 00:00:40,480
satellite you have to cut those wires

20
00:00:45,750 --> 00:00:42,960
and remove those caps and then install a

21
00:00:47,510 --> 00:00:45,760
fuel refueling tool transfer fuel and

22
00:00:48,869 --> 00:00:47,520
again close it out same as if you want

23
00:00:51,029 --> 00:00:48,879
to do it on the ground with your car

24
00:00:52,630 --> 00:00:51,039
right now satellites are designed to not

25
00:00:54,630 --> 00:00:52,640
be serviced at all they're closed out on

26
00:00:56,709 --> 00:00:54,640
the ground and never to be touched again

27
00:00:59,029 --> 00:00:56,719
which was part of what we wanted to do

28
00:01:01,590 --> 00:00:59,039
with rrm which was demonstrate that we

29
00:01:02,950 --> 00:01:01,600
could actually interface with those

30
00:01:05,109 --> 00:01:02,960
for example fill and drain valves

31
00:01:06,310 --> 00:01:05,119
electrical connectors mli if we can

32
00:01:08,870 --> 00:01:06,320
interface with these things that weren't

33
00:01:10,469 --> 00:01:08,880
meant to be serviced then we could prove

34
00:01:12,630 --> 00:01:10,479
that we could go up to the existing

35
00:01:15,830 --> 00:01:12,640
satellites and service them we built a

36
00:01:18,390 --> 00:01:15,840
series of unique and innovative tools to

37
00:01:20,149 --> 00:01:18,400
utilize the robot on the international

38
00:01:22,149 --> 00:01:20,159

space station dexter

39
00:01:24,950 --> 00:01:22,159
was intended to do maintenance on

40
00:01:27,429 --> 00:01:24,960
station move an oru or a box from one

41
00:01:29,670 --> 00:01:27,439
location to another location

42
00:01:31,830 --> 00:01:29,680
so we studied that robot and determined

43
00:01:34,390 --> 00:01:31,840
that we could build innovative tools

44
00:01:37,270 --> 00:01:34,400
that the robot could grab onto

45
00:01:39,350 --> 00:01:37,280
and remove these caps cut the wires and

46
00:01:42,870 --> 00:01:39,360
again transfer the fuel we have four

47
00:01:45,270 --> 00:01:42,880
tools on board one is what we call the

48
00:01:47,670 --> 00:01:45,280
multi-layer insulation tool it cuts the

49
00:01:49,830 --> 00:01:47,680
wire it grabs onto the blanket one is

50
00:01:51,749 --> 00:01:49,840
called a safety cap removal tool it

51
00:01:55,030 --> 00:01:51,759
grabs on to the safety cap on the fuel

52
00:01:57,030 --> 00:01:55,040
valve and removes it so one is our

53
00:01:58,870 --> 00:01:57,040
refueling tool that's designed just to

54
00:02:00,709 --> 00:01:58,880
thread onto the fuel valve transfer the

55
00:02:02,389 --> 00:02:00,719
fuel and then the other one is what we

56
00:02:03,429 --> 00:02:02,399
call a multi-function tool it's just

57
00:02:04,950 --> 00:02:03,439
like

58
00:02:07,429 --> 00:02:04,960
a standard socket wrench that you'd use

59
00:02:10,070 --> 00:02:07,439
in your garage we designed it so that we

60
00:02:12,550 --> 00:02:10,080
could fly multiple adapters or sockets

61
00:02:14,229 --> 00:02:12,560
like you would use in your garage

62
00:02:16,229 --> 00:02:14,239
and that way we don't have to have more

63
00:02:18,550 --> 00:02:16,239

tools we have the one tool and can fly

64
00:02:21,030 --> 00:02:18,560
smaller adapters so again like i said

65
00:02:23,190 --> 00:02:21,040
it's modular if we want to continue

66
00:02:25,030 --> 00:02:23,200
multiple iterations of the technology

67
00:02:27,190 --> 00:02:25,040
demonstration we just have to fly new

68
00:02:30,150 --> 00:02:27,200
adapters and we can continue using that

69
00:02:32,390 --> 00:02:30,160
one what we call multi-function tool to

70
00:02:33,910 --> 00:02:32,400
manipulate these adapters with the robot

71
00:02:36,229 --> 00:02:33,920
the first under tools that we had were

72
00:02:37,910 --> 00:02:36,239
great but we learned a lot of lessons

73
00:02:39,030 --> 00:02:37,920
and improvements and how we can make

74
00:02:40,869 --> 00:02:39,040
them

75
00:02:43,190 --> 00:02:40,879
easier to operate for the robotic

76
00:02:44,949 --> 00:02:43,200
operators on the ground and also more

77
00:02:47,430 --> 00:02:44,959
efficient at their task what kind of

78
00:02:49,589 --> 00:02:47,440
results have we seen so far we've had

79
00:02:53,030 --> 00:02:49,599
phenomenal results everything has really

80
00:02:55,509 --> 00:02:53,040
gone as planned slower sometimes we've

81
00:02:57,110 --> 00:02:55,519
found that alignment is key so you know

82
00:02:58,869 --> 00:02:57,120
we work very closely with the robot

83
