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

TESLA, INC.,
Petitioner

v.

iQAR INC.,
Patent Owner

U.S. Patent No. 8,972,161

Case No. IPR2024-00545

PATENT OWNER'S HEARING DEMONSTRATIVES

May 8, 2025

The ‘161 Patent Identified a Problem With the Prior Art

> Currently, drivers of automotive vehicles have only very imprecise methods for managing the fuel consumption of their cars. For example, drivers can slow down, they can brake lightly, and they can carry lighter loads. Generally, however, fuel consumption cannot be precisely controlled by the driver. More accurate and precise control of fuel consumption is one of the best ways to improve the energy efficiency of most cars. In particular, accurate control of fuel consumption may optimize the energy efficiency of a car.

Ex. 1001, ‘161 Patent at 1:16-24
(see also Paper 11, Response at 2-3)

The '161 Patent's Inventive Solution

For example, the power management logic may be used by a motor control mechanism to control the application of power to the vehicle engine as the vehicle travels along a route (either a predetermined or a non-predetermined route). The applied power may also be expressed as an optimized speed or speeds to which the vehicle is controlled. For example, the

The step of calculating an applied power may include determining a route, segmenting the route into one or more segment (or intermediate) destinations, calculating an energy efficient speed for the vehicle to travel to the segment destination, determining an optimized speed for the vehicle to travel to the segment destination, and calculating the applied power from the optimized speed for all of the segments. The

Ex. 1001, '161 Patent at 2:34-39, 5:8-14
(see also Paper 11, Response at 3)

The ‘161 Patent’s Inventive Solution

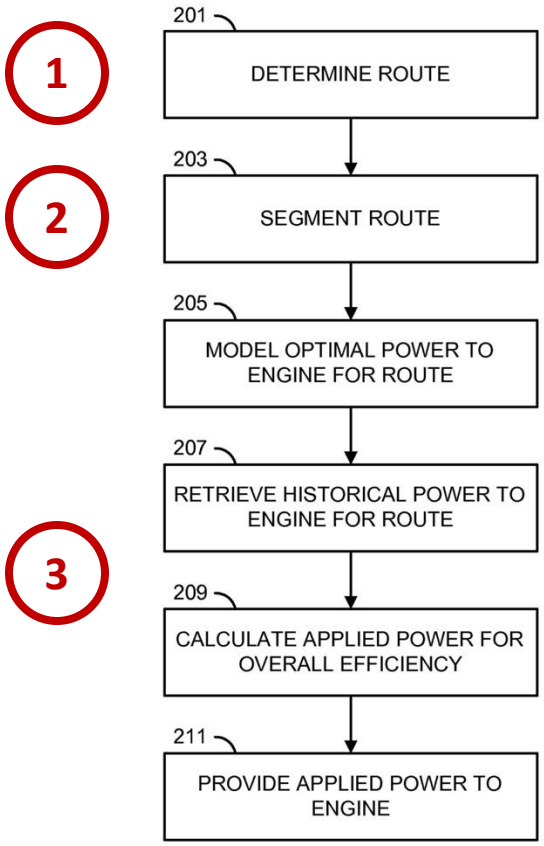


FIG. 2

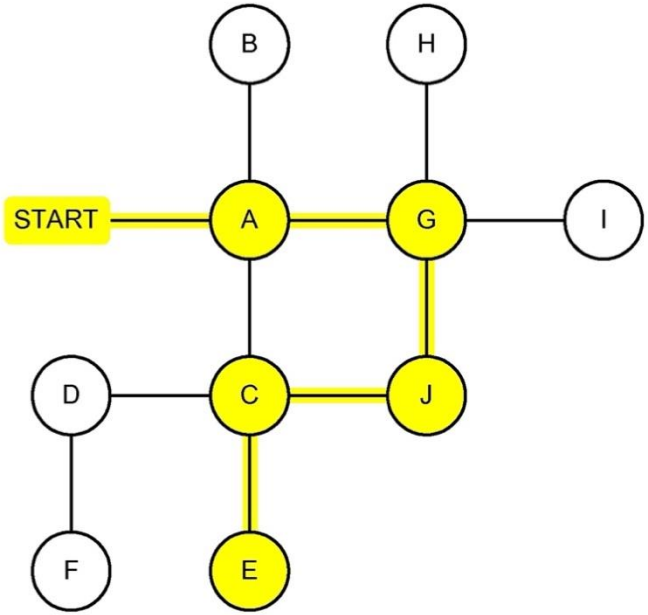


FIG. 3A

Ex. 1001, ‘161 Patent at Figs. 2, 3A
(see also Paper 11, Response at 3-4, 14, 20)

