

1 UNITED STATES PATENT AND TRADEMARK OFFICE

2
3 BEFORE THE PATENT TRIAL AND APPEAL BOARD

4
5 AXON ENTERPRISE INC., DEDRONE HOLDINGS INC.,
6 and SKYDIO INC.

7 Petitioners,

8 v.

9 AIRSPACE DEFENSE INC.

10 Patent Owner.

11
12 Case No. IPR2025-00629

13 US Patent No. 10,514,711

14
15 REMOTE ORAL DEPOSITION OF

16 NIKOLAOS P. PAPANIKOLOPOULOS, PhD

17 Wednesday, July 8, 2026

18
19
20 Stenographically Reported By:

21 Michael E. Miller, FAPR, RDR, CRR, Notary Public

22 Job No. 640751

1 REMOTE ORAL DEPOSITION OF NIKOLAOS P.
2 PAPANIKOLOPOULOS, PHD, produced as a witness at the
3 instance of the Petitioners and duly sworn, was
4 taken in the above-styled and numbered cause on the
5 above-referenced date from 8:32 AM to 11:10 AM CDT
6 before Michael E. Miller, FAPR, RDR, CRR, Notary
7 Public in and for the State of Texas, reported by
8 real-time stenographic means at the location of the
9 witness, Larnaca, Cyprus.

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NIKOLAOS P. PAPANIKOLOPOULOS, PhD

July 8, 2026

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P R O C E E D I N G S

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July 8, 2026, 8:32 AM CDT

4

5

NIKOLAOS P. PAPANIKOLOPOULOS, PhD,

6

having been duly sworn,

7

testified as follows:

8

9

EXAMINATION

10

11 BY MR. WALTERS:

12

Q. Good morning, Dr. Nikolaos.

13

A. Good morning.

14

Q. Could you state your full name for the

15

record, please.

16

A. Nikolaos Papanikolopoulos.

17

Q. And where are you physically located

18

right now.

19

A. In Larnaca, Cyprus, in Radisson Blu.

20

Q. Are you by yourself?

21

A. My counsel, Dr. Suhrid, is with me.

22

Q. Anyone else?

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1 A. No.

2 Q. You understand you've been sworn to
3 testify truthfully to the best of your ability?

4 A. I do.

5 Q. Is there any reason you cannot testify
6 truthfully today?

7 A. Not to the best of my knowledge.

8 Q. Okay. What did you do to prepare for
9 today's deposition?

10 A. I just review my second declaration, the
11 patent, prior art, everything that I'm stating that
12 I reviewed. But mainly my second declaration.

13 Q. And when you refer to the patent, are you
14 referring to the '711 patent, which is US Patent
15 No. 10,514,711?

16 A. That's correct.

17 Q. And your second declaration is
18 Exhibit 2036 in this IPR proceeding?

19 A. Just give me one minute. So I have hard
20 copy like yesterday, a marked hard copy.

21 I don't have the exhibit -- Exhibit 2036.

22 Q. About how long did you spend reviewing

1 documents to prepare for this deposition?

2 A. The number I mentioned -- the number of
3 hours I mentioned yesterday, five or six extra
4 hours, since my emphasis at the beginning was the
5 other two patents.

6 Q. Yesterday you testified that you spent an
7 estimate of 40 hours preparing for all three
8 depositions, the deposition on the '959 patent IPR,
9 the deposition on the '199 patent IPR and today's
10 deposition on the '711 patent IPR?

11 A. That's correct, plus the time -- I spent
12 some extra time reviewing material last night and
13 today, since it's, what, eight hours ahead of you.

14 Q. Did you meet with anyone to prepare for
15 today's deposition?

16 A. Well, Dr. Suhrid.

17 Q. Anyone else?

18 A. No.

19 Q. Did you have any phone calls with anyone
20 else to prepare for today's deposition?

21 A. No.

22 Q. When did the meetings with Dr. Suhrid

1 occur?

2 A. Last night, which was around -- around
3 noon Central, and 4:00 AM Central Time.

4 Q. You also met with counsel before
5 yesterday's deposition to help prepare for today's
6 deposition?

7 A. Yes, as I stated yesterday.

8 Q. And with whom did you meet for those --
9 in those meetings to prepare for today's deposition?

10 A. Dr. Suhrid.

11 Q. Anyone else?

12 A. No.

13 Q. At what rate are you being compensated
14 for your time in this proceeding?

15 A. My normal rate of \$500 an hour.

16 Q. And you submitted two declarations in
17 this proceeding, correct?

18 A. That's correct.

19 Q. One was Exhibit 2025 and the other is
20 Exhibit 2036?

21 A. I'm not sure about the number of the
22 first one.

1 What is the number you mentioned for the
2 first one?

3 Q. 2025.

4 A. I have Exhibit 629 -- sorry. No, this is
5 not -- yeah, you are right. 2025, that's correct.

6 Q. Is everything in Exhibit 2025 and
7 Exhibit 2036 accurate?

8 A. To the best of my knowledge.

9 Q. Who wrote your declarations?

10 A. As I mentioned yesterday, I have control
11 of the words with the exception of legal terms and
12 legal matters.

13 Q. What do you mean you have control of the
14 words?

15 A. So I provide guidance through different
16 means, including phone calls.

17 Q. So you may have provided guidance, and
18 your counsel may have written some of the analysis
19 in the declarations based on that guidance?

20 A. Technical stuff, mostly I write, unless
21 there are legal implications, which I'm not an
22 expert.

1 Q. Your counsel may have written some of the
2 technical stuff?

3 A. No. The way I operate is basically I
4 have control of the words and the technical stuff.

5 Q. Well, yesterday you testified that your
6 counsel may have written some of the original words
7 in the analysis in your declarations based on
8 guidance that you provided on the phone.

9 Is that the same procedure that occurred
10 for the declarations for the '711 IPR or was this
11 one done differently?

12 A. For all of them, it's the same.

13 Q. What is a range?

14 A. Generally -- do you want to point me to
15 something? Is this with respect to the patent? My
16 declaration? In general?

17 Q. With respect to the patent, what is a
18 range?

19 A. Do you want to upload a copy of my
20 declaration? I...

21 Q. Sure.

22 A. And also a copy of the patent, if you

1 don't mind.

2 Q. I uploaded a copy of your second
3 declaration, Exhibit 2036.

4 A. Bear with me a minute.

5 Q. And I've also uploaded Exhibit 2019,
6 which is a copy of the patent application that led
7 to the '711 patent.

8 A. Give me a minute.

9 Q. Sure. No problem.

10 (Document review.)

11 A. So I have several discussions about
12 range. Do you want to point me to a specific
13 paragraph?

14 BY MR. WALTERS:

15 Q. No. You asked to see your declaration.
16 I'm just asking what a range is under
17 your understanding.

18 A. I want to make sure that I -- that I
19 provide the right context.

20 Like, for example, I mention -- there is
21 a whole section before paragraph 88, I say:
22 specification discloses thresholds and ranges.

