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UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

PETROLEUM GEO-SERVICES INC. : Cases
and ION GEOPHYSICAL CORPORATION : IPR2014-00687
AND ION INTERNATIONAL S.A.R.L., : (U.S. Patent No. 7,162,967)
Petitioners,: IPR2014-00688
v. : (U.S. Patent No. 7,080,607)
WESTERNGECO, LLC, : IPR2014-00689
Patent Owner.: (U.S. Patent No. 7,293,520)

Volume 2
Deposition of MICHAEL S. TRIANTAFYLLOU, Sc.D
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Deposition of MICHAEL S. TRIANTAFYLLOU, Sc.D, held at the offices of:

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Pursuant to Notice, before Leslie Anne Todd, Court Reporter and Notary Public in and for the Commonwealth of Virginia, who officiated in administering the oath to the witness.

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PROCEEDINGS

MICHAEL S. TRIANTAFYLLOU, Sc.D,
having been previously duly sworn, was
examined and testified as follows:

FURTHER EXAMINATION BY COUNSEL FOR PETITIONER
BY MR. BERL:

Q Good morning, Doctor.

A Good morning.

Q We were discussing yesterday your declaration, paragraph 137, the uses of Kalman filters. If you could turn back to that.

A You are talking about my declaration?

Q Yes. Paragraph 137. It should be on the top.

A Oh, yes.

Q Paragraph 137. Do you recall yesterday at the end of the day we discussed A, B and C in paragraph 137 where you say: "Kalman filters can be used either A, B or C"?

A Yes.

Q And C and B use behavior prediction; is that right?

A B and C use a model to predict.

Q A behavior predictive model?

A Yes. To be successful.

Q And A does not.

A A, may not. So it can be ad hoc.

Q A, you said is a noise filter?

A Yes.

Q And by filtering noise, the Kalman filter provides an estimate of the variable in question, for example, location?

A It provides an estimate. It can be location or it can be something, whatever.

Q Whatever the variable is, it provides an estimate of the actual location.

A The estimate of -- an estimate.

Q The estimate of the actual location if the Kalman filter is working on locations.

A Yes. In the generalized sense of estimate.

Q Now, how does one term whether the Kalman filter is being used for A, B or C?

A The major distinguishing feature is the model that is used for the Kalman filter. So in a model-based prediction, you are using a model which has been based on some physical laws, whether simple or complicated. That's how you derive the Kalman filter structure.

In the case of the filter, it -- it still can be a model-based, just to clean the noise. Or it may be something that you concoct just to remove the noise.

Q So the model in B and C is taking account in this context of SPD locations for physical forces that act upon the SPDs.

A It can be a variety of things. So, it depends on the sophistication of the user.

Q But in order for it to be a model that is based on physical laws, it would account for physical forces on the SPD locations.

A It doesn't necessarily have to be forces. Because, for example, there can be implicit assumptions like the force is constant. Okay. So it can have a much more broader interpretation what the

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model is. Okay.

Q And you're now distinguishing a model from a behavior predictive model.

A No. It always -- always models will be models; they will be approximations.

Q What is the difference between a model and a behavior predictive model?

A A behavior-based model -- let's leave outside the word "prediction" which can be the subsequent step. But a model based on behavior is you use some laws, whether it's physical or chemical or whatever laws, to derive at whatever the model. That model can be simple or it can be very complicated. It depends on what you approximate. So there is no cut and dry to say the model has to be so sophisticated or less sophisticated. There will always be an approximation.

Q It depends in part on the complexity of the system that is being modeled.

A Exactly.

Q And if the Kalman filter is being used as a filter to remove noise, I take it that the output

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of the Kalman filter is in the same unit of measurement as the inputs. In other words, if -- now, let's use the example of predicting -- or of using a Kalman filter for SPD locations. If filtering is going on, then the Kalman filter would output an estimate of the SPD locations based on the input of the measurements of SPD locations, right?

A It depends. That's -- what you are saying in the pure filtering sense, yes, that's -- that's what you may mean for it -- usually that's what you will mean for filter, that you put certain units in and you get certain units out, but it can be different too. It all depends on what -- to the degree that you are using a model and to the degree to which you are using a filter.