The '161 Patent – Claim 1

1. A method of managing a power consumption of a vehicle, comprising the steps of:

(a) receiving a route at a computer of said vehicle;

(b) segmenting said route into a plurality of segment destinations;

(c) calculating a plurality of energy values consumed by said vehicle to travel said route based on a plurality of variations in a target speed of said vehicle between pairs of said segment destinations;

(d) determining a plurality of efficient speeds that achieve a best summation of said energy values; and

(e) notifying an operator of said vehicle about said efficient speeds to travel between each of said segment destinations.

Ex. 1001, '161 Patent at Claim 1

The Petition's Grounds

Ground	Basis
Ground 1A	Claims 1-3, 5-6, 8-15, 17-18 purportedly obvious over ***Neiss***
Ground 1B	Claim 4 purportedly obvious over Neiss, Hirasago
Ground 2	Claims 1, 3, 6-10, 12-13, 15-18 purportedly obvious over ***Schramm, Clapper***

Paper 2, Petition at 1

The Prior Art Fails to Teach What the Claims Require

- ✗ Neiss performs the claimed steps out of order
- ✗ Neiss's prediction horizon is not a ***"route"*** and includes no ***"segment destinations"***
- ✗ Schramm and Clapper fail to teach ***"determining a plurality of efficient speeds that achieve a best summation of energy values"***

Claim 1 Requires That the "Route" Be "Receiv[ed]" First

A method claim "requires an ordering of steps when the claim language, as a matter of logic or grammar, requires that the steps be performed in the order written, or the specification directly or implicitly requires" such an ordering.

Information Techs. v. Research in Motion Ltd., 764 F.3d 1392, 1398-99 (Fed. Cir. 2014) (see also Paper 11, Response at 12)

Claim 1 Requires That the "Route" Be "Receiv[ed]" First

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(b) segmenting said route into a plurality of segment destinations;

(c) calculating a plurality of energy values consumed by said vehicle to travel said route based on a plurality of variations in a target speed of said vehicle between pairs of said segment destinations;

(d) determining a plurality of efficient speeds that achieve a best summation of said energy values; and

(e) notifying an operator of said vehicle about said efficient speeds to travel between each of said segment destinations.

Ex. 1001, '161 Patent at Claim 1
(see also Paper 11, Response at 12)

The Petition Repeatedly Explains that Already *Existing* Routes Are Segmented

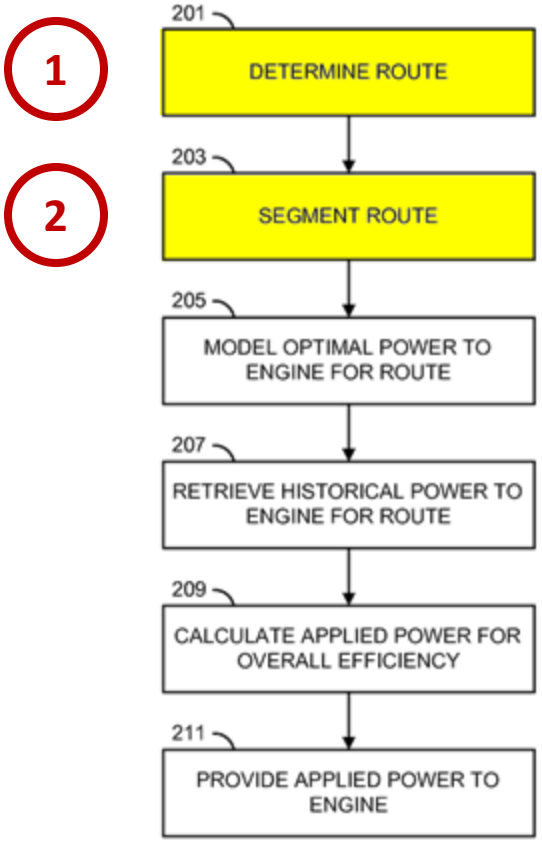


FIG. 2

Ex. 1001, '161 patent, Fig. 2
(see also Paper 11, Response at 14)