1 Q. Is a range a mathematical term?

2 A. In general or -- in general, yes.

3 Q. What does a range as a mathematical term
4 mean to you?

5 A. Something which is -- it has an upper
6 limit and a lower limit, so the range is basically
7 everything in between.

8 Q. Can a range be open-ended?

9 A. Yes.

10 Q. Is less than X a range?

11 A. Yes, if you include the infinity.

12 Q. Would greater than X be a range?

13 A. If you include -- yes, if you include the
14 plus infinity.

15 Q. I'd like to ask you some questions about
16 the substitute claims, and like yesterday, to do
17 that, it may be best to be reviewing the revised
18 motion to amend.

19 You don't have that revised motion to
20 amend in front of you, do you?

21 A. No.

22 Q. Okay. I will upload it to the chat.

1 And it may be best to go to the --

2 A. If you can give me one minute, just --

3 Q. Sure. I was going to say it may be best
4 to go to the appendix to see the complete set of
5 substitute claims.

6 A. Yeah.

7 THE WITNESS: Bear with me. I'm just
8 trying to...

9 Somehow, let me try -- because it's
10 not loading. Give me one minute.

11 (Document review.)

12 THE WITNESS: Okay. Let's make sure
13 it's -- Patent Owner's Contingent-in-Part and
14 Non-Contingent-in-Part Revised Motion to Amend
15 (Corrected). Is this the one?

16 BY MR. WALTERS:

17 Q. Yes.

18 A. Okay. Do you want me to go to the
19 appendix?

20 Q. Yes, please.

21 A. One thing I wanted to mention as I was
22 uploading this and I was trying to upload this:

1 Range can be bounded, just with reference to your
2 earlier question.

3 So just -- I'm there.

4 Q. Okay. I'd like to start with claim 37,
5 substitute claim 37.

6 A. Sure.

7 Q. And specifically, limitation 37.e3.

8 A. Yes.

9 Q. Do you want to read that limitation to
10 yourself to familiarize yourself with it?

11 A. Sure.

12 I have also some analysis of this in my
13 declaration. Do you want me to stick to this or do
14 you want me to read that to refresh my memory
15 regarding the declaration?

16 Q. I don't think you need to, but you're
17 welcome to if you'd like.

18 A. Yeah, just give me one minute.

19 Q. Sure.

20 (Document review.)

21 BY MR. WALTERS:

22 Q. Are you reviewing your declaration?

1 A. No, no, I'm just -- I'm basically -- I
2 may use segments from my declaration that start from
3 paragraph 65.

4 I'm ready, please.

5 Q. Okay. This limitation 37.e3 requires
6 selecting and applying either a first neural network
7 or a second neural network to the current image
8 based on certain conditions; is that fair?

9 A. There are other elements, but -- but I
10 will say this is -- I will add that depending on the
11 confidence level, how this confidence level
12 compares, affects threshold of a range.

13 And a second threshold -- so, basically,
14 we decide which -- we have first and second neural
15 network. Depending on some thresholds and a
16 confidence level and how this confidence level
17 relates to these thresholds, we decide which one is
18 selected and applied to the immediately preceding
19 image.

20 Q. To the immediately preceding image or to
21 the current image?

22 A. To the current image, sorry.

1 (Clarification requested by the court
2 reporter.)

3 A. So depending on how -- so we decide if
4 we're going to apply the first or second neural
5 network, depending on how the confidence level
6 compares with respect to a first threshold or a
7 second threshold.

8 MR. WALTERS: The question was to the
9 immediately -- the question was to the
10 immediately preceding image or to the current
11 image, and he answered to the current image.

12 BY MR. WALTERS:

13 Q. Is that right, Dr. Nikolaos?

14 A. Yeah.

15 Q. And this e3 limitation only applies when
16 the second neural network was selected and applied
17 to the immediately preceding image, correct?

18 A. That's correct.

19 Q. Can we move to limitation 37.e4.

20 A. I'm there.

21 Q. Would you like to refamiliarize yourself
22 with the limitation?

1 A. Yes, just give me one minute.

2 (Document review.)

3 A. Yes, I'm there.

4 BY MR. WALTERS:

5 Q. This limitation 37.e4 requires selecting
6 and applying either a second neural network or a
7 first neural network to the current image based on
8 certain conditions?

9 A. Yes. So -- so let me tell you, 37.e4 are
10 basically examining the following situations: The
11 37.e3 looks at the case when we have a second neural
12 network that was selected and applied to the
13 immediately preceding image, okay?

14 37.e4, it says instead of a second neural
15 network, we say when the first neural network was
16 selected and applied to the immediately preceding
17 image.

18 So 37.e3 says how do we do the selection
19 in the first case, and 37.e4 says how we can do the
20 selection when the first neural network was selected
21 and applied to the immediately preceding image.

22 Q. So if -- I'm sorry. I didn't mean to

1 interrupt you.

2 A. Sorry.

3 So basically, what I tried to say -- and
4 this is explained a little bit better -- or I will
5 say it's explained with some demonstratives in -- at
6 the end of the paragraph 67.

7 For example, I say: I further explain
8 the selection process below -- this is paragraph 67
9 from my declaration -- with reference claim element
10 37.e3 and Demonstrative 1 below.

11 And if you see, there is another one
12 which is -- there is another explanation that I have
13 which is -- follows with the Demonstrative 2.

14 And this is paragraph 71, paragraph 72,
15 where I explain what the specification -- what
16 follows from the specification and what's contained
17 in the claim elements.

18 Q. 37 -- the 37.e4 limitation only applies
19 when the first neural network was selected and
20 applied to the immediately preceding image, correct?

21 A. That's correct.

22 Q. Going back to 37.e3, there's a phrase:

1 when the confidence level is below a first threshold
2 of a range defined by the first threshold and a
3 second threshold greater than or equal to the first
4 threshold.

5 Do you see that?

6 A. I see that.

7 Q. This limitation requires both a first
8 threshold and a second threshold, correct?

9 A. That's correct.

10 Q. And for a prior art reference to
11 invalidate this claim, both a first threshold and a
12 second threshold must be shown in the art?

13 A. Can you repeat your question?

14 Q. For a prior art reference to invalidate
15 this claim, both a first threshold and a second
16 threshold must be shown in the art?

17 A. More than that, because we need all the
18 claim terms.

19 Q. Okay.

20 A. As far as I know, there is no prior art
21 that does that.

22 Q. You at least need to show a first

1 threshold and a second threshold, correct?

2 A. Among all the claim terms in 37.e3.

3 Q. This limitation contemplates that the
4 second threshold could be equal to the first
5 threshold?

6 A. It's a possibility. I think that the
7 specification -- yeah, I have some writing about
8 when both thresholds -- when we have one threshold.

9 Q. I'd like to look at substitute claim 24.

10 A. 24, you said?

11 Q. Yes.

12 A. Bear with me. Give me a minute.

13 I'm there.

14 Q. Would you like to refamiliarize yourself
15 with this claim?

16 A. Sure.

17 (Document review.)

18 A. Yes, I'm ready.

19 BY MR. WALTERS:

20 Q. The end of this limitation requires
21 identifying a model type of the target based on the
22 classification of the detected target?

1 A. That's correct.

2 Q. So one must classify the target and then
3 identify a model type based on that classification?

4 A. No. And I have some write-up in my -- in
5 my declaration about this in paragraph -- give me
6 one minute.

7 It starts at paragraph 101.

8 Q. How does one identify a model type of a
9 target based on the classification if you have not
10 yet classified the target?

