

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DIGITAL GLOBAL SYSTEMS, INC.,
Petitioner,

v.

DEEPSIG INC.,
Patent Owner.

Case IPR2025-00049
U.S. Patent No. 10,581,469

PATENT OWNER'S PRELIMINARY RESPONSE

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Pursuant to 37 C.F.R. § 42.107, Patent Owner DeepSig Inc. (“DeepSig” or “Patent Owner”) files this preliminary response to the Petition, setting forth reasons why the Petition for *inter partes* review (“IPR”) of claims 1-8, 10, 12-15, and 17-24 of U.S. Patent No. 10,581,469 (the “’469 Patent”), as requested by petitioner Digital Global Systems, Inc. (“DGS” or “Petitioner”), should be denied.¹

I. INTRODUCTION

The ’469 Patent is entitled, “Machine Learning-Based Nonlinear Pre-Distortion System.” The ’469 Patent describes methods, systems, and apparatuses “for correcting distortion of radio signals.” ’469 Pat., Abstract. In particular, the ’469 Patent disclosure “relates to integrating nonlinear pre-distortion machine learning into radio communication systems to correct for radio signal distortion and interference.” *Id.*, 1:15-17.

Notably, the ’469 Patent corrects for distortion in various actual components of a radio signal processing system and the actual communication channel, and does not simply correct for the distortion that arises in a single component, such as a transmitter. To achieve this, the ’469 Patent discloses a technique of comparing transmitted and received radio signals, and updating the values of model parameters for the pre-distortion machine learning model that are used to process

¹ By submitting this Preliminary Response, no waiver of any argument is intended by Patent Owner. Patent Owner will have a right to file a complete response to the Petition, should the Board institute *inter partes* review. 37 C.F.R. § 42.120(a).

the transmit signal based on this comparison between transmitted and received radio signals. This use of received signals from a radio receiver to update model parameters for the pre-distortion machine learning model that processes transmit signals prior to transmission, in order to account for signal distortions due to various components of the radio signal processing system, is neither disclosed by nor obvious in view of the asserted art in the Petition.

Petitioner relies heavily on the Jüschke² reference to disclose or suggest many features of the independent claims. But Jüschke expressly discloses that its neural network processor training is designed to accommodate the distortion resulting only *from the transmitter device*, and Jüschke does not disclose any comparison between a received signal from a radio receiver and a transmitted signal for the purpose of updating model parameters for the pre-distortion machine learning model for processing transmit signals. Jüschke’s training loop exists purely on the transmission side in order to model and accommodate the transmitter’s distortion, and the training is intended to “approximate the inverse transfer function of the non-ideal *transmitter device*’s transfer function.” Jüschke, ¶19 (emphasis added).

² Ex. 1005, EP 2,538,553 A1 to Jüschke *et al.* (“Jüschke”).

Petitioner's secondary reference also falls short. Holt³ primarily uses encoder models, decoder models, and channel models to emulate a transmitter device or component, a communication channel, and a receiver device or component respectively. Holt, 4:33-39. Holt's "channel coding model can be retrained in order to adapt the channel coding model and corresponding encoding scheme to changing conditions of a communication channel over time" Holt, 4:41-44. Then, the encoder model and decoder model portions of the channel coding model can be retrained, "thereby causing the encoder model and decoder model portions of the channel coding model to learn an updated encoding scheme that is appropriate for the new communication channel conditions." Holt, 4:49-54. Holt's "encoder model and the decoder model of the channel coding model can automatically devise an appropriate encoding scheme for the communication channel." Holt, 4:27-30. Holt makes no mention of distortions in a radio signal processing system, or training pre-distortion machine learning models to correct for such distortions.

Further, while Holt does disclose an actual communication channel in limited circumstances, Holt is abundantly clear in its disclosure that the use of an actual communication channel, as appearing in Figures 6 and 11 and described in corresponding portions of the specification, are for training a *decoder* model only,

³ Ex. 1006, U.S. Patent No. 10,552,738 to Holt et al. ("Holt").

not an *encoder* model. Thus, Holt does not use received signals from a radio receiver, received via an actual communication channel, to process transmit signals prior to transmission. Like Jüschke, Holt also fails to disclose using a signal received via an actual communication channel to train an encoder model or to update parameters for a pre-distortion machine learning model to process a transmit signal.

Thus, whether Jüschke and Holt are considered alone or in the combination proposed by the Petitioner, there is no disclosure or suggestion in Petitioner's asserted art to compute a distance metric between a transmit radio signal and a received radio signal that is then used to update model parameters for the pre-distortion machine learning model used for processing a transmit radio signal and generating a pre-distorted radio signal. Absent any such disclosure or suggestion, the sole basis for Petitioner's attempt to recreate the challenged claims from these references is impermissible hindsight. For these reasons as presented in more detail below, the Petition should be denied without institution.

