1
00:00:02,250 --> 00:00:04,320
>> Kelly Humphries: And this
is mission control, Houston.

2
00:00:04,320 --> 00:00:08,380
As promised, we have a special
guest with us today remotely,

3
00:00:08,380 --> 00:00:11,160
calling in from Moffett Field,

4
00:00:11,160 --> 00:00:14,500
California at the NASA
Ames Research Center.

5
00:00:14,500 --> 00:00:19,260
Welcome to International Space
Station Update, Mark Micire.

6
00:00:19,260 --> 00:00:20,070
Hi, Mark.

7
00:00:20,070 --> 00:00:23,000
>> Mark Micire: Hey,
glad to be here.

8
00:00:23,000 --> 00:00:24,350
>> Kelly Humphries:
Well so you're working

9
00:00:24,350 --> 00:00:26,960
with an experiment
on board that in --

10
00:00:26,960 --> 00:00:30,240
involves some small
robotic spacecraft.

11
00:00:30,240 --> 00:00:32,940

Tell us a little bit more
about your experiment.

12
00:00:32,940 --> 00:00:33,310
>> Mark Micire: Sure.

13
00:00:33,310 --> 00:00:37,030
So my time is kind of split
over two experiments right now.

14
00:00:37,030 --> 00:00:40,770
The first one is the Human
Exploration Telerobotics

15
00:00:40,770 --> 00:00:43,000
Technology Demonstration
Mission.

16
00:00:43,000 --> 00:00:46,180
And basically it's exploring
how telerobotics can take

17
00:00:46,180 --> 00:00:49,900
on routine, highly
repetitive or dangerous tasks,

18
00:00:49,900 --> 00:00:54,170
to improve human space
exploration missions.

19
00:00:54,170 --> 00:00:58,150
Within HET, my project called
Smart SPHERES is using the

20
00:00:58,150 --> 00:01:00,400
SPHERES platforms that
were developed by MIT,

21
00:01:00,400 --> 00:01:03,870
and fund [phonetic] a

station back in 2006.

22
00:01:03,870 --> 00:01:05,230
Basically we took a --

23
00:01:05,230 --> 00:01:08,580
we adopted a Google Nexus
S smartphone, and we --

24
00:01:08,580 --> 00:01:13,600
it flew on up to the
ISS on STS135 last year.

25
00:01:13,600 --> 00:01:15,600
Basically what we do is
we connect the smartphone

26
00:01:15,600 --> 00:01:17,720
to the SPHERE, and then
the smartphone is able

27
00:01:17,720 --> 00:01:19,950
to tell the SPHERES where
it would like to fly,

28
00:01:19,950 --> 00:01:22,270
and while it's doing this it
communicates with the ground,

29
00:01:22,270 --> 00:01:24,130
and provides video
and other information

30
00:01:24,130 --> 00:01:25,030
about what's happening.

31
00:01:25,030 --> 00:01:27,630
The other experiment
that I -- I --

32
00:01:27,630 --> 00:01:30,400
I work with, I'm the
SPHERES Engineering Manager

33
00:01:30,400 --> 00:01:32,050
for the ISS facility.

34
00:01:32,050 --> 00:01:34,800
So basically myself and a whole
host of other people at Ames,

35
00:01:34,800 --> 00:01:36,980
Marshall, and Johnson
Space Center work

36
00:01:36,980 --> 00:01:39,230
to assist other groups with
experiments that they want

37
00:01:39,230 --> 00:01:41,360
to perform on the
SPHERES platforms.

38
00:01:41,360 --> 00:01:44,470
So these groups can be inside
and outside universities,

39
00:01:44,470 --> 00:01:46,210
and even outside companies.

40
00:01:46,210 --> 00:01:47,790
And so basically my team assists

41
00:01:47,790 --> 00:01:49,210
in the tussing [phonetic]
verification

42
00:01:49,210 --> 00:01:52,110
and technical support of

all these experiments.

43
00:01:52,110 --> 00:01:53,250
>> Kelly Humphries: Okay
Mark, and I don't know

44
00:01:53,250 --> 00:01:55,040
if you can see it
right now on NASA TV,

45
00:01:55,040 --> 00:01:59,000
but we've got some video that
was recorded earlier last week

46
00:01:59,000 --> 00:02:00,850
as Don Pettit [phonetic] worked
with the SPHERES satellite,

47
00:02:00,850 --> 00:02:02,700
so we're kind of
watching some video there.