00:03:01,350 --> 00:02:58,879
operators at the johnson space center

84
00:03:03,030 --> 00:03:01,360
during real-time operations to ensure

85
00:03:04,630 --> 00:03:03,040
that the alignment aids that we've put

86
00:03:07,430 --> 00:03:04,640
on the tools and the alignment aids and

87
00:03:09,110 --> 00:03:07,440
overlays that they have on their screens

88
00:03:10,869 --> 00:03:09,120

are where we want them to be but there's

89
00:03:12,869 --> 00:03:10,879
been still a couple of things we haven't

90
00:03:14,790 --> 00:03:12,879
predicted and so but we've been able to

91
00:03:16,949 --> 00:03:14,800
work through all of them and

92
00:03:19,589 --> 00:03:16,959
successfully completed all of our tasks

93
00:03:21,110 --> 00:03:19,599
from again the first series was removing

94
00:03:23,350 --> 00:03:21,120
caps and cutting wires just kind of

95
00:03:25,830 --> 00:03:23,360
getting our feet wet and then the second

96
00:03:27,589 --> 00:03:25,840
series was doing the end and refueling

97
00:03:30,869 --> 00:03:27,599
where we cut all the wire removed all

98
00:03:32,470 --> 00:03:30,879
the caps and did the eventual refueling

99
00:03:34,789 --> 00:03:32,480
and then the third set of tasks is what

100
00:03:37,830 --> 00:03:34,799
we call our tertiary tasks it was

101
00:03:39,990 --> 00:03:37,840
manipulating blankets it was

102
00:03:42,470 --> 00:03:40,000
we manipulated some number 10 torx sets

103
00:03:43,910 --> 00:03:42,480
just small screws not designed to be

104
00:03:46,070 --> 00:03:43,920
done with the robot again but showing

105
00:03:48,789 --> 00:03:46,080
that the robot could align itself onto a

106
00:03:51,270 --> 00:03:48,799
small fastener or screw remove it and

107
00:03:52,869 --> 00:03:51,280
put it back in so just trying to give

108
00:03:54,710 --> 00:03:52,879
the community a flavor of what's

109
00:03:56,630 --> 00:03:54,720
available with robotic servicing

110
00:03:59,110 --> 00:03:56,640
technology the next step would be

111
00:04:01,270 --> 00:03:59,120
developing interfaces for the satellites

112
00:04:04,070 --> 00:04:01,280
that were designed to be serviced so by

113
00:04:06,390 --> 00:04:04,080

putting for example a target on that a

114
00:04:08,390 --> 00:04:06,400
robotic system could

115
00:04:11,030 --> 00:04:08,400
use for alignment

116
00:04:13,750 --> 00:04:11,040
putting in a

117
00:04:15,429 --> 00:04:13,760
valve or something else that had a more

118
00:04:17,830 --> 00:04:15,439
friendly robotic interface on it

119
00:04:18,710 --> 00:04:17,840
something that was more easily adaptable

120
00:04:20,629 --> 00:04:18,720
to

121
00:04:23,350 --> 00:04:20,639
a robotic system whereas now those

122
00:04:25,110 --> 00:04:23,360
interfaces are designed for interaction

123
00:04:26,469 --> 00:04:25,120
with human hands which is obviously much

124
00:04:28,550 --> 00:04:26,479
different than

125
00:04:30,469 --> 00:04:28,560
the robotic systems that we have

126
00:04:32,390 --> 00:04:30,479
it benefits everybody

127
00:04:33,990 --> 00:04:32,400
nasa is very interested because they can

128
00:04:36,550 --> 00:04:34,000
use the technology

129
00:04:38,550 --> 00:04:36,560
in order to service and upkeep their own

130
00:04:40,550 --> 00:04:38,560
satellite fleet in addition to the

131
00:04:42,550 --> 00:04:40,560
commercial industry who can

132
00:04:45,270 --> 00:04:42,560
utilize the technology for

133
00:04:47,030 --> 00:04:45,280
their own purposes and their satellites

134
00:04:49,350 --> 00:04:47,040
and by doing

135
00:04:51,350 --> 00:04:49,360
by having those organizations utilize

136
00:04:52,629 --> 00:04:51,360
the technology it benefits everybody

137
00:04:54,310 --> 00:04:52,639
else here

138
00:04:56,070 --> 00:04:54,320

on earth

139
00:04:59,030 --> 00:04:56,080
all the different satellites that are up

140
00:05:02,230 --> 00:04:59,040
in space right now that do things like

141
00:05:05,270 --> 00:05:02,240
satellite tv uh weather things like that

142
00:05:07,830 --> 00:05:05,280
if those satellites can be better

143
00:05:10,629 --> 00:05:07,840
serviced and if we can develop an

144
00:05:13,029 --> 00:05:10,639
ecosystem where satellites are capable

145
00:05:15,029 --> 00:05:13,039
of being serviced on a regular basis and

146
00:05:17,990 --> 00:05:15,039
not just replaced once something breaks

147
00:05:20,150 --> 00:05:18,000
or they or they reach their end of life

148
00:05:22,469 --> 00:05:20,160
then it becomes a cheaper and more