The Petition Repeatedly Explains that Already *Existing* Routes Are Segmented

the initial and the final positions. In some variations, the route may be broken up into segments that may be used by a power management device to optimize the power needed to travel this segment. A segment may comprise any distance to be

The route may be segmented in any appropriate manner. For example, the route may be broken into segments based on predetermined or anticipated changes in speed (e.g., switching from 65 to 55 mph), changing traffic patterns (e.g., turns, stops, yields, etc.), traffic or anticipated traffic, distance (e.g., x miles), terrain (e.g., the gradient or condition of a road), or the like. In some variations, the route may be segmented

In some variations, the entire route (or the entire predicted route) may be divided up into N segments. The number (N) of segments may be fixed or may depend upon the route. The more segments that the route is split into, the more accurate the model may be. However, more segments may also require

In this example, the route may be split into five segments of 5 kin each with the following altitudes measured at the end of

Ex. 1001, '161 patent, 13:44-47, 13:51-57, 14:5-12, 14:65-67
(see also Paper 11, Response at 14-15)

Petitioner Identifies Neiss's "Prediction Horizon" as a "Route" and the End of Its Frames as "Segment Destinations"

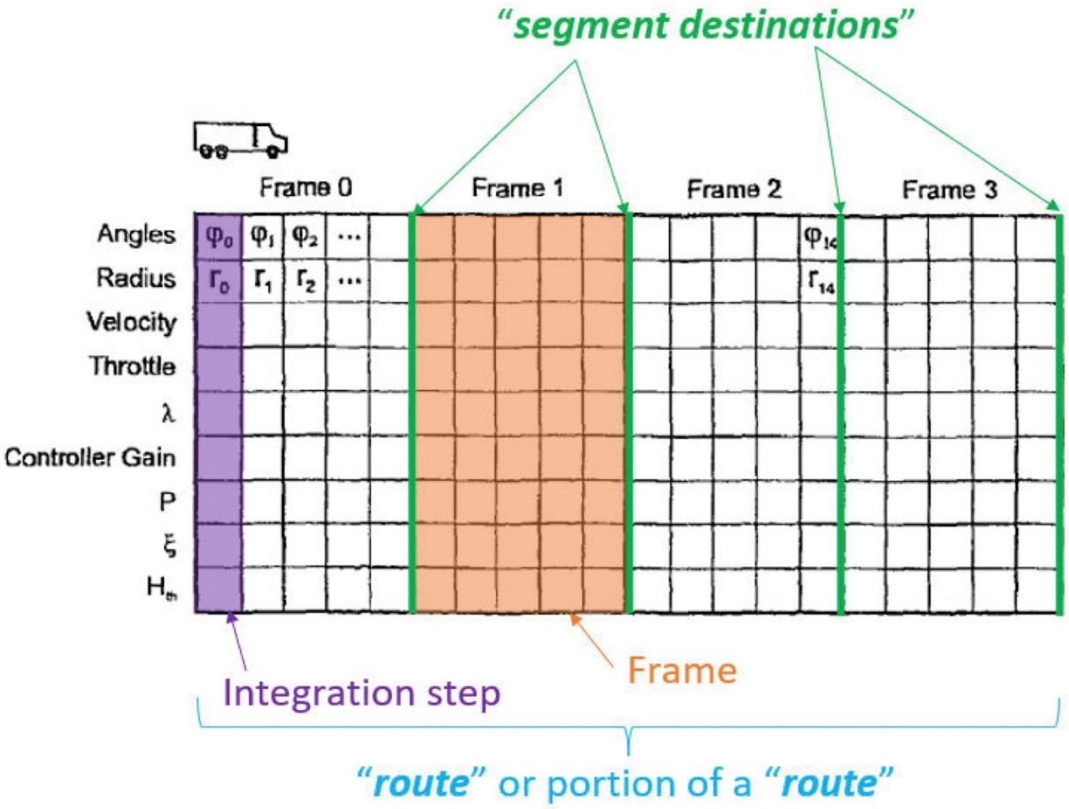


Fig. 12a

Paper 2, Petition at 21

The "Prediction Horizon" Is Nothing More than a Parameter That Determines How Much Data Neiss Stores in its Ring Buffer

[0162] For an area around the current vehicle positioned ("Prediction Horizon"), the optimal velocity, throttle pedal positions, and controller gain series are stored in a look-up table (which is contained in a ring buffer memory, as discussed hereinafter). The resolution of this look-up table is