48
00:02:02,700 --> 00:02:02,850
>> Mark Micire: Okay.

49
00:02:02,850 --> 00:02:02,920
>> Kelly Humphries:

50
00:02:02,920 --> 00:02:04,550
You mentioned this is
involving a smartphone,

51
00:02:04,550 --> 00:02:06,340
is there an app for that?

52
00:02:06,340 --> 00:02:11,640
>> Yeah. Actually if you
-- if you go to the --

53

00:02:11,640 --> 00:02:14,750
the Google App Store, and
search for cellbots logger,

54
00:02:14,750 --> 00:02:17,040
that is a downloadable
application,

55
00:02:17,040 --> 00:02:20,090
and it's the same application
that we used in November

56
00:02:20,090 --> 00:02:22,330
for what we called our checkout.

57
00:02:22,330 --> 00:02:24,730
And you can download that onto
your Android phone, and --

58
00:02:24,730 --> 00:02:27,000
and basically duplicate the
experiments for yourself.

59
00:02:27,000 --> 00:02:29,470
>> Kelly Humphries:
That sounds pretty cool.

60
00:02:29,470 --> 00:02:31,590
Well, can you tell
us a little bit

61
00:02:31,590 --> 00:02:34,730
about SPHERES satellites,
and how they work?

62
00:02:34,730 --> 00:02:35,040
>> Mark Micire: Sure.

63
00:02:35,040 --> 00:02:36,300
The -- the SPHERES themselves,

64
00:02:36,300 --> 00:02:38,330
they're about the
size of a volleyball.

65
00:02:38,330 --> 00:02:41,030
We have three of them
that are up on station.

66
00:02:41,030 --> 00:02:45,040
And how they move around,
they use a CO2 gas thruster.

67
00:02:45,040 --> 00:02:47,070
They're -- they're tiny little
thrusters that are on each

68
00:02:47,070 --> 00:02:50,230
of the -- the various faces
of the -- of the SPHERE.

69
00:02:50,230 --> 00:02:52,800
And it's able to fire those
thrusters in such a way

70
00:02:52,800 --> 00:02:56,380
that it can move itself
around in microgravity.

71
00:02:56,380 --> 00:03:00,830
It uses these tiny
little ultrasonic beacons,

72
00:03:00,830 --> 00:03:04,300
so these are -- it basically
uses ultrasonic sound to figure

73
00:03:04,300 --> 00:03:05,720
out where it is on station.

74
00:03:05,720 --> 00:03:09,350
And then inside of the SPHERE
there is a tiny microprocessor

75
00:03:09,350 --> 00:03:12,310
that uses the -- the
time of flight of sound

76
00:03:12,310 --> 00:03:13,600
to determine its location.

77
00:03:13,600 --> 00:03:17,570
Then what the microprocessor
does is it uses a combination

78
00:03:17,570 --> 00:03:20,400
of those thrusters, and
figures out which ones to fire

79
00:03:20,400 --> 00:03:24,930
so that it can go from
point A to point B.

80
00:03:24,930 --> 00:03:26,080
>> Kelly Humphries: That's wild.

81
00:03:26,080 --> 00:03:28,120
And a lot of people
have compared these

82
00:03:28,120 --> 00:03:32,640
to the target droids that
were used by Luke Skywalker

83
00:03:32,640 --> 00:03:36,360
in Star Ward to hone
his light sabre skills.

84
00:03:36,360 --> 00:03:37,020

>> Mark Micire: Absolutely.

85
00:03:37,020 --> 00:03:40,220
If -- if you go back and talk to
a lot of the engineers that were

86
00:03:40,220 --> 00:03:44,050
on the original team, that was
a huge source of inspiration

87
00:03:44,050 --> 00:03:46,590
for that, and a couple
other free flyer projects

88
00:03:46,590 --> 00:03:49,510
that have been on the --
on the ISS and on shuttle.

