1
00:00:00,000 --> 00:00:03,381
[MUSIC PLAYING]

2
00:00:13,550 --> 00:00:17,040
A NASA project called
Resilient Autonomy

3
00:00:17,040 --> 00:00:19,290
has developed autonomous
software to help

4
00:00:19,290 --> 00:00:21,540
prevent airplane crashes.

5
00:00:21,540 --> 00:00:25,080
This software is called the
Expandable Variable Autonomy

6
00:00:25,080 --> 00:00:29,130
Architecture or EVAA, which
stems from the automatic ground

7
00:00:29,130 --> 00:00:32,189
collision avoidance
system or Auto GCAS.

8
00:00:32,189 --> 00:00:35,700
This technology started
off 35 years ago

9
00:00:35,700 --> 00:00:39,840
on the F-16 only a few hundred
feet away from us right now.

10
00:00:39,840 --> 00:00:42,810
That was the first aircraft
on a high performance

11
00:00:42,810 --> 00:00:45,150

aircraft with a digital
flight control system.

12
00:00:45,150 --> 00:00:47,430
And we started to bring a
lot of automation onto it.

13
00:00:51,700 --> 00:00:55,720
We quickly found that automated
safety was a critical component

14
00:00:55,720 --> 00:00:58,210
just even to flight tested.

15
00:00:58,210 --> 00:01:01,915
Over the next 25 years, we work
towards our automatic ground

16
00:01:01,915 --> 00:01:03,790
collision avoidance
system and eventually got

17
00:01:03,790 --> 00:01:06,470
it field in the F-16 fleet.

18
00:01:06,470 --> 00:01:08,020
Taking a roll inverted.

19
00:01:08,020 --> 00:01:10,690
The Auto GCAS
system takes control

20
00:01:10,690 --> 00:01:13,840
of an aircraft from the pilot
at the last possible moment

21
00:01:13,840 --> 00:01:15,860
to avoid an imminent
ground collision.

22
00:01:15,860 --> 00:01:17,390
That's all automatic.

23
00:01:17,390 --> 00:01:22,400
Today it's saved up to 11
lives out there in the fleet.

24
00:01:22,400 --> 00:01:27,160
But that technology was
focused on supporting fighters.

25
00:01:27,160 --> 00:01:29,590
And it didn't scale
well to other platforms.

26
00:01:33,270 --> 00:01:35,460
The team changed
the algorithms used

27
00:01:35,460 --> 00:01:38,370
in the F-16 version
of Auto GCAS to make

28
00:01:38,370 --> 00:01:41,640
them suitable for non-fighter
aircraft like Cessnas

29
00:01:41,640 --> 00:01:44,160
or remotely piloted aircraft.

30
00:01:44,160 --> 00:01:46,800
We've created a
software architecture

31
00:01:46,800 --> 00:01:50,760
that can be expanded to support
any mission or platform.

32
00:01:50,760 --> 00:01:52,180

[SIDE CONVERSATION]

33
00:01:52,180 --> 00:01:54,510
We support variable
autonomy in the fact

34
00:01:54,510 --> 00:01:59,730
that it can be a
safety augmentation

35
00:01:59,730 --> 00:02:04,500
and warn a pilot to all the way
to a fully unpiloted aircraft

36
00:02:04,500 --> 00:02:06,990
that doesn't even have
a pilot in the loop.

37
00:02:06,990 --> 00:02:11,009
The intent is to create a
software architecture that

38
00:02:11,009 --> 00:02:16,500
can easily be adapted to any
form of mission or platform

39
00:02:16,500 --> 00:02:18,380
or autonomy level you want.

40
00:02:18,380 --> 00:02:21,150
See if it'll pick
right or left here.

41
00:02:21,150 --> 00:02:24,570
This version includes functions
to prevent smaller airplanes

42
00:02:24,570 --> 00:02:27,810
from diving into a canyon,
into the side of a mountain,

43
00:02:27,810 --> 00:02:31,440
or into the ground in the event
of an emergency by avoiding

44
00:02:31,440 --> 00:02:34,830
obstacles and guiding the
plane to a safe landing area.

45
00:02:34,830 --> 00:02:39,390
It draws upon multiple
systems, multiple sensors.

46
00:02:39,390 --> 00:02:42,180
And it leverages
hopping from one system

47
00:02:42,180 --> 00:02:45,360
to the next prioritizing
different safety

48
00:02:45,360 --> 00:02:47,460
elements or the mission.

49
00:02:47,460 --> 00:02:51,900
So we're emphasizing that timing
element of going from one thing

50
00:02:51,900 --> 00:02:54,150
on to the next in
rapid succession.

51
00:02:54,150 --> 00:02:56,490
Now we will be in
altitude hold mode.

52
00:02:56,490 --> 00:02:58,770
Slightly different than
we were before that

53
00:02:58,770 --> 00:03:03,810
is going to fly us through that
notch over this very complex

54
00:03:03,810 --> 00:03:05,370
wind turbine farm.

55
00:03:05,370 --> 00:03:08,880
All right, now we just picked
up a detection of a king air

56
00:03:08,880 --> 00:03:10,650
at our 6 o'clock high.

