1
00:00:08,270 --> 00:00:05,930
comets and asteroids are very

2
00:00:10,160 --> 00:00:08,280
fascinating places that may contain

3
00:00:12,010 --> 00:00:10,170
building blocks or the remnants of the

4
00:00:14,600 --> 00:00:12,020
building blocks of the solar system

5
00:00:16,369 --> 00:00:14,610
however to explore but they present a

6
00:00:18,200 --> 00:00:16,379
unique set of challenges there is the

7
00:00:20,570 --> 00:00:18,210
low gravity environment or microgravity

8
00:00:22,010 --> 00:00:20,580
as we call it for example a person here

9
00:00:23,810 --> 00:00:22,020
on earth would weigh as little as a

10
00:00:25,880 --> 00:00:23,820
paperclip on the surface of a comet

11
00:00:27,529 --> 00:00:25,890
so Rover Lake curiosity which is

12
00:00:29,510 --> 00:00:27,539
currently exploring Mars would actually

13
00:00:30,800 --> 00:00:29,520

only weigh a couple of kilograms it

14
00:00:33,049 --> 00:00:30,810
wouldn't be able to generate much

15
00:00:34,400 --> 00:00:33,059
traction and in fact as it turns its

16
00:00:36,290 --> 00:00:34,410
wheels it would probably just push

17
00:00:38,150 --> 00:00:36,300
itself away from the surface it's

18
00:00:40,220 --> 00:00:38,160
actually quite likely to end up rotating

19
00:00:42,080 --> 00:00:40,230
and landing upside down at which point

20
00:00:43,550 --> 00:00:42,090
it's ended the mission for the rover so

21
00:00:45,050 --> 00:00:43,560
in step together JPL and Stanford have

22
00:00:47,060 --> 00:00:45,060
been working on a totally different

23
00:00:48,650 --> 00:00:47,070
Rover concept that is well suited to

24
00:00:50,630 --> 00:00:48,660
these environments called Hedgehog

25
00:00:52,790 --> 00:00:50,640
instead of rolling around on wheels the

26
00:00:55,190 --> 00:00:52,800
Hedgehog design actually puts three fly

27
00:00:56,900 --> 00:00:55,200
wheels on the inside of a cube by

28
00:00:58,880 --> 00:00:56,910
spinning these flavors up very slowly

29
00:01:00,709 --> 00:00:58,890
and then very quickly applying a brake

30
00:01:02,330 --> 00:01:00,719
which transfers all the momentum from

31
00:01:06,139 --> 00:01:02,340
the fly wheels we were able to cause

32
00:01:08,419 --> 00:01:06,149
Hedgehog to either hop or tumble or

33
00:01:10,639 --> 00:01:08,429
perform small adjustments we've done

34
00:01:13,039 --> 00:01:10,649
many tests here on earth in gravity

35
00:01:15,529 --> 00:01:13,049
offloading test beds recently we've

36
00:01:18,230 --> 00:01:15,539
flown to Hedgehog prototypes on a zero-g

37
00:01:19,669 --> 00:01:18,240
aircraft in these tests we demonstrated

38
00:01:22,069 --> 00:01:19,679

that we would be able to perform on a

39
00:01:23,809 --> 00:01:22,079
comet or an asteroid Hedgehog doesn't

40
00:01:25,370 --> 00:01:23,819
have a right way up instead it can

41
00:01:27,649 --> 00:01:25,380
tumble over the surface and come to rest

42
00:01:29,660 --> 00:01:27,659
on any one of its phases and still work

43
00:01:31,370 --> 00:01:29,670
purposing the Rosetta mission has sent

44
00:01:34,249 --> 00:01:31,380
back lots of very fascinating images

45
00:01:35,870 --> 00:01:34,259
from the surface of Comet 67p and these

46
00:01:38,209 --> 00:01:35,880
images show us an incredibly rugged

47
00:01:39,980 --> 00:01:38,219
terrain including large sinkholes where

48
00:01:41,899 --> 00:01:39,990
a traditional Rover would get terribly

49
00:01:43,399 --> 00:01:41,909
stuck so we've even tested Hedgehog

50
00:01:45,739 --> 00:01:43,409
performing a type of escape maneuver

51
00:01:47,359 --> 00:01:45,749
where it spins itself up and does this

52
00:01:49,730 --> 00:01:47,369
tornado-like maneuver where it can

53
00:01:51,760 --> 00:01:49,740
actually launch itself vertically out of

54
00:01:53,900 --> 00:01:51,770
a sandpit

55
00:01:55,790 --> 00:01:53,910
in our future work we're looking at

56
00:01:57,470 --> 00:01:55,800
increasing their level autonomy giving

57
00:01:59,120 --> 00:01:57,480
the Hedgehog Rovers the ability to think

58
00:02:00,770 --> 00:01:59,130
for himself and to navigate from one

59
00:02:02,510 --> 00:02:00,780
point to another the Hedgehog Rovers

60
00:02:04,310 --> 00:02:02,520
ability to move around on the surface of

61
00:02:06,470 --> 00:02:04,320
comets and asteroids could enable a wide