
NASA
SPACESTATION
LIVE

1
00:00:09,270 --> 00:00:07,030
next week danish astronaut andreas

2
00:00:11,830 --> 00:00:09,280
mogensen is scheduled for a first of its

3
00:00:13,990 --> 00:00:11,840
kind experiment operation during his

4
00:00:16,390 --> 00:00:14,000
week-long visit to the international

5
00:00:18,950 --> 00:00:16,400
space station this experiment is called

6
00:00:21,750 --> 00:00:18,960
interact and in it he will be operating

7
00:00:23,509 --> 00:00:21,760
a rover on the earth from the internet

8
00:00:25,589 --> 00:00:23,519
from inside the international space

9
00:00:28,230 --> 00:00:25,599
station with controls that will give him

10
00:00:30,630 --> 00:00:28,240
tactile force feedback as the robot

11
00:00:33,590 --> 00:00:30,640
encounters resistance this experiment is

12
00:00:36,470 --> 00:00:33,600
a product of the european space agency's

13
00:00:38,869 --> 00:00:36,480

tele-robotics and haptics lab in the

14
00:00:41,910 --> 00:00:38,879
netherlands and joining us today is the

15
00:00:44,150 --> 00:00:41,920
principal investigator for that dr andre

16
00:00:45,830 --> 00:00:44,160
sheila joining us this morning dr andre

17
00:00:47,510 --> 00:00:45,840
sheila how are you doing today

18
00:00:49,910 --> 00:00:47,520
thanks i'm very fine

19
00:00:51,830 --> 00:00:49,920
you had a precursor to this experiment

20
00:00:53,910 --> 00:00:51,840
previously on the international space

21
00:00:56,150 --> 00:00:53,920
station what were you able to learn from

22
00:00:59,349 --> 00:00:56,160
the first version of this experiment

23
00:01:01,990 --> 00:00:59,359
that is correct in june this year we

24
00:01:04,469 --> 00:01:02,000
actually performed the first network

25
00:01:06,950 --> 00:01:04,479
connectivity test uh between our force

26
00:01:08,950 --> 00:01:06,960
reflective joystick on the space station

27
00:01:11,190 --> 00:01:08,960
and another force reflective joystick

28
00:01:13,670 --> 00:01:11,200
that we had here on ground in norwich at

29
00:01:15,910 --> 00:01:13,680
the laboratories in isa

30
00:01:18,230 --> 00:01:15,920
and we tested out the delay and the

31
00:01:20,469 --> 00:01:18,240
bandwidths and the signal quality that

32
00:01:23,030 --> 00:01:20,479
we can achieve by sending these

33
00:01:25,350 --> 00:01:23,040
bilateral control signals between space

34
00:01:28,230 --> 00:01:25,360
and ground through the tetris ku forward

35
00:01:30,789 --> 00:01:28,240
link so signals travel about 90 000

36
00:01:32,950 --> 00:01:30,799
kilometers and we didn't know exactly

37
00:01:35,670 --> 00:01:32,960
how much delay it would give because for

38
00:01:37,109 --> 00:01:35,680

the robotic controls it's an essential

39
00:01:39,830 --> 00:01:37,119
metric to know

40
00:01:43,109 --> 00:01:39,840
so we performed a remote handshake which

41
00:01:46,550 --> 00:01:43,119
was a visual test that we do did with

42
00:01:49,830 --> 00:01:46,560
terry wurtz and kimia yui uh in june and

43
00:01:51,590 --> 00:01:49,840
and august and we are now ready we know

44
00:01:53,590 --> 00:01:51,600
about the properties of this link and we

45
00:01:55,590 --> 00:01:53,600
are now ready to move on to the next

46
00:01:57,510 --> 00:01:55,600
bigger step to actually control the full

47
00:01:58,630 --> 00:01:57,520
robotic system

48
00:02:03,030 --> 00:01:58,640
next week

49
00:02:04,389 --> 00:02:03,040
the cinetar from inside the

50
00:02:06,550 --> 00:02:04,399
international space station can you

51
00:02:08,150 --> 00:02:06,560
describe that hardware for us and its

52
00:02:10,710 --> 00:02:08,160
design

53
00:02:14,070 --> 00:02:10,720
right centaur is actually a new robot

54
00:02:15,990 --> 00:02:14,080
that we designed it's uh it's a five to

55
00:02:19,430 --> 00:02:16,000
six hundred kilogram

56
00:02:22,790 --> 00:02:19,440
class rover it has four wheels it can

57
00:02:25,670 --> 00:02:22,800
drive and steer as any normal vehicle

58
00:02:27,670 --> 00:02:25,680
actually it's a it's a pretty fast robot

59
00:02:30,229 --> 00:02:27,680
so we decided to make something that's

60
00:02:33,190 --> 00:02:30,239
fast and that can operate at human scale

61
00:02:35,509 --> 00:02:33,200