11 A. Can you repeat, please, the question?

12 Q. How does one identify a model type of a
13 target based on a classification if you have not yet
14 classified the target?

15 A. Give me a minute.

16 So if you go to paragraph 102 of my
17 declaration, I explain this. We don't -- for
18 example, if you look at the claim element -- if you
19 look at the paragraph -- so there are -- there are
20 not necessarily two steps in a series that we
21 perform sequentially.

22 In other words, classification -- and

1 this is supported by the specification -- it can be,
2 in the case of UAVs, friendly UAVs and contrarian or
3 foe UAVs, or we can say this is UAV Reaper 171.

4 And, for example, if you see the
5 specification, in the patent, column 7, 32 --
6 rows 32 to 41, it says: The one or more machine
7 learning models 205 may be trained using a set of
8 training data. The set of training data includes a
9 set of positive examples and a set of negative
10 examples. For example, the set of positive examples
11 may include a plurality of feature vectors that
12 indicate the detected object is a UAV. The set of
13 negative examples may include a plurality of feature
14 vectors that indicate the detected object is not a
15 UAV.

16 Now, the specification also states -- and
17 this is column -- from the patent, column 17, from
18 25 to 38. The output of image analysis, for
19 example, output from applying the machine learning
20 model, may include a classification of the detected
21 target, inside parentheses, type, model, class,
22 manufacturer, size, et cetera, of the detected

1 target.

2 And I think also I'm concluding this
3 analysis by saying that: I believe that the board
4 has performed substantially -- has done the same
5 analysis and has reached the same conclusion.

6 Q. Okay. And forgive me, I'm having a hard
7 time understanding how that answers my question, so
8 I'll just -- I'll read my question again.

9 The question was: How does one identify
10 a model type of a target based on a classification
11 if you have not yet classified the target?

12 A. Let me try to -- basically by -- so what
13 I'm saying -- what the specification states is that,
14 first of all, we can have, through the image
15 processing and the classification, an outcome. So
16 we have two types of classification.

17 One, the first type is UAV or not UAV,
18 so, basically, it's what we call a binary
19 classifier. And then we can have a more elaborate
20 scheme, which is disclosed in this column 17, 35-38,
21 a second type of classification which says: The
22 output of the image analysis, output from applying

1 the machine learning, may include the classification
2 of the detected target, which may include type,
3 model, class, manufacturer.

4 So we have to look at the classification,
5 just to answer your question, as broader than -- we
6 have two types.

7 Q. In your example, are you classifying the
8 target before you identify model type?

9 A. There's one step.

10 Q. I'm sorry, is the answer to my question:
11 No, you're not classifying the target before you
12 identify model type?

13 A. No, I -- the answer is no. It's just --
14 I'm doing this, and as part of a multi-class
15 classification schema. So it's a one-step process.

16 Q. The limitation does require that the
17 target be classified, correct?

18 A. The -- the claim basically says that the
19 machine learning model -- so it says the method of
20 claim 21, wherein detecting the target in the image
21 including by applying at the reference aerial
22 vehicle the machine learning model to the image

1 includes identifying the model type of the target
2 based on the classification of the detected target.

3 So it's one step, the classification. As
4 one of the many outputs of the classification, we
5 may have -- for example, it could be big drone,
6 small drone, or this particular model and type that
7 I mention.

8 Q. Does the limitation require that the
9 target be classified?

10 MS. L'ESPERANCE: Objection, asked
11 and answered.

12 A. Classification may have different
13 outputs. Do you see, it may have -- you may not
14 have classification, so it's not one answer.

15 BY MR. WALTERS:

16 Q. If the Board was interested in the
17 question of whether this limitation requires that
18 the target be classified, what would your answer for
19 the Board be?

20 A. What is contained in my declaration, that
21 we may have many outputs, including big drone, small
22 drone, Reaper drone, Iranian drone, type Shahed or

1 whatever we are interested.

2 Q. Is that a yes or a no?

3 A. So, for example, if you look at claim 21,
4 we have one type of a classification. If you look
5 at claim 21, output of the classification. 24
6 provides another type of classification, another
7 output of this classification process.

8 These things are not sequential. Think
9 of step -- the step -- the claim 21 is one type of
10 classification, and the claim 22, another type of
11 classification, another output of the classification
12 schema.

13 Q. Okay. So claim 24 -- strike that.

14 The classification recited in claim 24
15 may be a different classification than that recited
16 in claim limitation 21.b?

17 A. Give me a minute to think about this.
18 Let me read my...

19 The 24 -- let me read -- let me read my
20 declaration. Just give me one minute. I want to be
21 accurate, because I think this an important point.
22 All of them are important, but just I want to make

1 sure.

2 (Document review.)

3 A. So if you look at paragraph 104 in my --
4 in my declaration: the first kind of classification
5 may only classify a detected object as a UAV or not
6 a UAV.

7 The second kind -- which is basically
8 what we're referring to, or what we can look at, at
9 claim 24 -- may classify maybe more specific. In
10 other words, it may classify the detected object
11 according to the model type. Like, for example, we
12 may say Shahed or Reaper or whatever else model or
13 type we're interested in.

14 BY MR. WALTERS:

15 Q. So I think I'm understanding you to say
16 that the classification in 24 may be different than
17 the classification recited in 21.b; is that right?

18 A. I think the correct characterization is
19 more specific.

20 Q. So it may not be the same?

21 A. Again, I will insist, more specific.
22 It's a different type.

1 So just for the record, we have what is
2 called binary classification, and -- in other words,
3 we have two classes, and we say either the target
4 belongs to this class or doesn't belong to this
5 class.

6 And then we have what we call a
7 multi-class classifier, where we can have additional
8 characteristics of the classes. It will be more
9 specificity in this second kind of classification.

10 THE COURT REPORTER: Did we lose
11 Amanda?

12 (Pause.)

13 MR. WALTERS: Let's go off the
14 record.

15 THE COURT REPORTER: Off the record.

16 (Recess taken, 9:17 AM to

17 9:18 AM CDT)

18 THE COURT REPORTER: Back on the
19 record.

20 BY MR. WALTERS:

21 Q. Dr. Nikolaos, I'd like to turn to
22 Exhibit 2019, which is the application that led to

1 the '711 patent.

2 A. Okay. If you can --

3 Q. I previously uploaded it to the chat.

4 A. Just one minute. Let me see. Give me a
5 couple of minutes.

6 You said 2016?

7 Q. 2019.

8 A. 2019.

9 (Document review.)

10 A. This is the -- let me see.

11 This is the patent application '452; am I
12 right? Or no? Do I have the correct one?

13 BY MR. WALTERS:

14 Q. It's the application that led to the '711
15 patent.

16 A. Yeah, I think I have the correct
17 document, yeah.

18 Q. Okay. Can you turn to Figure 10.

19 A. Give me one minute. Yes.

20 Q. What do equations 7 and 8 in Figure 10
21 represent?

22 A. Let me look at the spec.

1 If I'm -- if I'm not mistaken, I believe
2 the same equations appear also in the patent. Do
3 you still want me to look at the patent application
4 or the patent?

5 BY MR. WALTERS:

6 Q. Feel free to look at either one. Can you
7 tell me what you'd like to look at.

8 A. Since I have the patent -- since most of
9 my statements are from the patent, is it possible
10 to -- I don't think you have uploaded -- you have
11 given me the patent; am I right?