57
00:03:10,650 --> 00:03:12,900
An element called
the moral compass

58
00:03:12,900 --> 00:03:15,090
helps the software
decide which moves

59
00:03:15,090 --> 00:03:19,110
to make by switching control to
the highest priority task based

60
00:03:19,110 --> 00:03:21,150
on weighing the odds of safety.

61
00:03:21,150 --> 00:03:24,885
The moral compass is at the
heart of this rapid switching.

62
00:03:24,885 --> 00:03:27,540
OK, you can see it's
triggered into the yellow mode

63
00:03:27,540 --> 00:03:30,120
there well clear

so it's in a dive.

64
00:03:30,120 --> 00:03:33,750
You can see we've got basically
a fence or a wall of these wind

65
00:03:33,750 --> 00:03:35,340
turbines in front of us.

66
00:03:35,340 --> 00:03:38,430
And we're just cresting over
the top of a line of them

67
00:03:38,430 --> 00:03:39,570
behind us.

68
00:03:39,570 --> 00:03:41,310
But we're still in
well clear mode,

69
00:03:41,310 --> 00:03:43,540
it doesn't yet care
about the wind turbines.

70
00:03:43,540 --> 00:03:45,000
So we're descending
out of the way

71
00:03:45,000 --> 00:03:48,810
of that traffic that's almost
directly overhead us now

72
00:03:48,810 --> 00:03:50,940
on the approach.

73
00:03:50,940 --> 00:03:53,010
We're getting closer
to those wind turbines.

74

00:03:53,010 --> 00:03:55,680
OK, now GCAS is
taking over climbing

75
00:03:55,680 --> 00:03:58,770
right turn and aggressive
turn to the right.

76
00:03:58,770 --> 00:04:01,230
Now it detects it's fairly
close to the aircraft

77
00:04:01,230 --> 00:04:03,690
so it is doing an
aggressive left ACAS

78
00:04:03,690 --> 00:04:08,520
turn climbing away right on
the edge of these wind turbine

79
00:04:08,520 --> 00:04:09,780
obstacles.

80
00:04:09,780 --> 00:04:12,180
And now it's back
into well clear.

81
00:04:12,180 --> 00:04:16,709
We're trying to deconflict
the hazards temporally.

82
00:04:16,709 --> 00:04:19,440
Separate them in time
and then quickly resolve

83
00:04:19,440 --> 00:04:21,660
each individual
one so that now we

84
00:04:21,660 --> 00:04:24,190

can switch from one to the
next, to the next, to the next.

85
00:04:24,190 --> 00:04:26,910
So we bring this
metadata processed,

86
00:04:26,910 --> 00:04:29,160
metadata onto the
aircraft, whether it's

87
00:04:29,160 --> 00:04:33,480
terrain or obstacles
or risk of landing.

88
00:04:33,480 --> 00:04:37,170
And that gives our
algorithms a strategic vision

89
00:04:37,170 --> 00:04:39,240
of how it needs
to execute things.

90
00:04:39,240 --> 00:04:41,910
So we can then trade
these and decide this

91
00:04:41,910 --> 00:04:43,890
is the most important thing.

92
00:04:43,890 --> 00:04:47,880
To increase aviation safety and
decrease the number of crashes,

93
00:04:47,880 --> 00:04:50,370
the DOD, the FAA
and other groups

94
00:04:50,370 --> 00:04:52,680
such as the Alaska

Bush Pilot community

95
00:04:52,680 --> 00:04:54,600
are looking into how
the software could

96
00:04:54,600 --> 00:04:58,530
be integrated into a variety
of aircraft in the future.

97
00:04:58,530 --> 00:05:02,310
General aviation, especially
the Bush Pilot community

98
00:05:02,310 --> 00:05:06,990
has a very challenging task
to go out there and fly

99
00:05:06,990 --> 00:05:10,350
in a very rough environment.

100
00:05:10,350 --> 00:05:13,140
And they see higher loss rates.

101
00:05:13,140 --> 00:05:16,040
This technology
could prevent that.

102
00:05:16,040 --> 00:05:17,610
[INAUDIBLE]

103
00:05:17,610 --> 00:05:19,500
The EVAA software
is being managed

104
00:05:19,500 --> 00:05:22,560
under the NASA Armstrong Flight
Research Center Technology

105

00:05:22,560 --> 00:05:23,820
Transfer Office.

106
00:05:23,820 --> 00:05:27,030
Future availability and
capability enhancement

107
00:05:27,030 --> 00:05:30,180
will be managed by an extended
potential collaboration

108
00:05:30,180 --> 00:05:33,420
of NASA, the DOD, and the FAA.

109
00:05:33,420 --> 00:05:35,250
[INAUDIBLE]

110
00:05:35,250 --> 00:05:37,650
Other NASA projects
such as advanced air

111
00:05:37,650 --> 00:05:41,280
mobility are looking at
potential use cases of EVAA,

112
00:05:41,280 --> 00:05:44,610
as they investigate how
to help the FAA integrate