type of speeds uh it has two arms that

62
00:02:37,430 --> 00:02:35,519
are seven degrees of freedom each

63
00:02:39,509 --> 00:02:37,440

like your human arms so they can reach

64
00:02:42,150 --> 00:02:39,519
out to objects to the ground they can

65
00:02:45,110 --> 00:02:42,160
reach up they can manipulate

66
00:02:47,830 --> 00:02:45,120
together with humans and the robot arms

67
00:02:49,750 --> 00:02:47,840
are very specific because they are very

68
00:02:52,309 --> 00:02:49,760
force sensitive they can be controlled

69
00:02:54,550 --> 00:02:52,319
in compliance control which means they

70
00:02:57,270 --> 00:02:54,560
can render any stiffness damping that we

71
00:02:59,430 --> 00:02:57,280
program it to and this way interact

72
00:03:01,750 --> 00:02:59,440
center can interact with stiff objects

73
00:03:03,990 --> 00:03:01,760
and it can assemble mechanical

74
00:03:06,550 --> 00:03:04,000
facilities or do complex tasks that

75
00:03:10,070 --> 00:03:06,560
require force control so it looks a bit

76
00:03:11,350 --> 00:03:10,080
like wally online media

77
00:03:13,430 --> 00:03:11,360
wrote but

78
00:03:16,070 --> 00:03:13,440
other media wrote they compared it with

79
00:03:19,110 --> 00:03:16,080
number five so i'm not sure which robots

80
00:03:20,949 --> 00:03:19,120
that is famous looks closest to it

81
00:03:23,110 --> 00:03:20,959
so tell me about the experiment where

82
00:03:25,270 --> 00:03:23,120
will the centaur be what will mogensen

83
00:03:28,149 --> 00:03:25,280
have it do and how will you determine

84
00:03:30,309 --> 00:03:28,159
whether it was a success or not

85
00:03:32,309 --> 00:03:30,319
so morganson will be in the columbus

86
00:03:34,869 --> 00:03:32,319
module on the international space

87
00:03:37,589 --> 00:03:34,879
station he will use our haptics one

88
00:03:38,789 --> 00:03:37,599

joystick and a tablet pc that's all he

89
00:03:41,030 --> 00:03:38,799
has

90
00:03:42,070 --> 00:03:41,040
to control that robotics system on the

91
00:03:44,309 --> 00:03:42,080
surface

92
00:03:47,190 --> 00:03:44,319
the robot itself has many many degrees

93
00:03:49,430 --> 00:03:47,200
of freedom about 30 degrees of freedom

94
00:03:51,750 --> 00:03:49,440
so we design specific graphical user

95
00:03:54,390 --> 00:03:51,760
interfaces for him now the task that he

96
00:03:57,830 --> 00:03:54,400
has to complete is actually a sub

97
00:04:00,390 --> 00:03:57,840
millimeter position task where he has to

98
00:04:04,470 --> 00:04:00,400
actually mate a connector into a socket

99
00:04:06,869 --> 00:04:04,480
with a tolerance of only 150 micrometers

100
00:04:08,710 --> 00:04:06,879
in order to do that he first needs to

101
00:04:10,869 --> 00:04:08,720
scan around the environment here in

102
00:04:12,710 --> 00:04:10,879
north like we have an indoor environment

103
00:04:14,550 --> 00:04:12,720
where the robot is located so we are

104
00:04:16,710 --> 00:04:14,560
independent from the weather condition

105
00:04:18,069 --> 00:04:16,720
which is known not always to be optimal

106
00:04:20,310 --> 00:04:18,079
in the netherlands

107
00:04:22,790 --> 00:04:20,320
and he needs to scan the the indoor

108
00:04:25,270 --> 00:04:22,800
environment to look for a task board

109
00:04:28,230 --> 00:04:25,280
after that he has to use the tablet pc

110
00:04:31,030 --> 00:04:28,240
to actually real time control that robot

111
00:04:32,710 --> 00:04:31,040
to drive towards that task board and

112
00:04:34,710 --> 00:04:32,720
park in front of task board at a

113
00:04:37,189 --> 00:04:34,720

suitable location

114
00:04:39,830 --> 00:04:37,199
for this he will be using augmented

115
00:04:42,710 --> 00:04:39,840
reality that we implant implemented in

116
00:04:45,110 --> 00:04:42,720
the video stream in order to hint him at

117
00:04:47,189 --> 00:04:45,120
ideal locations for that robot for arm

118
00:04:48,950 --> 00:04:47,199
money pullability afterwards

119
00:04:51,270 --> 00:04:48,960
so once he parked he will need to

120
00:04:54,070 --> 00:04:51,280
control the robotic arm via the tablet

121
00:04:56,310 --> 00:04:54,080
pc and the joystick to actually insert

122