[0192] In the example of **FIGS. 12 and 13**, the parameters Prediction Horizon and Number of Frames are chosen very small in order to make the basic operation of the ring buffer clear. Realistic values for the Prediction Horizon would be 4000 assuming an Integration Step Size of 1 m, and 200 for the Number of Frames. Thus, nearly 200 optimization itera-

Ex. 1005, Neiss, ¶¶ [0162], [0192]
(see also Paper 11, Response at 16)

Neiss Begins by Initializing Its Prediction Horizon / Ring Buffer

[0178] The initialization of the ring buffer (**FIG. 12***a-c*) must be completed before the vehicle reaches the start point on the road where the PCC system is triggered. Two stages of the initialization can be distinguished:

[0179] 1. First, the ring buffer memory is filled with angle and radius values from cell zero up to the last cell of the next to last frame. (**FIG. 12***a*.) (For example, the value ϕ_k is the grade of the road at the position specified by the driven distance since the start point $S_k = k \cdot h$ (where again h is the Integration Step Size), as read from the road map (**FIG. 6**) . While filling these ring buffer cells, also starting values are estimated for the velocity trajectory, and the appropriate throttle pedal positions are computed, as illustrated in **FIG. 12***b*.

[0180] 2 In the second step several optimization iterations are applied on the memory range described above until the algorithm has converged and thus the values are optimal, as shown in **FIG. 12***c*.

Ex. 1005, Neiss, ¶¶ [0178]-[0180]
(see also Paper 11, Response at 16)

Neiss's "Segment Destinations" Come *Before* its "Route"

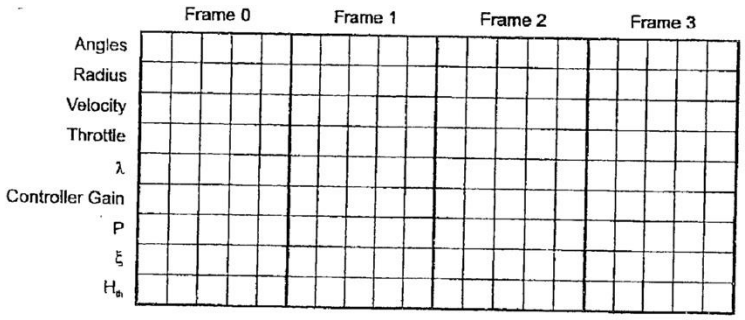


Fig 11

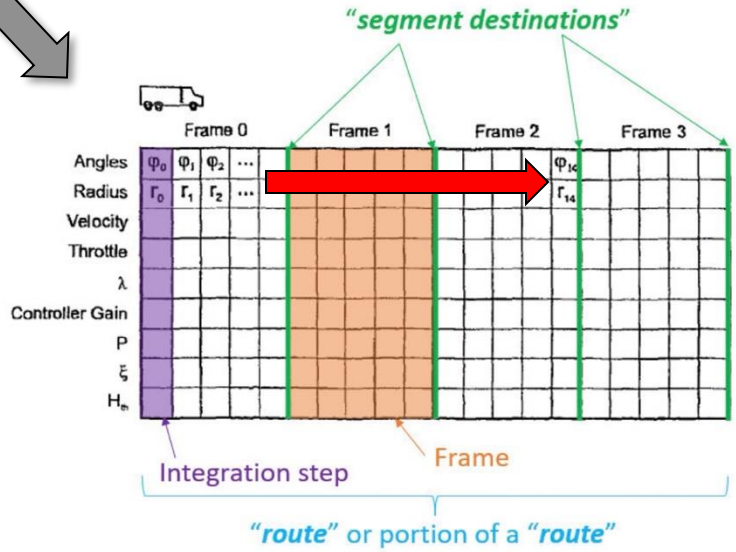


Fig. 12a

Ex. 1005, Neiss, Figs. 11, 12a
(see also Paper 11, Response at 16-17)

The Prior Art Fails to Teach What the Claims Require

- ✗ Neiss performs the claimed steps out of order
- ✗ Neiss's prediction horizon is not a ***"route"*** and includes no ***"segment destinations"***
- ✗ Schramm and Clapper fail to teach ***"determining a plurality of efficient speeds that achieve a best summation of energy values"***

Claim 1 Requires Both a *"Route"* and *"Segment Destinations"*

1. A method of managing a power consumption of a vehicle, comprising the steps of:

(a) receiving a route at a computer of said vehicle;

(b) segmenting said route into a plurality of segment destinations;

(c) calculating a plurality of energy values consumed by said vehicle to travel said route based on a plurality of variations in a target speed of said vehicle between pairs of said segment destinations;

(d) determining a plurality of efficient speeds that achieve a best summation of said energy values; and

(e) notifying an operator of said vehicle about said efficient speeds to travel between each of said segment destinations.