Q And if you are using a model, then the units can change.

A Yes. You can go from forces to displacements. But also you can use -- they can be in the same units too because someone may model motion of a location of the streamer and get motion in another point.

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So the modeling part allows you a very wide latitude of what to do.

Q If you use a Kalman filter with a model, then you can have the output as either the same units or different units than the inputs.

A You may. Depending on the model you're using.

Q But we're -- well, let's turn to Workman again. I think -- it's right there marked as 1004, next to you -- no, right there.

You know that Workman discloses the use of a Kalman filter, correct?

A Correct.

Q Let's go to that area of Workman. It's in column 3. And it's also, if you would like to look at Figure 2, obviously you are free to do that. That shows what the numbers mean graphically.

It says: "The network solution system, 10, implements a Kalman filter solution" --

A Okay, let me get there. Where are you?

Q Oh, sorry. Line 46.

A Line 46. "Typically."

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Q Yes. It says: "Typically the network solution system, 10, implements a Kalman filter solution on the signals it receives from the vessel positioning system, 20, and location sensing devices, 15."

Do you see that?

A Yes.

Q So that explains when a Kalman filter is used in Workman, right?

A Yes.

Q Okay. And it explains which signals or measurements go into the Workman Kalman filter, right?

A Yes.

Q And the inputs into the network solution system are the locations and the vessel positioning system, correct?

A That's what it says. From the vessel positioning system, the signals it receives from the vessel positioning system and location sensing devices.

Q And the vessel positioning system, among

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other information, can provide the velocity of the system, correct?

A Where do you see that?

Q Well, no, I'm just asking you. The vessel positioning system can provide information about the velocity, correct?

A I have to -- to remember whether that's part of the system or not.

Q Well --

A Are you saying you can derive it from the position, the velocity?

Q The vessel positioning system information can be used to obtain information about the velocity of the vessel, correct?

A The velocity -- you are talking about the vessel itself, the ship.

Q Yes.

A So some sensing device that can provide the ship. So if the ship has a sensing, you can sense its velocity, yes.

Q And the streamers are towed by -- or attached to the ship, correct?

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A Yes.

Q And the location measurements that are the inputs into the Kalman filter in the sentence we just read, column 3, lines 36 through 48, are not described as realtime location measurements, correct?

A Can you specify what you mean by "realtime location measurements"?

Q Well, it doesn't identify the measurements in the sentence we just read about the inputs into the Kalman filter as realtime measurements, right?

A Realtime versus something that was done a year ago?

Q Something that's not realtime.

A Well, if they were measured sometime earlier, yes. But it doesn't -- it doesn't say anything about the history of such signals, if that's what you are asking.

Q No, what I'm asking is, it does not identify the signals that are the inputs into the Kalman filter as realtime measurements, right? That phrase is not used in the sentence we just read in

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column 3.

A It will use the latest signals it has. That's the interpretation here when you say "the position."

Q But those signals are not identified as realtime in that sentence, correct?

A They must be realtime. I mean it's a system that works realtime.

Q Well, does that sentence, column 3, lines 46 through 48, identify the signals being received from the location sensing devices as realtime signals?

MR. KIKLIS: Objection. Asked and answered.

THE WITNESS: In the absence of a device that will store them, we have to assume that, yes, they are realtime.

BY MR. BERL:

Q It doesn't say that they are realtime, does it?

A It does not specify whether they would be stored, so in the absence of storing, the signals

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can't stay in thin air. It would have to have a separate system to somehow store them if they are not realtime.

Q Now, let's maybe look at column 2. That can perhaps help us. If we look at the paragraph that begins on line 10 of column 2. Do you see that it says: "Location sensing devices and methods for determining the positions of the seismic sources and seismic streamer cables are also well known in the art"?

Do you see that?

A I see that.

Q And you agree with that?

A It depends on what location sensing devices and methods for determining means, whether these were to locate the -- they were used for locating the hydrophones for the purposes of knowing where the streamers were. Specifically location sensing devices, I wouldn't say that it was something that was practiced or established in the -- in the art because there was no such system working at the time.

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