89
00:03:49,510 --> 00:03:50,930
>> Kelly Humphries: Well,
so with the upcoming work

90
00:03:50,930 --> 00:03:52,720
that you're going to
be doing, what in --

91
00:03:52,720 --> 00:03:55,760
in kind of simple terms
are you trying to learn?

92
00:03:55,760 --> 00:03:56,170
>> Mark Micire: Sure.

93
00:03:56,170 --> 00:03:58,350
The -- one of the big
things that we're --

94
00:03:58,350 --> 00:04:00,210
we're trying to explore
is -- is --

95
00:04:00,210 --> 00:04:04,060
is the idea of allowing
crew to do other things.

96
00:04:04,060 --> 00:04:04,820
There's a lot of -- if you --

97
00:04:04,820 --> 00:04:06,650
if you've watched any
of the ISS activity,

98
00:04:06,650 --> 00:04:08,920
you know the crew
is very, very busy.

99
00:04:08,920 --> 00:04:12,570
And often the job that they
perform can be very dangerous.

100
00:04:12,570 --> 00:04:15,430
And we're trying to find
ways to leverage telerobotics

101
00:04:15,430 --> 00:04:18,190
to help lessen the burden on
crew, and give them more time

102
00:04:18,190 --> 00:04:20,210
for interesting things,
such as science

103
00:04:20,210 --> 00:04:22,150
and mission-related tasks.

104
00:04:22,150 --> 00:04:24,770
On earth we're becoming very
accustomed to having things

105

00:04:24,770 --> 00:04:27,920
like robot vacuum cleaners, and
we hear about new developments

106
00:04:27,920 --> 00:04:29,680
like self-driving cars.

107
00:04:29,680 --> 00:04:32,130
Our research is similar,
but it's in space.

108
00:04:32,130 --> 00:04:34,020
We hope to have robots
on the ISS,

109
00:04:34,020 --> 00:04:37,200
and in future missions
performing a lot of the mundane

110
00:04:37,200 --> 00:04:41,180
and dangerous tasks
that humans now perform.

111
00:04:41,180 --> 00:04:44,720
>> Kelly Humphries: And -- and
so I remember in the remake

112
00:04:44,720 --> 00:04:46,720
of Flubber, that had
Robin Williams in it,

113
00:04:46,720 --> 00:04:49,450
he had a little robot
helper that floated --

114
00:04:49,450 --> 00:04:51,710
flew around and --
and helped him out.

115
00:04:51,710 --> 00:04:53,300

Are you looking at
something like that --

116
00:04:53,300 --> 00:04:55,970
using SPHERES for use on
-- inside the station?

117
00:04:55,970 --> 00:04:57,060
>> Mark Micire: Absolutely.

118
00:04:57,060 --> 00:04:57,750
The -- it is -- that --

119
00:04:57,750 --> 00:05:01,180
that's one of several different
use cases that we're looking at.

120
00:05:01,180 --> 00:05:04,710
You can imagine the idea -- like
in -- in that case, I think --

121
00:05:04,710 --> 00:05:07,650
I think its name was Weebo,
that it's kind of like a --

122
00:05:07,650 --> 00:05:09,370
a personal assistant
that's there to --

123
00:05:09,370 --> 00:05:12,150
to kind of help him through his
experiments and stuff like that.

124
00:05:12,150 --> 00:05:15,000
But you can also imagine
scenarios where the --

125
00:05:15,000 --> 00:05:19,020
the robot is off doing
tasks, completely unattended.

126
00:05:19,020 --> 00:05:23,220
So astronauts have to do things
like check for radiation,

127
00:05:23,220 --> 00:05:25,650
they have to do what they
call audio dissymmetry,

128
00:05:25,650 --> 00:05:28,010
and that's determining
sound levels on station.

129
00:05:28,010 --> 00:05:31,250
And so you can not only imagine
robots working in combination

130
00:05:31,250 --> 00:05:34,610
with humans as a teammate,
but then them also going off

131
00:05:34,610 --> 00:05:36,290
on station and kind of
doing their own thing,

132
00:05:36,290 --> 00:05:39,060
and providing -- providing
their own services.

133
00:05:39,060 --> 00:05:42,440
>> Kelly Humphries: Well I guess
with the timeline is so packed

134
00:05:42,440 --> 00:05:45,060
for the crew all the
time, that would free them

135
00:05:45,060 --> 00:05:47,420
up for additional research,
or other activities, huh?