Ex. 1001, '161 Patent at Claim 1
(see also Paper 11, Response at 20-21)

The ’161 Patent Repeatedly Emphasizes that a “Route” Is the Path to a Vehicle’s ***Destination***

mized. Such calculations of power requirements at different speeds typically use information inputs from the vehicle, the user, and the environment over the route from the initial position to a destination (e.g., a final destination or an intermediate destination). Any appropriate information input may

travels at a fuel-efficient speed. To determine an optimally efficient speed for the optimal power to be supplied to the engine), a route is determined **201** from the starting position and an actual or estimated ending position, the route is segmented **203** into one or more segments, a model optimal

Ex. 1001, ‘161 Patent at 14:19-22, 11:13-17
(see also Paper 11, Response at 18-20)

The ’161 Patent Repeatedly Emphasizes that a “Route” Is the Path to a Vehicle’s ***Destination***

1. Determine Route

The route is determined based on the current position of the vehicle and a final destination position. The destination posi-

the distances traveled. The power management system also includes or deduces information about the route (e.g., from point A to point B), and the acceptable range of speeds that the

Thus, over an entire route, the most energy efficient speed at which to drive may be continuously calculated. This may be done by determining a destination, and then coming up with a route for that destination. If the destination is not known

Ex. 1001, ‘161 Patent at 11:30-32, 6:54-56, 5:18-21
(see also Paper 11, Response at 18-20)

The '161 Patent Repeatedly Emphasizes that a "Route" Is the Path to a Vehicle's *Destination*

> The route used by the power management device typically includes a starting position (e.g., the current position of the vehicle, which may be indicated by GPS), an ending position, as described above, and any intermediate positions between the initial and the final positions. In some variations, the route

> 1. Determine Route
> The route is determined based on the current position of the vehicle and a final destination position. The destination posi-

> status information. For example, the destination (either a final or an intermediate destination) may be estimated based on the current location of the vehicle, the direction that the vehicle is traveling, the time of day and/or the driver of the vehicle (e.g., if it's 8:00 am, and driver X is driving the car on interstate 280, then the final destination is most likely to the address of X's work place).

Ex. 1001, '161 Patent at 13:40-44, 11:30-44, 9:33-38
(see also Paper 11, Response at 20)

Neiss's Prediction Horizon Is Just the Road Ahead

[0048] Optimization Algorithm Module **27**: This is the main module, in which optimal velocity trajectory, the optimal throttle pedal positions, and the controller gains are calculated for the approaching road within the Prediction Horizon, based on opti-

[0162] For an area around the current vehicle positioned ("Prediction Horizon"), the optimal velocity, throttle pedal positions, and controller gain series are stored in a look-up table (which is contained in a ring buffer memory, as discussed hereinafter). The resolution of this look-up table is thereby the Integration Step Size h. (The optimal velocity is considered to be constant for small distances h.) The output values of the PCC system are then determined by reading out the values corresponding to the estimated vehicle position.

Ex. 1005, Neiss, ¶¶ [0048], [0162]
(see also Paper 11, Response at 22)

Neiss Recognizes that the Vehicle May Not Follow that Road

[0163] The look-up table values are calculated online, in real time as the vehicle proceeds along the traveled route. Such online, real time calculation adapts the look-up table during the drive by taking the current vehicle velocity into account. The advantages of such a system (compared to an offline version in which the stored values are determined in advance and are invariable) are:

[0164] Less memory is needed.