12 Q. I don't believe so.

13 A. Can you please?

14 Give me a minute.

15 Q. I just uploaded the patent.

16 A. Okay. Okay. Okay. Finally it uploaded.
17 Sorry for the delay.

18 Q. That's okay.

19 A. So I believe it's the same -- we're
20 talking about the same figure, Figure 10. The
21 equations you told me, 7 and 8; am I right?

22 Q. Yes.

1 A. Just give me one minute to -- because
2 there is a description in the spec.

3 (Document review.)

4 A. So if you go -- let me tell you the
5 exact...

6 So if you go to the paragraph 123 of my
7 declaration, towards the end of the page. Tell me
8 when you are there.

9 BY MR. WALTERS:

10 Q. I'm there.

11 A. So 123, I'm saying: Also, regarding
12 Equations 7 and 8, a POSITA would have readily
13 recognized those as corresponding to a type of
14 sigmoid functions, the use of which for smoothing
15 variables, those representing changes, change in
16 speed in this context, is well known.
17 Coincidentally, sigmoid functions are used
18 extensively in the design of artificial neural
19 networks.

20 As such, I say, a POSITA would have
21 recognized the function of the equation constants,
22 and how to select them via a reasonable amount of

1 experimentation.

2 Q. Are equations 7 and 8 used to determine
3 the speed adjustment factor?

4 A. Potentially, yes.

5 Q. What is the difference between equations
6 7 and 8?

7 A. Let me look at them.

8 It's along in the X direction and the Y
9 direction.

10 Q. What does that mean?

11 A. So think of -- one application I can
12 think which is related to the equations 4, 5 and 6.

13 So if you look -- I don't know if you see
14 the equations 4, 5 and 6, Figure 10?

15 Q. I see them.

16 A. So the U distance, according to the spec,
17 up and down. LR means left-right, and so,
18 basically, think of the following.

19 Do you see Figure 9?

20 Q. Yes.

21 A. So visuals can operate in two ways,
22 either as, basically, quantitatives or qualitatives,

1 so as the camera sensor is mounted on the aerial
2 vehicle.

3 So let's suppose we have the target in
4 the image, and the target is basically at the
5 center. It tells you when you are at the center,
6 when the target is locked on, you may need to have a
7 different speed adjustment in a certain direction in
8 the center.

9 Then, basically, if the target is off or
10 the smoothing that can take place, in other words,
11 the way -- we don't want to have jumps up and down
12 in the speed adjustment because this will completely
13 destabilize the drone.

14 So this tells you how you can have a
15 smooth change in speed, a smooth speed adjustment,
16 and there is a lot of write-up in the spec about how
17 the different ways that this could be done. But an
18 important component is the one which is described by
19 the Figure 9 and the Figure 10 in particular.

20 So if I want to compensate for basically
21 the target is moving up in the way that I'm viewing
22 from my perspective, then I'm using this speed

1 factor as a way of basically determining the speed
2 adjustment factor that I need in this up motion.
3 So -- because my objective is always to be locked on
4 the target, to have the target dead-on on the
5 center.

6 Q. Equations 5 and 6 utilize a speed factor
7 that has already been determined?

8 A. I think it can be determined -- possibly
9 can be determined by the equations 7 and 8. Just
10 for simplification here, the X and Y are not --
11 since the direction is given by the up and down or
12 left to right, the -- basically, we don't have it in
13 parentheses, degree X, degree Y for direction X,
14 direction Y.

15 Q. Are A, B and C in equations 7 and 8
16 constants?

17 A. Are selected in general or can be part of
18 a lookup table or something which is associated.
19 There is a whole set of things associated with the
20 drone mechanics and the dynamical and kinematical
21 models that may tell you the proper selection of A
22 and B.

1 Q. What do A, B and C represent?

2 A. These are parameters that tells you the
3 spread of the sigmoid and how basically -- how sharp
4 the sigmoid may be and so on and so forth.

5 Q. Would a POSITA need to use all three
6 constants, A, B and C, when determining a speed
7 adjustment factor?

8 A. They can use all of them or they can have
9 fixed some of them and then play -- depending -- it
10 depends if they know the mass and the distribution
11 of the mass and the kinematic and dynamic model of
12 the drone.

13 It's drone specific. Let's put it this
14 way.

15 Q. What is robustness in terms of a neural
16 network?

17 A. Are you asking me in general or...

18 Because there are several -- so accuracy,
19 the first thing that comes to my mind. And then
20 when we're talking about accuracy, we're talking
21 about terms like precision and recall, which are
22 associated with things like true positives and true

1 negatives and false positives.

2 So in other words, let's suppose we have
3 a neural network that classifies a drone that misses
4 a drone. This is a false negative.

5 So then we have what we call precision or
6 recall metrics that can help us measure the
7 robustness accuracy or any other related term you
8 may want to use.

9 Q. Does robustness mean accuracy?

10 A. Yes, this is the first thing that comes
11 in my mind.

12 Q. Can robustness mean -- refer to anything
13 else?

14 A. If you look at paragraph 132. Let me --
15 give me a minute to go to paragraph 32 [sic].

16 Q. Is this paragraph 132 of your
17 declaration?

18 A. Yeah.

19 I'm mentioning that 132 -- tell me when
20 you are there.

21 Q. I'm there.

22 A. So the term "robustness" in the context

1 of a neural network and a processing scheme in
2 general has the same meaning as in other contexts,
3 susceptibility to adverse conditions, for example,
4 noise, in the case of image analysis, which is
5 really prevalent in the scenarios in the use cases
6 we examined.

7 A POSITA will have been aware that
8 robustness can be determined in terms of failure
9 rate or frequency.

10 If one looks at the literature of neural
11 networks, they use the term "robustness" in this
12 way, and I have added some references, Exhibit 2047,
13 Exhibit 2048, Exhibit 2042, to that effect.

14 Q. You reference paragraph 132. It says:
15 Robustness is susceptibility to adverse conditions.

16 Does that mean a higher robustness means
17 a greater susceptibility to adverse conditions?

18 A. High robustness depends on the structure
19 of the algorithm and how the algorithm -- it's --
20 it's how the algorithm deals with these adverse
21 conditions.

22 So in other words, the answer is yes in

1 this particular context.

2 Q. How does one measure robustness?

3 A. I just mentioned two metrics, precision
4 and recall.

5 Q. Is there an objective way to measure
6 robustness?

7 A. These are used for decades.

8 Q. What is the objective way to measure
9 robustness?

10 A. We want to see how accurate our method
11 is.

12 Q. Is there an objective way to determine
13 how accurate the method is?

14 A. There are many metrics that can be used,
15 depending on your particular interest.

16 Like, for example, if you are interested
17 not missing drones and we are able to intercept,
18 then you want to use the precision metric. If you
19 don't care about missing drones and you're more
20 interested in having reduction in the false
21 negatives, then you may want to look at other
22 metrics.

1 So it depends on the context of your
2 interests.

3 Q. What are metrics other than precision you
4 could look at?

5 A. A percentage, for example, of -- let's
6 say I have a human. It looks at the scene and says
7 I have two pedestrians, and the system says I have
8 one pedestrian. Then the accuracy in this case is
9 50%.