136
00:05:47,420 --> 00:05:48,100
>> Mark Micire: Sure.

137
00:05:48,100 --> 00:05:50,030
The -- the other thing
that it does is it benefits

138
00:05:50,030 --> 00:05:50,850
ground control.

139
00:05:50,850 --> 00:05:53,740
So you -- as -- as -- as
I'm sure you well know,

140
00:05:53,740 --> 00:05:56,010
there's a lot of cases
where a camera isn't exactly

141
00:05:56,010 --> 00:05:58,360
in the right position, or
it would be really nice

142
00:05:58,360 --> 00:06:00,570
if we could go over
and look at this panel,

143
00:06:00,570 --> 00:06:02,720
or see something that's been
going on, you know, in --

144
00:06:02,720 --> 00:06:04,230
in a different area of station

145
00:06:04,230 --> 00:06:06,050
from where you might
have camera coverage.

146
00:06:06,050 --> 00:06:09,720

So you can imagine a case where
you not only have the robots

147
00:06:09,720 --> 00:06:11,850
that are helping crew, but
then you also have robots

148
00:06:11,850 --> 00:06:14,610
that are helping ground
control, and allowing them to --

149
00:06:14,610 --> 00:06:16,970
to fly and look in places

150
00:06:16,970 --> 00:06:19,920
where they otherwise might
not have cameras or coverage,

151
00:06:19,920 --> 00:06:22,510
or communications
with the astronauts.

152
00:06:22,510 --> 00:06:23,440
>> Kelly Humphries: Ahh.

153
00:06:23,440 --> 00:06:26,400
And so how -- it -- it's
a little obvious to me,

154
00:06:26,400 --> 00:06:27,980
but maybe you could explain

155
00:06:27,980 --> 00:06:31,640
to our viewers how microgravity
makes this experiment possible.

156
00:06:31,640 --> 00:06:32,090
>> Mark Micire: Sure.

157

00:06:32,090 --> 00:06:33,420
Well, for mission in space,

158
00:06:33,420 --> 00:06:35,910
microgravity is really how
the astronauts work and live.

159
00:06:35,910 --> 00:06:40,830
For robots to work successfully
in space, we need to know how

160
00:06:40,830 --> 00:06:43,430
to control them safely
and productively.

161
00:06:43,430 --> 00:06:46,240
We -- we take it for granted on
earth that we have a fair amount

162
00:06:46,240 --> 00:06:48,110
of -- of friction and gravity,

163
00:06:48,110 --> 00:06:49,310
and other things
that are in our life.

164
00:06:49,310 --> 00:06:52,200
So if you're in your car and
you take your foot off the gas,

165
00:06:52,200 --> 00:06:53,810
the car will eventually
roll to a stop,

166
00:06:53,810 --> 00:06:55,590
due to friction and
other effects.

167
00:06:55,590 --> 00:06:58,630
But when you're in microgravity

and you fire a thruster

168
00:06:58,630 --> 00:07:01,130
in one direction, you're going
to need to fire a thruster

169
00:07:01,130 --> 00:07:02,890
in the opposite direction
to stop.

170
00:07:02,890 --> 00:07:04,670
And so there's a subtlety there.

171
00:07:04,670 --> 00:07:08,690
And also, imagine trying to
drive your car where there's a 1

172
00:07:08,690 --> 00:07:10,810
to 2 second delay
between what you do

173
00:07:10,810 --> 00:07:12,290
and what the car actually does.

174
00:07:12,290 --> 00:07:14,720
It's not -- that would
not only be difficult,

175
00:07:14,720 --> 00:07:16,580
but it'd actually
be very unsafe.

176
00:07:16,580 --> 00:07:20,370
And so our experiment is helping
us design intelligent robotic

177
00:07:20,370 --> 00:07:23,720
systems that can enable us
to work in microgravity,

178
00:07:23,720 --> 00:07:27,030
and cope with these
unique issues.