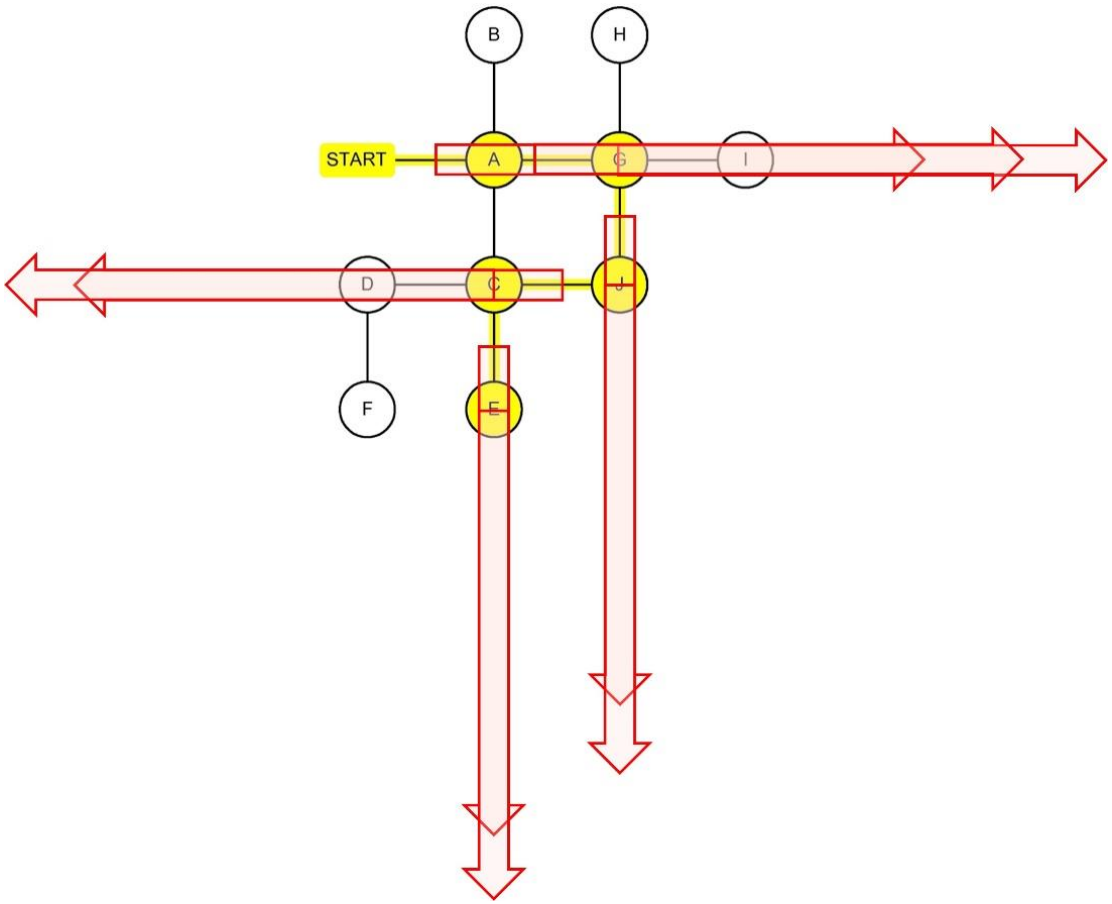
[0165] An online determination gives the opportunity to change the route while driving.

• • •

[0169] It is therefore important to implement the optimization algorithm in a manner which permits online adaptation of the look-up table. While the optimization calculation

Ex. 1005, Neiss, ¶¶ [0163]-[0169]
(see also Paper 11, Response at 22-23)

Neiss's Prediction Horizon is Not a "Route" and Does Not Include "Segment Destinations"



Ex. 2003, Hoff Decl., ¶¶ 152-158
(see also Paper 11, Response at 24)

It *Would Not* Have Been Obvious to Modify Neiss to Use an Entire Route as the Prediction Horizon

- Neiss purposefully does not perform calculations for an entire route
- Neiss employs a short Prediction Horizon to allow its system to adapt when conditions change
- Neiss explains that its system is designed to limit the computational burden

Paper 11, Response at 26-30

Neiss Notes that Performance of Calculations for an Entire Route is *Problematic*

[0007] One disadvantage to the known prior art systems, such as the '472 patent, is that they require at least one "record drive" to be performed prior to operation of the system. This in turn requires that every route in the road network contained within a potential operating area of the vehicle must first be transited by an expert driver. Furthermore, control of the vehicle throttle based on such historical driver generated information is only as good as the "expert driver" who first traveled the route, establishing the historical profile to control throttle position. To the extent that such driver deviates from the actual optimum operating parameters during the initial "record drive" subsequent vehicles traveling the same route will deviate from the optimum in a corresponding manner.

