



Jim Dutton
NASA Astronaut

1
00:00:02,516 --> 00:00:06,546
[Music]

2
00:00:07,046 --> 00:00:13,846
Okay SIM control we're
ready to go to run.

3
00:00:14,286 --> 00:00:14,836
Thank you.

4
00:00:14,896 --> 00:00:17,556
Well Jim, it looks like
the GPS residual's down.

5
00:00:17,556 --> 00:00:19,256
They ought to be calling
us here any minute.

6
00:00:20,126 --> 00:00:20,506
Yeah I agree.

7
00:00:20,506 --> 00:00:21,636
It's looking pretty good.

8
00:00:22,426 --> 00:00:24,096
Probably just waiting
on C-band tracking.

9
00:00:25,296 --> 00:00:26,516
Discovery, take GPS.

10
00:00:27,576 --> 00:00:28,646
Copy. Take GPS.

11
00:00:30,226 --> 00:00:31,086
All right, looks like it took.

12
00:00:31,576 --> 00:00:31,746

Yup.

13

00:00:33,056 --> 00:00:34,206

Well Jim, you ready
to get some lunch?

14

00:00:34,276 --> 00:00:35,036

That was a great run.

15

00:00:35,506 --> 00:00:35,946

Yeah I agree.

16

00:00:35,946 --> 00:00:36,456

Let's do it.

17

00:00:37,076 --> 00:00:37,416

All right.

18

00:00:37,806 --> 00:00:40,866

Maybe we can find
that new restaurant.

19

00:00:42,186 --> 00:00:45,336

Navigation is the science
of following a planned path

20

00:00:45,506 --> 00:00:46,906

from one point to another.

21

00:00:47,446 --> 00:00:51,076

This includes using a GPS,
or Global Positioning System,

22

00:00:51,316 --> 00:00:54,356

to navigate your car to a
destination, guide a hiker

23

00:00:54,356 --> 00:00:57,406

through the woods, or help

first responders locate you

24

00:00:57,406 --> 00:00:59,406
in an emergency.

25

00:00:59,466 --> 00:01:02,466
GPS is also used by
financial institutions

26

00:01:02,466 --> 00:01:05,846
to timestamp transactions like
the swipe of a credit card

27

00:01:06,086 --> 00:01:07,866
or a cash withdrawal
from an ATM.

28

00:01:09,376 --> 00:01:11,496
Accurate timing is
also necessary

29

00:01:11,496 --> 00:01:13,956
to support critical
applications in space

30

00:01:14,096 --> 00:01:16,846
such as NASA's communication
and tracking networks.

31

00:01:17,516 --> 00:01:24,616
[Music]

32

00:01:25,116 --> 00:01:29,616
NASA's Small Business Innovation
and Research, or SBIR program,

33

00:01:29,756 --> 00:01:33,166
supports the development of
technologies that benefit NASA,

34

00:01:33,486 --> 00:01:35,806

encourages private
sector commercialization

35

00:01:35,806 --> 00:01:38,476

of innovations, and in
turn provides spin-offs

36

00:01:38,476 --> 00:01:39,966

that improve our
lives every day.

37

00:01:41,086 --> 00:01:45,336

SBIR program is very important
to developing technology

38

00:01:45,336 --> 00:01:48,616

for NASA as it insulates
NASA programs

39

00:01:48,616 --> 00:01:50,286

from the risks associated

40

00:01:50,486 --> 00:01:53,066

with the far reaching
technology development.

41

00:01:53,516 --> 00:01:56,476

It also gives NASA
access to the efficiencies

42

00:01:56,476 --> 00:01:59,976

and the capabilities
of small businesses.

43

00:02:00,046 --> 00:02:02,576

The small business innovative
research program develops

44

00:02:02,576 --> 00:02:04,196
technologies in three phases.