10 Q. What are some other metrics you could use
11 in addition to accuracy or precision?

12 A. The recall, I mentioned.

13 Q. What --

14 A. Sometimes you're going to hear the term
15 "F1" as well.

16 Q. What is the recall?

17 A. The recall is actually true -- the number
18 of true positives divided by the number of true
19 positives plus the number of false negatives.

20 Q. Are there other metrics to use to measure
21 robustness?

22 A. Yes. There are other combinations, but

1 these are some of the most commonly used.

2 Q. Can you think of any others?

3 A. If you tell me an application you have in
4 mind, I can tell you. If you tell me the context, a
5 POSITA will know based on the context.

6 Q. The context of the '711 patent.

7 A. In the context of the use case.

8 Q. I'm sorry?

9 A. In the context of the use case.

10 So, for example, I will give you one
11 example that includes pedestrians since I have -- I
12 have worked in the area quite a lot.

13 If I'm interested -- if I have a traffic
14 light -- this is some work that we did. If I have a
15 traffic light that is activated based on the
16 presence of pedestrians as they are crossing the
17 street in order to allocate enough time for a
18 pedestrian to cross the street, let's suppose we're
19 in Minnesota, where we want to have things robust to
20 the extreme weather conditions. We cannot afford
21 cars killing pedestrians because we have snow.

22 The metrics we're going to use are not

1 going to be just the accuracy, because the accuracy,
2 even if we have a 99 accurate system, 1% means we're
3 going to lose one out of a hundred pedestrians. So
4 that's why the context is important.

5 And if you look at the case of drones,
6 think of the case of a drone -- the example that I
7 mentioned yesterday, a drone in DC going towards the
8 White House. You cannot afford...

9 So, for example, if you have fire
10 detection, you cannot say false detection all the
11 time. Do you see what I mean?

12 You need to be -- everything that is
13 critical with respect to human safety is going to
14 have a different metric that is going to be
15 applicable to this case.

16 If I want to see how many -- another
17 area. If I want to say roughly I have 50,000
18 pedestrians per -- 50,000 pedestrians using a retail
19 area, missing a few pedestrians or walkers or
20 visitors is not going to matter, but in a traffic
21 light or in the case of drone, this may be extremely
22 critical. And I think that's the beauty of this

1 patent and this scheme.

2 Q. How many different metrics could be used
3 in the drone case?

4 A. Depends on the context.

5 Q. Could it be hundreds?

6 A. No. Like, for example, in a case that I
7 mention, drone -- let's suppose -- the use case that
8 we have here, I will use precision.

9 The ones that I mentioned are the most
10 common.

11 Q. What --

12 A. And there are --

13 Q. Go ahead.

14 A. One of the thing that I want to mention
15 is actually, generally, this area has enough
16 metrics. It's a problem that is well understood on
17 how to measure.

18 The problem as stated in the
19 specification is how you can do this on the drone.
20 Think of the following: You have a flying drone
21 with a camera, which makes the problem highly
22 nonlinear, extremely prone to noise and to other

1 weather conditions; and you try to do this type of
2 classification that I mentioned earlier.

3 MR. WALTERS: We've been going over
4 an hour. Would now be a good time to take a
5 break?

6 THE WITNESS: That's fine with me.

7 THE COURT REPORTER: Off the record.

8 (Recess taken, 9:47 AM to
9 10:00 AM CDT)

10 THE COURT REPORTER: Back on the
11 record.

12 BY MR. WALTERS:

13 Q. Welcome back, Dr. Nikolaos.

14 A. Thank you.

15 Q. What is a Tiny-YOLO?

16 A. Let me go to my declaration, because...

17 So if you look at the -- let's go to the
18 patent. If you go to column 28, row 41, there is
19 some discussion about different groups of,
20 basically, neural networks can be used. So the
21 group A, the group (i) high cost, low refresh rate,
22 high robustness can include modified tiny -- tiny,

1 and then YOLO. YOLO means "you only look once,"
2 Convolutional Neural Networks, CNN, on 448 pixels
3 input tiles in the frame.

4 So this is a disclosure done when you
5 need high robustness, and it may take more time, you
6 can use the Tiny-YOLO in order to do the object
7 detection. And this is a construction to the
8 SqueezeNet, which is a low robustness but high-speed
9 neural network related to the discussion we had as
10 part of the claim 37.

11 Q. I see that this portion of the patent
12 references Tiny-YOLO, but what is a Tiny-YOLO?

13 A. It's a Convolutional Neural Network.

14 Q. Is it different than just a regular YOLO?

15 A. Yes.

16 Q. What's the difference?

17 A. It's something that is tuned to be faster
18 than the -- than the -- basically, the YOLO. That's
19 why -- that's why it's called Tiny-YOLO.

20 Q. Is there a metric that determines whether
21 it's a Tiny-YOLO versus a YOLO?

22 A. Let me think a little bit about this.

1 If you look -- let me go to what I --
2 because I think I have some text. If my memory
3 serves me well, that is Redmon.

4 So if you go to paragraph 244 of my
5 declaration. Tell me when you are there.

6 Q. I'm there.

7 A. I'm saying -- I'm using the Exhibit 2051,
8 where -- and I'm saying: Likewise, Wong states: A
9 particular interesting family of object detection
10 networks designed around efficiency is the YOLO
11 family of neural network architectures... which can
12 achieve embedded object detection performance on
13 high-end GPUs. However, these network architectures
14 remain too large for many edge and mobile scenarios.
15 For example, 240 megabytes in the case of the YOLO
16 v3 architecture, and their inference speeds drop
17 considerably when running on edge and mobile
18 processors due to their computational complexity.

19 And I mention -- the paper mentions, for
20 example, 65B operations in the case of YOLO
21 version 3: To address this issue, Redmon et al
22 introduced the Tiny-YOLO family of network

1 architectures, which -- which has greatly reduced
2 model sizes at the cost of object detection
3 performance.

4 And also I have more text in
5 paragraph 248, where Redmon, I'm saying, discloses a
6 traditional YOLO, also called a base network, and a
7 fast YOLO. And this is Exhibit 1036.

8 And it says the fast YOLO -- and so on
9 and so forth. And the -- that the traditional YOLO
10 has 24 convolutional layers, while the fast YOLO
11 uses a neural network with far fewer convolutional
12 layers; nine in this case.

13 Q. Is there a standard to differentiate a
14 Tiny-YOLO from a YOLO?

15 A. Yes.

16 Q. What is that standard?

17 A. The number of the layers that you have.

18 Q. How many layers do you need to have to be
19 a Tiny-YOLO versus a YOLO?

20 A. I just mentioned the example here, and
21 the person who -- Redmon defined this, and I just
22 stated from his exhibit.

1 Q. What is that number of layers that makes
2 the distinction?

3 A. Nine versus 24 of the traditional YOLO.

4 Q. So if you have nine layers, it's a
5 Tiny-YOLO?

6 A. Yeah. We have to be careful. This is
7 not a scale. You see, it's not something -- it's
8 not weight. We try to balance accuracy versus
9 computational performance.

10 Q. Can two different Tiny-YOLOs have
11 different compute costs?

12 A. No.

13 Q. How do you measure compute costs?

14 A. I have -- I have a write-up. Just give
15 me one minute.

16 The latency, but I have a write-up also
17 on my -- let me give you...

18 Let me find the paragraph. Just one
19 minute.

20 (Document review.)