179
00:07:27,030 --> 00:07:29,860
>> Kelly Humphries: Well, so
how did you get into this kind

180
00:07:29,860 --> 00:07:32,450
of research for --
to help people

181
00:07:32,450 --> 00:07:36,280
that might have similar
interests in robotics,

182
00:07:36,280 --> 00:07:40,120
or in developing apps
for -- for space?

183
00:07:40,120 --> 00:07:40,910
What's your background?

184
00:07:40,910 --> 00:07:41,560
Where are you from?

185
00:07:41,560 --> 00:07:42,660
Where'd you go to school?

186
00:07:42,660 --> 00:07:42,980
>> Mark Micire: Sure.

187
00:07:42,980 --> 00:07:47,980
So I am a self-confessed geek,
grew up working and playing

188
00:07:47,980 --> 00:07:49,490
with radio-controlled
cars and --

189
00:07:49,490 --> 00:07:51,180
and other kinds of good geekery.

190
00:07:51,180 --> 00:07:53,190
Prior to coming to NASA,

191
00:07:53,190 --> 00:07:56,530
I worked for about a decade
designing robots for search

192
00:07:56,530 --> 00:07:59,410
and rescue, and explosive
ordinates, or some --

193
00:07:59,410 --> 00:08:01,560
sometimes called
bomb squad robots.

194
00:08:01,560 --> 00:08:03,970
I grew up in central Florida,

195
00:08:03,970 --> 00:08:06,470
so was always near
Kennedy Space Center,

196
00:08:06,470 --> 00:08:09,410
and have always been a --
a fan of space science.

197
00:08:09,410 --> 00:08:12,940
I did my undergraduate and
master's in computer science,

198
00:08:12,940 --> 00:08:15,670
and have always kind of
been a -- a computer geek.

199
00:08:15,670 --> 00:08:18,290

I did that back at the
University of South Florida,

200
00:08:18,290 --> 00:08:20,180
and I did my PhD
at the University

201
00:08:20,180 --> 00:08:21,480
of Massachusetts, Lowell.

202
00:08:21,480 --> 00:08:25,120
And I worked in robotics labs
at both of those locations.

203
00:08:25,120 --> 00:08:28,940
Strangely enough, in addition to
all of that, as part of my work

204
00:08:28,940 --> 00:08:31,100
in search and rescue, I'm
also trained and certified

205
00:08:31,100 --> 00:08:35,000
as a firefighter, and I
work part-time with FEMA

206
00:08:35,000 --> 00:08:37,020
and other search and rescue
teams, trying to figure out how

207
00:08:37,020 --> 00:08:41,190
to bring robotics and other
technology to the field.

208
00:08:41,190 --> 00:08:42,200
>> Kelly Humphries:
That's really interesting.

209
00:08:42,200 --> 00:08:45,340
Tell us a little bit about

where you work at Ames now.

210
00:08:45,340 --> 00:08:45,780
>> Mark Micire: Sure.

211
00:08:45,780 --> 00:08:49,110
I work -- I really have kind
of two locations that I work

212
00:08:49,110 --> 00:08:50,790
with here at -- at Ames.

213
00:08:50,790 --> 00:08:53,540
One is in the Intelligent
Robotics Laboratory,

214
00:08:53,540 --> 00:08:55,250
and we're a group
here that works

215
00:08:55,250 --> 00:08:58,560
on not only free flying
robots like SPHERES,

216
00:08:58,560 --> 00:09:01,010
but also ground rovers, and --

217
00:09:01,010 --> 00:09:02,860
and basically anything
that involves --

218
00:09:02,860 --> 00:09:06,350
in robotics and trying to put
intelligence into these machines

219
00:09:06,350 --> 00:09:08,640
that -- that help and
work with us every day.

220

00:09:08,640 --> 00:09:11,320
And then the other role that
I have, as I mentioned before,

221
00:09:11,320 --> 00:09:13,810
is with the -- the
SPHERES National Facility.

222
00:09:13,810 --> 00:09:17,700
And so we help -- we have
a whole lab here that we --

223
00:09:17,700 --> 00:09:21,470
we are able to fly the SPHERES
more or less frictionless

224
00:09:21,470 --> 00:09:23,790
on a large polished
granite table.