45

00:02:04,786 --> 00:02:08,096
In phase one, a six-month
conceptual study is performed

46

00:02:08,166 --> 00:02:09,986
to determine feasibility
of the idea.

47

00:02:10,746 --> 00:02:13,906
In phase two, a two-year
hardware development

48

00:02:13,906 --> 00:02:16,866
or software development
is undertaken.

49

00:02:16,946 --> 00:02:19,816
At the end of that time, a
prototype is delivered for NASA.

50

00:02:20,686 --> 00:02:25,206
Phase three is when the
prototype is incorporated

51

00:02:25,206 --> 00:02:27,776
or adopted by an
internal NASA program

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00:02:27,776 --> 00:02:30,476
or by a large American business
for further development.

53

00:02:31,346 --> 00:02:34,856
Most US rocket launches take
place along the US eastern

54

00:02:34,856 --> 00:02:37,226

launch range at either
Kennedy Space Center

55

00:02:37,226 --> 00:02:39,326

or Cape Canaveral

Air Force Base.

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00:02:39,696 --> 00:02:41,026

In the event of a failure,

57

00:02:41,026 --> 00:02:44,326

the NASA range flight safety

systems provides a means

58

00:02:44,326 --> 00:02:46,976

to prevent that launcher from

reaching populated areas.

59

00:02:47,356 --> 00:02:49,456

Three, two-- As part

of the effort

60

00:02:49,456 --> 00:02:51,436

to improve safety

during launches,

61

00:02:51,576 --> 00:02:53,416

NASA is developing a system

62

00:02:53,416 --> 00:02:57,196

that uses Global Positioning

System Receivers placed directly

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00:02:57,196 --> 00:02:58,696

on-board the launch vehicle

64

00:02:58,696 --> 00:03:00,936

to track its trajectory

during ascent.

65

00:03:01,106 --> 00:03:06,006

The SBIR program allows us to help guide outside expertise

66

00:03:06,006 --> 00:03:07,876

and exploring fundamental problems

67

00:03:08,356 --> 00:03:10,376

and interests that NASA has.

68

00:03:11,016 --> 00:03:14,336

We're looking at ways to mitigate possible interference

69

00:03:14,706 --> 00:03:19,956

of the GPS signals on a launch vehicle using commercial

70

00:03:19,956 --> 00:03:21,606

GPS receivers.

71

00:03:22,036 --> 00:03:25,016

So it usually involves antenna technology to look

72

00:03:25,016 --> 00:03:29,386

at multiple satellites and compare different signals

73

00:03:29,386 --> 00:03:33,976

and be able to cancel out any potential interference.

74

00:03:34,116 --> 00:03:37,016

The SBIR program funds a number of initiatives

75

00:03:37,056 --> 00:03:38,976

that support navigation
from the time

76

00:03:38,976 --> 00:03:41,706
of launch throughout
interplanetary transfer.

77

00:03:42,296 --> 00:03:45,436
These initiatives may one
day help navigate spacecraft

78

00:03:45,436 --> 00:03:47,366
in deep space using x-ray

79

00:03:47,366 --> 00:03:49,856
and gamma ray pulsar
based navigation.

80

00:03:50,236 --> 00:03:52,716
Pulsars are rapidly
spinning stars,

81

00:03:52,716 --> 00:03:54,676
which broadcast a
repeating signal.

82

00:03:55,106 --> 00:03:58,876
They are, in fact, lighthouses
in the cosmos that can be used

83

00:03:58,876 --> 00:04:01,346
to help spacecraft
navigate through space.

84

00:04:02,236 --> 00:04:05,846
We do have a success to talk
about through the SBIR program

85

00:04:05,846 --> 00:04:09,386
and that is with x-ray

navigation we have developed a

86

00:04:09,386 --> 00:04:12,826

catalog of pulsars that
are good for our purposes,

87

00:04:12,996 --> 00:04:15,726

and we've also developed
first generation algorithms

88

00:04:15,726 --> 00:04:16,826

to analyze the data.