21 A. Bear with me, I'm almost there.

22 Can you please go to paragraph 133.

1 BY MR. WALTERS:

2 Q. Yes, I'm there.

3 A. Compute cost is simply the cost of
4 computations. In general, this cost can be
5 expressed using many parameters, individual or in
6 combination. For example, compute cost can simply
7 be the total number of computations, or the number
8 of floating-point computations.

9 So the total number of computations, for
10 example.

11 Q. You state there that it can be the size
12 of hardware and/or software used for the
13 computation?

14 A. Just give me -- give me one minute. Give
15 me one minute, and if you can repeat your question.

16 Q. You state there that it can be the size
17 of hardware and/or software used for the
18 computation?

19 A. I state this, but also I believe the
20 patent -- the specification in the patent. Give me
21 one minute.

22 Give me -- just to go...

1 (Document review.)

2 A. So, for example, if you look at the
3 patent, there is a whole discussion about compute
4 cost and robustness and refresh rate and clarity and
5 consistency.

6 So column 27, rows 53 to 64; 28 column,
7 5 to 8; 28, 40 to 29.3. And, in fact, I'm stating
8 here that Dr. Singhose agrees.

9 And if you see, for example, the patent
10 talks about latency.

11 Q. Your statement in paragraph 133 that the
12 compute costs can be the size of hardware and/or
13 software used for the computation, does that refer
14 to the model size of the YOLO?

15 A. Yes.

16 Q. I'm going to upload Exhibit 2045 to the
17 chat.

18 A. Just, I found -- before we go there, if
19 you look, for example, in the patent, line --
20 column 21, 52-54, it -- it says, for example: the
21 cost and/or latency of the algorithm per
22 spacio-temporal frame.

1 You said which? 2045?

2 Q. Yes.

3 A. I'm waiting to upload it.

4 Yes, I got it.

5 Q. Are you familiar with this exhibit?

6 A. Let me refresh. Can you point me -- did
7 I analyze this exhibit or no? I need to refresh my
8 memory.

9 It talks about the Tinier-YOLO. Yeah,
10 it's just these are big words, Tiny-YOLO with
11 Tinier-YOLO.

12 Q. Are you familiar with it?

13 A. Yes.

14 Q. Can you turn to exhibit page 8 of
15 Exhibit 2045.

16 A. Let me go there.

17 Yes, I'm there.

18 Q. At the top of that page, there's a
19 Table 7.

20 Do you see that?

21 A. Yes.

22 Q. And that Table 7 compares performance and

1 model size of different YOLOs.

2 Do you see that?

3 A. That's correct.

4 Q. Tiny-YOLO-V2 has a size of 63.4 megabytes
5 and Tiny-YOLO-V3 has a size of 34.9 megabytes?

6 A. That's true.

7 Q. Does that mean that different Tiny-YOLOs
8 can have different model sizes?

9 A. They're improvements. And also, we have
10 to consider that this paper is -- was 2019 also, so
11 things are changing.

12 Q. Can two different Tiny-YOLOs have
13 different compute costs?

14 A. Under this specific set of experiments --
15 let me just read the -- how this Table 7 was
16 created. Just give me one minute to refresh my
17 memory.

18 (Document review.)

19 A. There are different -- let me check the
20 implementation details. Just give me one minute.

21 (Document review.)

22 A. So implementation details are not given

1 completely, but basically it says -- if you go on
2 page 7, do you see where it says: 1, Performance
3 Comparison on BFLOP per second and the Model Size?

4 BFLOP is often used as a measure of the
5 computational power required by a model. The larger
6 the BFLOP per second, the higher the requirements
7 for the device. As shown in Table 7, BFLOP of
8 Tinier-YOLO is only 2.563, which is less than half
9 of Tiny-YOLO-V3, and is suitable for constrained
10 environments.

11 In other words, when you have something
12 that you don't have unlimited resources.

13 The model size of Tinier-YOLO is almost
14 four times smaller than Tiny-YOLO version 3, and
15 seven times smaller than Tiny-YOLO-V2.

16 The type is still important, the type of
17 the Tiny-YOLO that we have.

18 BY MR. WALTERS:

19 Q. The different versions of Tiny-YOLOs can
20 have different compute costs?

21 A. Yes.

22 Q. Can you go back to the Revised Motion to

1 Amend?

2 A. You want me to keep this open or...

3 Q. I don't think I'm going to have any more
4 questions with that exhibit.

5 A. Okay. Let me -- because it's getting
6 slower with the upload speeds. Let me kill this.

7 Do you want me to look at the appendix?

8 Q. Yes, please.

9 A. I'm there.

10 Q. Specifically, limitation 37.e1.

11 A. Give me a minute.

12 Yes.

13 Q. That limitation ends with "based on a
14 confidence level for a detection of the target in
15 the current image."

16 Do you see that?

17 A. That's correct.

18 Q. What is the confidence level for
19 detection of a target?

20 A. I have this explanation. I think I
21 mentioned this earlier. So let me...

22 Can you repeat your question? I just

1 want to make sure that I...

2 Q. What is the confidence level for
3 detection of a target?

4 A. In the current image?

5 Q. Yes.

6 A. So confidence is always and only from the
7 preceding image. So in other words, it's I have 10%
8 confidence based on the information that I have
9 from, or 90% confidence based on the preceding
10 image.

11 In other words, when we have video in the
12 camera of the drone, we have something that's called
13 always, when we're doing this type of processing,
14 backward differencing, when we have video streams.

15 So if somehow we're doing well and we
16 have the target locked, our confidence level is
17 going to be very high based on the information.

18 And then 37.e1 discloses if we're going
19 to keep -- if we have, let's say -- and I have these
20 diagrams, these demonstratives. For example, in
21 paragraph 66, Demonstrative 1, if I'm doing very
22 well, there is no -- I mean, I can decide if -- if

1 I'm using something that has a high computational
2 cost --

3 Let me go and -- at the specific...

4 So if you go to 66, let me summarize what
5 I'm saying here. The claim element 31.e [sic]
6 states "making a selection, from between the first
7 and the second neural networks, of only one of the
8 first and the second neural networks, based on the
9 confidence level for a detection of the target in
10 the current image."

11 In other words, the decision-making
12 process -- in other words, the meat of the claim is
13 if we want to be efficient, we need to select only
14 one neural network, either the first one or the
15 second one.

16 The selection of -- if we're going to use
17 the first or the second one is based on -- it's made
18 based on the confidence level that is determined for
19 the detection of a target in the current image.

20 The confidence level is not based on the
21 detection of the target in the current image.
22 Rather, the confidence level is obtained from the

1 detection of a target in the immediately preceding
2 image informs the confidence for a detection in the
3 current image, if the same -- this is resulting.

4 If the same processing scheme that were
5 used to process the immediately preceding image were
6 also going to use the process -- to process the
7 current image.

8 As such, the decision-making process is
9 not based on the current image. Rather, it is based
10 on the immediately preceding image.

11 In other words, if we are doing well,
12 then this informs -- the confidence in the
13 immediately preceding image, this informs what I'm
14 going to do, my confidence for the current image.