[0008] In addition, unforeseeable driving situations which occurred during driving with automatic throttle control are not considered in the recorded historical throttle profile. Such a situation might arise, for example, where the driver manually overrules the cruise control system (for example, by applying the vehicle brakes) when the vehicle approaches a slower vehicle ahead, or when the cruise control is overruled by another driving system, such as an adaptive cruise control system with distance control. In such situations, it is necessary to adjust the subsequent driving parameters according to a profile which differs from an historical profile in order yet to achieve optimum vehicle operation. However, the prior art systems, such as the '472 patent contain no provision for reconfiguring the system to return to the record/preselected throttle control profile, since the recorded control values are not modified, and do not themselves adapt to changing driving situations in this manner.

Ex. 1005, Neiss, ¶¶ [0007]-[0008]
(see also Paper 11, Response at 27)

Neiss's System Is *Purposefully* Designed to Be Adaptable, Does Not Calculate in Advance, and Limits Calculations

[0163] The look-up table values are calculated online, in real time as the vehicle proceeds along the traveled route. Such online, real time calculation adapts the look-up table during the drive by taking the current vehicle velocity into account. The advantages of such a system (compared to an offline version in which the stored values are determined in advance and are invariable) are:

[0164] Less memory is needed.

[0165] An online determination gives the opportunity to change the route while driving.

[0166] There is no need for a previous "record drive" by an expert driver, and the system can be used on any route, the first time it is traveled.

[0167] When vehicle velocity drifts significantly from the velocity stored in the look-up table for the current position (as might be caused, for example, by a slower vehicle driving ahead), the velocity values for the following positions in the look-up table then can no longer be considered to be optimal. In this case an online version of the algorithm can adapt these values by taking the current velocity into account.

[0168] An on-line version has the advantage of being able to adapt the optimal trajectories to variable vehicle parameters, such as vehicle mass, which has a significant impact on the dynamics of the vehicle.

[0169] It is therefore important to implement the optimization algorithm in a manner which permits online adaptation of the look-up table. While the optimization calculation could be performed for every computational cycle given enough computing power, this approach was not used in the current implementation. Rather, a new optimization calculation only occurs once the vehicle has covered a specified distance, which is referred to hereinafter as a "frame", or when the set speed is changed. In addition, the calculation is distributed over several computational cycles to reduce the computational burden.

Ex. 1005, Neiss, ¶¶ [0163]-[0169]
(see also Paper 11, Response at 22-23)

The Prior Art Fails to Teach What the Claims Require

- ✗ Neiss performs the claimed steps out of order
- ✗ Neiss's prediction horizon is not a ***"route"*** and includes no ***"segment destinations"***
- ✗ Schramm and Clapper fail to teach ***"determining a plurality of efficient speeds that achieve a best summation of energy values"***

Claim 1 Requires "Determining a Plurality of Efficient Speeds"

1. A method of managing a power consumption of a vehicle, comprising the steps of:

(a) receiving a route at a computer of said vehicle;

(b) segmenting said route into a plurality of segment destinations;

(c) calculating a plurality of energy values consumed by said vehicle to travel said route based on a plurality of variations in a target speed of said vehicle between pairs of said segment destinations;

(d) determining a plurality of efficient speeds that achieve a best summation of said energy values; and

(e) notifying an operator of said vehicle about said efficient speeds to travel between each of said segment destinations.

Ex. 1001, '161 Patent at Claim 1
(see also Paper 11, Response at 12)

Schramm Makes No Speed Determinations

Next, at block **54** of FIG. **2**, the logic receives the desired average speed at which the operator intends to drive vehicle to the destination point "B". If desired, the operator may indicate a desire to select, as a default, the current speed of the vehicle **12**. Accordingly, the computer **14** would access the speedometer of the vehicle **12** to set the default speed at block **54**.

Ex. 1009, Schramm at 5:14-20
(see also Paper 11, Response at 31)

Clapper's Speeds Are Not *"Determined … Efficient Speeds"*

> A memory **28** coupled to a controller **22** may provide information about speeds used at given locations in the past. For example, a given driver may drive the same route to work repeatedly. Based on prior history and detected current position, the automatic cruise control **20** may set the vehicle's speed based on the speed that the driver used previously at the same location. This may reduce the amount of

> If no match is found in the user's own database of prior speeds, the current location may be compared to a speed limit database (block **44**). The database may provide information about speed limits on existing roads and highways correlated to their GPS coordinates. In such case, the speed

Ex. 1006, Clapper at 1:50-56, 3:13-17
(see also Paper 11, Response at 32)