89

00:04:17,286 --> 00:04:20,046

We are in the process
of building instruments

90

00:04:20,216 --> 00:04:22,866

for x-ray navigation-- one
to fly on the space station

91

00:04:23,166 --> 00:04:24,686

and perhaps elsewhere.

92

00:04:25,296 --> 00:04:28,066

One area where we have a
gap in our knowledge is

93

00:04:28,066 --> 00:04:30,876

in onboard autonomous
navigation.

94

00:04:31,486 --> 00:04:34,566

So we want to have pinpoint
landings on various objects

95

00:04:34,566 --> 00:04:39,966

and when the round-trip light
time becomes prohibitive,

96

00:04:40,416 --> 00:04:42,226

you want on-board
autonomous nav.

97

00:04:42,226 --> 00:04:44,006

And that's an area of
focus that we would

98

00:04:44,006 --> 00:04:44,976

like to delve into more.

99

00:04:45,756 --> 00:04:48,966

The SBIR also funds a
number of technologies

100

00:04:49,006 --> 00:04:51,856

that support navigation
once we reach the surface

101

00:04:51,856 --> 00:04:52,796

of other planets.

102

00:04:53,066 --> 00:04:57,056

There have been a number of
successes in the SBIR subtopic

103

00:04:57,516 --> 00:04:59,506

for planetary surface
navigation.

104

00:04:59,936 --> 00:05:02,946

In particular, there's been
a phase two effort that's

105

00:05:02,946 --> 00:05:06,976

developed a GPS-like
capability that,

106

00:05:06,976 --> 00:05:11,106

for surface planetary navigation
position fixing that operates

107

00:05:11,106 --> 00:05:15,996

over ranges between one
and say 10 kilometers.

108

00:05:16,186 --> 00:05:20,296

Here we have an example
of a piece of hardware

109

00:05:20,296 --> 00:05:24,566

that could be deployed on a
suit or perhaps a vehicle or,

110

00:05:24,566 --> 00:05:28,406

and would also be deployed
on the fixed nodes on towers.

111

00:05:28,556 --> 00:05:30,466

This was developed as part

112

00:05:30,466 --> 00:05:32,776

of the phase two
and delivered to us.

113

00:05:32,826 --> 00:05:36,676

There's also been
successes in the areas

114

00:05:36,676 --> 00:05:40,106

of celestial navigation for
planetary surface navigation

115

00:05:40,446 --> 00:05:44,076

as well as Bayesian filtering
for surface navigation.

116

00:05:45,046 --> 00:05:47,366

The development of these

cutting-edge mission-critical

117

00:05:47,366 --> 00:05:50,356

technologies not only
help us navigate our way

118

00:05:50,356 --> 00:05:52,566

through deep space,
they help us get

119

00:05:52,566 --> 00:05:54,776

to where we're going
right here on earth.

120

00:05:55,266 --> 00:05:57,936

Turn left on second street.

121

00:05:57,936 --> 00:06:00,886

I'm not an expert on
GPS's but it looks

122

00:06:00,966 --> 00:06:02,646

like Tim, we've arrived.

123

00:06:03,176 --> 00:06:05,646

Yeah, this place
looks incredibly good.

124

00:06:06,366 --> 00:06:09,886

Well that was some of the best
driving I've ever seen Bob.

125

00:06:09,986 --> 00:06:12,166

It's not quite as
good as your flying

126

00:06:12,166 --> 00:06:14,826

of the space shuttle
but- I try to do my best.

127

00:06:15,566 --> 00:06:17,736

So whether you swipe
your ATM card,

128

00:06:17,926 --> 00:06:20,936

make a call on your cell
phone, or try to find your way

129

00:06:20,936 --> 00:06:24,336

to a new restaurant, many of the
advancements in communication

130

00:06:24,336 --> 00:06:27,986

and navigation technologies
that we enjoy today started