15 If I'm doing badly, this is going to
16 inform my confidence -- based on the preceding image
17 is going to inform my confidence in the current
18 image.

19 And then I'm saying that I'm using this
20 narrative, which is pretty standard for the ones --
21 in order to demonstrate, for example, how we process
22 video streams.

1 If I have a video stream that has four
2 frames, each one of them has a time stamp. The
3 current frame -- and as indicated by FC, is at t_0 .
4 The frame at $t-1$ is indicated as FP1, and then I
5 have slots that indicate $t-2$ and $t-3$.

6 If at $t-1$ I have the second neural
7 network with low robustness but high refresh rate,
8 what does it mean -- I indicate this with blue --
9 that it's running fast. For example, as the patent
10 discloses, it's the SqueezeNet.

11 So -- but the accuracy is not desirable.
12 I make a comparison with the threshold value low.
13 If this is smaller, then I'm going to switch to the
14 red one, which is the first neural network with high
15 robustness and a low refresh rate. This is, again,
16 the -- the demonstrative one.

17 If the confidence is not smaller, then I
18 keep going with high speed, because, again, what is
19 the objective? The objective is since my camera is
20 moving at very high speeds, I want to be able always
21 to look on the target.

22 If I'm doing well, I keep using that, but

1 if my confidence -- if things do not look promising,
2 based on what I'm computing at the preceding image,
3 immediately preceding image, I need to switch, and I
4 need to switch, for example, to a Tiny-YOLO as an
5 example in order basically to come back to the high
6 robustness and accuracy. And that's -- that's
7 basically what -- what is the objective of this
8 whole scheme.

9 And I use another demonstrative, also the
10 demonstrative -- the Demonstrative 2, which is
11 before paragraph 71, where I have actually a high
12 robustness, low refresh rate running at the -- the
13 immediately preceding frame, and I'm saying this
14 is -- this is low speed, high accuracy.

15 Now, if the confidence is higher than the
16 threshold height, then it will be waste of resources
17 to stick with this expensive -- computationally
18 expensive scheme.

19 So then, if yes, I'm showing the second
20 neural network, which has low robustness. It's
21 basically a tracker, like SqueezeNet, as disclosed
22 by the patent. Or if still the confidence is not

1 higher, then I keep using the red one.

2 Sorry for the longwinded, but I think
3 this -- these demonstratives hopefully clarify what
4 has been disclosed and what has been claimed.

5 Q. Does the specification say that a
6 confidence level of a preceding frame is indicative
7 of a confidence level for a current frame?

8 A. Yes.

9 Q. Where?

10 A. Let me find it. It is in my report. Let
11 me find the...

12 If you go -- go to the application -- go
13 to my paragraph 74. Tell me when you are there.

14 Q. Of your declaration?

15 A. Of my declaration, yeah.

16 Q. I'm there.

17 A. So if you look at the -- I'm saying: In
18 particular, the specification states: on a fixed
19 compute budget, there is a negative relation between
20 robustness of an algorithm and the cost or latency
21 of the algorithm per spacio-temporal frame.

22 This is the 109.

1 And also, there is paragraph 76. Give me
2 one minute.

3 If you go to paragraph 76, I'm saying:
4 Additional, the specification states: An example
5 aspect includes optimized video processing scheme
6 scheduling. In an example implementation,
7 processing schemes include localization algorithm
8 that process video frames of one or more video data
9 streams. The processing schemes produce a
10 prediction of objects within the video frame, as
11 well as a confidence number that is a measure of the
12 quality for that prediction. And I have italicized
13 the confidence number.

14 This is 141, I believe.

15 The specification also states, if we
16 combine multiple algorithms in a way that achieves
17 high combined frame rate with higher quality
18 prediction, the system improves outcomes on a
19 limited resource budget.

20 Q. It's your opinion that those portions in
21 paragraph 109 and 141 of the specification say that
22 a confidence level of a preceding frame is

1 indicative of a confidence level for a current
2 frame?

3 A. Yes, because also I say this in 77 as
4 well.

5 Q. When you say --

6 A. So --

7 Q. I'm sorry. Go ahead.

8 A. Let me -- let me -- I'm pretty sure that
9 I have -- either it's the last sentence or the one
10 before the end.

11 Can you go to paragraph 77.

12 Q. Yes.

13 A. And 78.

14 It says: the specification -- I'm after
15 "is achieved." The specification teaches that the
16 optimized schedule identifies the most suitable
17 algorithm on a per spacio-temporal frame basis, that
18 is, for each -- each frame/image in a video data
19 stream to be processed.

20 In particular, the specification states
21 that the processing schemes produce a prediction of
22 objects within the video frame, as well as a

1 confidence number that is a measure of quality for
2 that prediction, paragraph 141.

3 The '711 patent's teaching of prediction,
4 detection of the target, within the video frame, and
5 of providing the corresponding confidence level for
6 each frame inform that in each frame/image, a target
7 is detected and a corresponding confidence number is
8 obtained, which is then used to select the most
9 suitable processing scheme, that is, a neural
10 network, for the next frame/image to be processed.

11 And it continues on 79.

12 Q. Can you turn to paragraph 30 of your
13 declaration.

14 A. Give me one minute.

15 Yes, I'm there.

16 Q. In this paragraph, you state: At this
17 near stage, the challenge was how to enable an
18 interceptor to autonomously navigate toward the
19 target, which meant not being reliant in any way on
20 the ground station for the information required for
21 such autonomous navigation, whether for control,
22 guidance, et cetera.

1 Do you see that?

2 A. I see this, yeah.

3 Q. If a drone receives a command from a
4 remote station to go to a particular location, would
5 that be autonomous navigation?

6 A. No.

7 Q. If a drone received a set of waypoints
8 from a remote station for a flight path that the
9 drone flies on, would that be autonomous navigation?

10 A. No.

11 "Autonomous" comes -- it's a Greek word.
12 So "auto" means myself, and "nomous" is the law. So
13 I'm navigating myself based on my laws, on my
14 decisions.

15 MR. WALTERS: I'd like to take maybe
16 a 15-minute break. I may be done with my
17 questions.

18 THE COURT REPORTER: Off the record.

19 (Recess taken, 10:43 AM to
20 11:02 AM CDT)

21 THE COURT REPORTER: Back on the
22 record.

1 BY MR. WALTERS:

2 Q. Welcome back, Dr. Nikolaos.

3 If a drone receives a command from a
4 remote station to go to a particular location that
5 it flies to, would that be autonomous navigation?

6 A. Just receiving the command or moving?

7 Q. Both.

8 A. Just receiving the command, which you
9 asked me before, is not. If it moves with its own
10 means, yes, after receiving the command.

11 MR. WALTERS: I'll pass the witness.

12 MR. WADEKAR: Thank you, Mr. Walters.

13 Thank you, Dr. Nikolaos.

14 I just have a few questions.

15 -----

16 EXAMINATION

17 -----

18 BY MR. WADEKAR:

19 Q. But before I begin, you had mentioned
20 that you wanted to mention -- make an update to your
21 CV; is that correct?

22 A. Yes.

1 Q. What is that update?

2 A. That for the work in computer vision, I
3 became a fellow of the Academy of -- of the National
4 Academy of American Inventors, and the ceremony of
5 induction was a few weeks ago, again, for the work
6 in computer vision.

