1
00:00:00,600 --> 00:00:01,501
[upbeat music]

2
00:00:01,534 --> 00:00:02,201
[Mars 2020: Terrain
Relative Navigation]

3
00:00:02,234 --> 00:00:03,503
>> We are in Death Valley,

4
00:00:03,536 --> 00:00:05,905
testing Terrain
Relative Navigation,

5
00:00:05,938 --> 00:00:09,275
the new technology
for Mars 2020.

6
00:00:09,308 --> 00:00:13,112
The terrain in Death Valley
is very much like Mars.

7
00:00:13,145 --> 00:00:16,816
It has a lot of sand
dunes and steep slopes.

8
00:00:16,849 --> 00:00:18,818
It's quite similar
to the landing site

9
00:00:18,851 --> 00:00:20,953
that Mars 2020 will be going to.

10
00:00:20,986 --> 00:00:24,590
We're taking a
copy of the system

11
00:00:24,623 --> 00:00:28,261
that will be on the spacecraft

and we're testing it

12
00:00:28,294 --> 00:00:30,096
in the way that it would

13
00:00:30,129 --> 00:00:32,565
be used during the
flight mission.

14
00:00:32,598 --> 00:00:35,068
>> Terrain Relative Navigation
gives the vehicle the ability

15
00:00:35,101 --> 00:00:36,602
to figure out where it is.

16
00:00:36,635 --> 00:00:38,137
This is kind of along
those same lines

17
00:00:38,170 --> 00:00:41,140
as what the Apollo astronauts
did with people in the loop,

18
00:00:41,173 --> 00:00:42,341
back in the day.

19
00:00:42,374 --> 00:00:44,310
Those guys were
looking out the window

20
00:00:44,343 --> 00:00:45,645
and looking for
different craters

21
00:00:45,678 --> 00:00:47,046
and other features
on the moon

22

00:00:47,079 --> 00:00:47,880
that they knew of

23
00:00:47,913 --> 00:00:49,115
from the maps
we had in the moon.

24
00:00:49,148 --> 00:00:50,616
So, that way they could
figure out where they are

25
00:00:50,649 --> 00:00:53,453
and figure out where they
needed to land to be safe.

26
00:00:53,486 --> 00:00:54,921
So, for the first
time here on Mars,

27
00:00:54,954 --> 00:00:56,456
we're automating that.

28
00:00:56,489 --> 00:00:57,857
>> Andrew: What Terrain
Relative Navigation gives you

29
00:00:57,890 --> 00:01:00,193
is the ability
to avoid hazards

30
00:01:00,226 --> 00:01:01,828
that you already know about.

31
00:01:01,861 --> 00:01:03,329
So, large hazards.

32
00:01:03,362 --> 00:01:06,032
Hills, craters, things
that you've seen before.

33
00:01:06,065 --> 00:01:08,935
With the camera we take
images as we're descending

34
00:01:08,968 --> 00:01:13,172
and we match pieces of the
image to orbital imagery

35
00:01:13,205 --> 00:01:15,408
that we have stored onboard.

36
00:01:15,441 --> 00:01:18,077
And if we make many
of these matches,

37
00:01:18,110 --> 00:01:21,881
we are able to figure out where
we are relative to the map.

38
00:01:21,914 --> 00:01:24,383
>> If we didn't have
Terrain Relative Navigation,

39
00:01:24,416 --> 00:01:27,120
the probability of landing
safely at Jezero Crater

40
00:01:27,153 --> 00:01:29,956
is about 80 to 85%.

41
00:01:29,989 --> 00:01:33,426
But with Mars 2020, we can
actually bring that probability

42
00:01:33,459 --> 00:01:36,896
of success of landing safely at
Jezero Crater all the way up to

43
00:01:36,929 --> 00:01:39,265

99% safe every single time.

44
00:01:39,298 --> 00:01:40,633
>> We don't have an
astronaut that we can put

45
00:01:40,666 --> 00:01:42,235
onboard Mars 2020.

46
00:01:42,268 --> 00:01:43,703
But we can put this system,

47
00:01:43,736 --> 00:01:45,338
this Terrain Relative
Navigation system,

48
00:01:45,371 --> 00:01:48,040
so that the spacecraft could
figure it out on its own.

49
00:01:48,073 --> 00:01:50,610
>> [Andrew] I could see it being
used on lunar missions,

50
00:01:50,643 --> 00:01:53,379
science missions, as
well as human missions,

51
00:01:53,412 --> 00:01:56,249
future Mars missions, of
course, Mars sample return,

52
00:01:56,282 --> 00:01:58,918
Europa lander,
landing on a comet,

53
00:01:58,951 --> 00:02:00,653
pretty much everywhere
you wanna land,

54
00:02:00,686 --> 00:02:02,922
you're gonna want to have
Terrain Relative Navigation.

55
00:02:02,955 --> 00:02:03,823
[upbeat music]