00:04:58,870 --> 00:04:56,320
that pack into the hole or the connector

123
00:05:02,150 --> 00:04:58,880
into its sockets

124
00:05:04,390 --> 00:05:02,160
dr sheila so what are the future space

125
00:05:06,150 --> 00:05:04,400
technology applications and also what

126
00:05:09,430 --> 00:05:06,160
are some of the earth applications we

127
00:05:12,070 --> 00:05:09,440
could see from this experiment

128
00:05:14,710 --> 00:05:12,080
well in space much talk has happened

129
00:05:17,189 --> 00:05:14,720
about combined human robotic exploration

130
00:05:19,270 --> 00:05:17,199
in the future and um

131
00:05:22,070 --> 00:05:19,280
ideas have been brought out for humans

132
00:05:24,629 --> 00:05:22,080
to go back to mars or or to moon or

133
00:05:27,350 --> 00:05:24,639
perhaps to an asteroid what we decided

134
00:05:30,230 --> 00:05:27,360
at esa is to actually prepare generic

135
00:05:32,150 --> 00:05:30,240
technologies that would allow a somewhat

136
00:05:34,710 --> 00:05:32,160
different mission scenario

137
00:05:37,590 --> 00:05:34,720
in our case we promote humans being in

138
00:05:41,270 --> 00:05:37,600

orbiting stations around planets

139
00:05:43,749 --> 00:05:41,280
so for example if you take mars uh it is

140
00:05:45,749 --> 00:05:43,759
currently impossible to send humans to

141
00:05:48,150 --> 00:05:45,759
the surface of mars but it would be

142
00:05:50,950 --> 00:05:48,160
perhaps quite possible to actually send

143
00:05:53,430 --> 00:05:50,960
humans to an orbit around mars and have

144
00:05:55,590 --> 00:05:53,440
robotics located on the martian surface

145
00:05:57,270 --> 00:05:55,600
to do human-like tasks so

146
00:05:59,670 --> 00:05:57,280
interact will demonstrate in fact

147
00:06:02,070 --> 00:05:59,680
technologies how human presence can be

148
00:06:04,710 --> 00:06:02,080
projected into those robotic systems

149
00:06:07,029 --> 00:06:04,720
that are on planetary surfaces without

150
00:06:07,830 --> 00:06:07,039
requiring humans to be there

151
00:06:10,469 --> 00:06:07,840
and

152
00:06:11,350 --> 00:06:10,479
applications can be multiple ranging

153
00:06:13,430 --> 00:06:11,360
from

154
00:06:15,350 --> 00:06:13,440
setting up telescope facilities for

155
00:06:18,469 --> 00:06:15,360
example on the lunar surface on the far

156
00:06:22,150 --> 00:06:18,479
side of the moon or extracting

157
00:06:24,390 --> 00:06:22,160
minerals and doing geophysical research

158
00:06:27,029 --> 00:06:24,400
on mass or other bodies

159
00:06:29,670 --> 00:06:27,039
so there are multiple application cases

160
00:06:31,749 --> 00:06:29,680
we could actually invert the scenario as

161
00:06:34,550 --> 00:06:31,759
well and have humans on the surface

162
00:06:36,790 --> 00:06:34,560
control robotics with this technology in

163
00:06:39,350 --> 00:06:36,800

the space environment if we're thinking

164
00:06:41,749 --> 00:06:39,360
about satellite servicing or debris

165
00:06:44,309 --> 00:06:41,759
removal where intuitive controlled

166
00:06:47,110 --> 00:06:44,319
robots could catch satellites and tow

167
00:06:50,469 --> 00:06:47,120
them to different locations

168
00:06:52,950 --> 00:06:50,479
and earth the applications are similar

169
00:06:55,510 --> 00:06:52,960
so in any places basically where humans

170
00:06:58,790 --> 00:06:55,520
cannot go for example in the deep sea if

171
00:07:01,270 --> 00:06:58,800
you think of deep water horizon uh

172
00:07:03,749 --> 00:07:01,280
robotics was heavily used to actually

173
00:07:04,870 --> 00:07:03,759
fix the problem of the oil spell

174
00:07:06,629 --> 00:07:04,880
oil spill

175
00:07:08,230 --> 00:07:06,639
so with the technology we are showing

176
00:07:10,629 --> 00:07:08,240
this would be probably a bit more

177
00:07:12,950 --> 00:07:10,639
efficient and more intuitive or

178
00:07:14,710 --> 00:07:12,960
fukushima as another example as a

179
00:07:16,710 --> 00:07:14,720
disaster site where these robotic

180
00:07:18,550 --> 00:07:16,720
systems could intervene

181
00:07:20,070 --> 00:07:18,560
well dr sheila we appreciate you so much

182
00:07:22,150 --> 00:07:20,080
for joining us this morning and telling