7 Q. Congratulations.

8 A. Thank you.

9 Q. So earlier, if you recall, just before
10 the break, we were discussing paragraph 30 of your
11 declaration.

12 Do you still have that in front of you?

13 A. Yeah, just let me...

14 Yes.

15 (Interruption by the court reporter.)

16 BY MR. WADEKAR:

17 Q. So would you mind just refreshing your
18 memory about paragraph 30 of your declaration?

19 A. Just give me a minute.

20 (Document review.)

21 A. Yes.

22 ///

1 BY MR. WADEKAR:

2 Q. Okay. So does autonomous navigation
3 happen only at the near stage?

4 A. No, it can happen -- it's -- it's very
5 useful if it happens at this near stage, but it can
6 happen at the approach phase as long as you use your
7 own resources in order to get closer.

8 For example, why is this useful? Let's
9 suppose you have loss of communication; you're going
10 to lose your drone, basically.

11 Q. Okay. Now, earlier, do you recall the
12 discussion about equations 7 and 8 of the '711
13 patent?

14 A. Yeah, let me go there. Just -- may I go
15 there?

16 Q. Yeah. I was going to say that, but
17 before you go there, let's look at the Revised
18 Motion to Amend appendix.

19 Do you still have that?

20 A. Just a minute. Yes.

21 Q. And let's look at claim element 21.d in
22 particular.

1 A. 21.b?

2 Q. 21.d, as in David.

3 So starting in -- feel free to read the
4 claim element, but I want you to focus on the
5 wherein clause, where it says: wherein performing
6 the flight control operation includes determining a
7 first speed adjustment factor based on a magnitude
8 of deviation of -- and then it just describes what
9 the magnitude of deviation is.

10 Are you familiar with this limitation?

11 A. Yes.

12 Q. Okay.

13 A. Give me a minute to...

14 Q. Okay.

15 (Document review.)

16 A. Yes.

17 BY MR. WADEKAR:

18 Q. Okay. So now if we go to equations 7 and
19 8.

20 A. Can you remind me the figure?

21 Q. Give me one second. I have to look it up
22 myself.

1 A. I think it's Figure 10.

2 Q. Your memory is better than mine, and yes,
3 it is Figure 10.

4 A. Okay.

5 Q. Okay. So when you were discussing these
6 figures, you mentioned that the difference between 7
7 and 8 is the direction.

8 Do you recall that?

9 A. Yeah.

10 Q. So is this direction related to the
11 deviation? Is that -- is there a relationship?

12 A. Let me explain what I mean by this.

13 So we discuss the near situation, okay?
14 So the interceptor drone with a camera has locked on
15 the target. These are two moving -- very
16 fast-moving targets. It's a highly nonlinear
17 system, and the only link is the camera.

18 So imagine my frame, I'm the interceptor
19 drone, and my frame is basically, what? It has
20 pixels along X and Y. The drone -- let's suppose
21 it's on -- it's not dead center; it's actually off
22 the center, so it's to my left of the center.

1 So what I'm saying, I may need -- based
2 on this deviation, which is actually the speed
3 adjustment factor you mentioned, based on the
4 deviation angle, it means I need to move along X in
5 order, basically, to bring it back to the center.
6 So -- and it can happen left and right, up or down.

7 Again, this is from the frame associated
8 with the image sensor which is mounted on the
9 interceptor. And this is extremely important -- and
10 this is the innovation of this patent.

11 Q. So left and right is X-axis?

12 A. Yeah.

13 Q. And up and down is Y-axis in this
14 scenario?

15 A. Yeah.

16 MR. WADEKAR: All right. So I have
17 no further questions. I would like to pass
18 the witness.

19 MR. WALTERS: I don't have any
20 additional questions, so this will end the
21 deposition.

22 THE COURT REPORTER: We're off the

1 record.

2 (Time noted: 11:10 AM CDT)

3 (Review and Signature by the witness
4 was reserved.)

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C E R T I F I C A T E

I, MICHAEL E. MILLER, FAPR, RDR, CRR, Notary
Public, do hereby certify:

That NIKOLAOS P. PAPANIKOLOPOULOS, PhD, the
witness whose deposition is hereinbefore set forth,
was duly sworn by me and that such deposition is a
true record of the testimony given by such witness.

I further certify that the adverse party
was represented by counsel at the deposition.

I further certify that the deposition of
NIKOLAOS PAPANIKOLOPOULOS occurred remotely via
Zoom videoconference on Wednesday, July 8, 2026,
commencing at 8:32 a.m. to 11:10 a.m.

I further certify that I am not related
to any of the parties to this action by blood or
marriage, I am not employed by or an attorney to
any of the parties to this action, and that I am
in no way interested, financially or otherwise, in
the outcome of this matter.

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1 I HEREBY CERTIFY that I have read this
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4 me, with the changes or corrections, if any, as
5 noted.

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1 ERRATA SHEET FOR THE TRANSCRIPT OF:

2 CASE NAME: IPR2025-00629

3 DEP DATE: July 8, 2026

4 DEPONENT: NIKOLAOS P. PAPANIKOLOPOULOS, PhD

5 Pg. Ln. Now Reads Should Read Reason

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Re: Deposition of **Nikolaos Papanikolopoulos, Ph.D.**

Date: 7/8/2026

Case: Axon Enterprise, Inc., et al. -v- Airspace Defense, Inc. (PTAB)

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Page	Line	Correction/Change and Reason
28	10	"22" s/b "24" (transcription error)
45	22	"tiny," s/b "tiny" (transcription error)
46	1	"and then YOLO" s/b "YOLO" (transcription error)
51	6	"28 column" s/b "column 28" (transcription error)
51	7	"5 to 8" s/b "rows 5 to 8" (transcription error)
51	7	"28, 40 to 29.3" s/b "column 28, row 40 to column 29, row 3" (transcription error)
56	21	"66" s/b "67" (transcription error)
60	16	"threshold height" s/b "threshold H" (transcription error)
8	10	"review" s/b "reviewed" (transcription error)
8	19	"hardcopy" s/b "a hardcopy" (transcription error)
17	12	"threshold of a range" s/b "threshold and the range" (transcription error)
19	9	"are" s/b "is" (transcription error)
28	21	"this" s/b "this is" (transcription error)
34	16	"U distance" s/b "UD distance" (transcription error)
35	7	"direction in" s/b "direction from" (transcription error)
36	20	"kinematical" s/b "kinematic" (transcription error)
37	2	"tells" s/b "tell" (transcription error)
43	2	"99" s/b "99%" (transcription error)
44	14	"thing" s/b "things" (transcription error)
46	7	"a construction" s/b "contrary" (transcription error)
52	10	"are big words" s/b "words" (transcription error)

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60	21	"look" s/b "lock" (transcription error)
62	4	"Additional" s/b "Additionally" (transcription error)
67	4	"American Inventors" s/b "Inventors" (transcription error)

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ACKNOWLEDGMENT OF DEPONENT

I, Nikolaos Papanikolopoulos, Ph.D., do hereby acknowledge that I have read and examined the foregoing testimony, and the same is a true, correct and complete transcription of the testimony given by me and any corrections appear on the attached Errata sheet signed by me.

7/10/2026

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