225
00:09:23,790 --> 00:09:26,760
And we can bring visitors in,
and other investigators in,

226
00:09:26,760 --> 00:09:30,010
and allow them to fly their
experiments on the ground

227
00:09:30,010 --> 00:09:33,390
in two-dimensions before
they actually fly 'em

228
00:09:33,390 --> 00:09:35,260
up on the International
Space Station.

229
00:09:35,260 --> 00:09:36,850
>> Kelly Humphries: And there've
been some student experiments

230

00:09:36,850 --> 00:09:37,370
too on that.

231
00:09:37,370 --> 00:09:38,920
Have you worked with
students on this?

232
00:09:38,920 --> 00:09:39,790
>> Mark Micire: Absolutely.

233
00:09:39,790 --> 00:09:43,810
So that's -- probably the Zero
Robotics program is what you're

234
00:09:43,810 --> 00:09:44,420
talking about.

235
00:09:44,420 --> 00:09:47,240
And my group in particular
provides a lot --

236
00:09:47,240 --> 00:09:48,430
some of the technical support,

237
00:09:48,430 --> 00:09:50,890
and other support
features for that.

238
00:09:50,890 --> 00:09:54,060
That's actually mostly
coordinated through MIT,

239
00:09:54,060 --> 00:09:58,260
and it is a huge, huge event,
and talk about a powerful --

240
00:09:58,260 --> 00:10:01,650
powerful, you know, combination
of -- of schools and --

241
00:10:01,650 --> 00:10:04,050
and other groups that -- that,
you know, allow these students

242
00:10:04,050 --> 00:10:07,160
to fly their algorithms
up on the Space Station.

243
00:10:07,160 --> 00:10:07,730
>> Kelly Humphries: Well thanks.

244
00:10:07,730 --> 00:10:10,020
You know, you mentioned a
couple of applications in --

245
00:10:10,020 --> 00:10:14,440
in your background, such
as search and rescue.

246
00:10:14,440 --> 00:10:17,670
Well how can you apply the
results of your experiments

247
00:10:17,670 --> 00:10:20,760
in space to helping
people here on earth?

248
00:10:20,760 --> 00:10:23,540
>> Mark Micire: Well how we
use robots in space is very,

249
00:10:23,540 --> 00:10:26,740
very similar to how we
use robots on earth,

250
00:10:26,740 --> 00:10:29,540
in terms of them going
into hazardous locations,

251

00:10:29,540 --> 00:10:31,170
and doing mundane tasks.

252
00:10:31,170 --> 00:10:32,900
So you can think of
a lot of examples,

253
00:10:32,900 --> 00:10:35,520
like bomb squad robots,
search and rescue robots,

254
00:10:35,520 --> 00:10:38,530
and even surgery
robots nowadays.

255
00:10:38,530 --> 00:10:41,610
All these robots require
a high level of precision,

256
00:10:41,610 --> 00:10:45,420
and our research in space
can better inform how these

257
00:10:45,420 --> 00:10:48,430
earth-based robots might be
better designed in the future.

258
00:10:48,430 --> 00:10:51,200
>> Kelly Humphries: Well that's
really interesting, Mark.

259
00:10:51,200 --> 00:10:53,500
I really appreciate your
being here with us today

260
00:10:53,500 --> 00:10:57,360
on National Space Station
update, and we wish you the best

261
00:10:57,360 --> 00:11:01,220

in your activities next week,
and in the future using SPHERES

262
00:11:01,220 --> 00:11:02,470
and -- and smartphones.

263
00:11:02,470 --> 00:11:05,660
And we hope you come back and
-- and talk to us again later,

264
00:11:05,660 --> 00:11:09,200
and let us know how the
whole smartphone thing works.

265
00:11:09,200 --> 00:11:10,020
>> Mark Micire: Absolutely.

266
00:11:10,020 --> 00:11:11,350
Thanks for having me on.

267
00:11:11,350 --> 00:11:12,050
>> Kelly Humphries:
Alright, thanks again.

268
00:11:12,050 --> 00:11:14,950
That was Mark Micire from
the Ames Research Center

269
00:11:14,950 --> 00:11:17,610
in Moffett Field,
California, who's working

270
00:11:17,610 --> 00:11:19,290
with connecting smartphones

271
00:11:19,290 --> 00:11:23,560
to the SPHERE satellites onboard
the International Space Station,