II. THE '469 PATENT

A. The '469 Patent Discloses Techniques to Correct for Widespread Distortion in the Transmitter, Channel, and Receiver at the Transmitter Side Using a Received Signal

As introduced above, the '469 Patent discloses a nonlinear pre-distortion machine learning model that includes model parameters and at least one nonlinear

function to correct for radio signal distortion and/or interference in a deployment scenario. More specifically, the ’469 Patent discloses a “radio communication system 100 with an integrated nonlinear pre-distortion system for correcting radio signal distortions and interferences.” ’469 Pat., 5:20-22. “Within the radio communication system 100, a transmitting radio signal processing system 101 transmits radio signals to a receiver 109.” ’469 Pat., 5:23-25.

The ’469 Patent discloses techniques to correct—at the transmitter side—for distortions and interferences that occur not only at the transmitter side, but also along the communication channel and at the receiver side using a received signal. As the ’469 Patent discloses, “[i]n the transmission process, one or more components, e.g., an amplifier 108, of the radio communication system 100 may distort or interfere with the radio signals to be transmitted to a receiver 109.” ’469 Pat., 5:25-28. The ’469 Patent also notes that “[s]ignal interference may occur when the radio communication system 100 experiences large time delays or transmits large bandwidths of data streams that include the radio signals.” ’469 Pat., 5:40-43. Other sources of “distortion or interference” are not limited to the transmitter side, and can occur at various points along the signal path to the receiver, as enumerated by the ’469 Patent. ’469 Pat., 5:43-50 (disclosing “responses from other analog electronic components” as potential sources of distortion or interference); *see also* ’469 Pat., 8:58-65.

As also noted above, the '469 Patent corrects for distortion in actual components and the actual communication channel, and does not simply correct for the distortion that arises in a particular component, such as a transmitter device or transmitter-side amplifier. To achieve this, the '469 Patent discloses comparing transmitted and received radio signals, and updating the values of the model parameters for the pre-distortion machine learning model based on this comparison between transmitted and received radio signals. Specifically, the “system computes a distance metric between the candidate transmit radio signal and the received radio signal 408.” '469 Pat., 8:66-9:1. “The system determines updated values for the set of model parameters of that minimize the distance metric computed between the candidate transmit radio signal and the received radio signal 410.” '469 Pat., 9:11-14. These updated values for the model parameters for the pre-distortion machine learning model are used to process the transmit radio signal and thereby generate a pre-distorted radio signal to be transmitted.

By updating these model parameters, the '469 Patent can adjust to complex deployment scenarios having a variety of deployment-specific sources of error in a signal. Distortion or interference during signal propagation, such as that caused by reflection or absorption, bad connections, unintended coupling, or other site-specific features can be detected and corrected. *See* '469 Pat., 5:43-53. In

addition, environmental conditions such as temperature and humidity effects on system components may be addressed. *Id.*; *see also* '469 Pat., 10:24-32.

Thus, the pre-distortion added at the transmitter side ideally corrects for the distortion that occurs up to and including the actual channel and the actual radio receivers receiving the transmitted signal. As described in the '469 Patent, the “transmit output signal [is sent] to one or more radio receivers 208” and the “received signal includes both the pre-distortion and the distortion effects, which in ideal circumstances combine to form a highly linear and ideal signal over the air” '469 Pat., 7:60-8:7.

B. The Challenged Claims Apply Pre-Distortion at the Transmitter Based on Distance Metrics Computed Between a Transmitted Signal and a Received Signal

Consistent with the '469 Patent's disclosure, each independent claim recites a “distance metric computed between the transmit radio signal and a received signal that is obtained from” at least one radio receiver. In order to minimize that distance metric, updated values for the set of model parameters are determined or updated in the nonlinear pre-distortion machine learning model. Further, these model parameters are applied via a nonlinear pre-distortion machine learning model, which is used *to process the transmit radio signal* to generate a pre-distorted radio signal. Thus, a received radio signal is used to update model parameter values used for processing the transmit radio signal. As discussed

below, these features are neither disclosed nor suggested by Petitioner's asserted art.

Independent claim 1 of the '469 Patent recites:

1. A method for correcting distortion of radio signals, the method comprising:

obtaining a transmit radio signal corresponding to an output of a transmitting radio signal processing system;

generating a pre-distorted radio signal by processing the transmit radio signal using a nonlinear pre-distortion machine learning model, wherein the nonlinear pre-distortion machine learning model includes model parameters and at least one nonlinear function to correct radio signal distortion;

obtaining a transmit output radio signal by processing the pre-distorted radio signal through the transmitting radio signal processing system;

transmitting the transmit output radio signal to one or more radio receivers; and

updating the model parameters *based on a distance metric computed between the transmit radio signal and a received signal that is obtained from the one or more radio receivers*, the received signal corresponding to the transmit output radio signal that was transmitted to the one or more radio receivers.

'469 Patent, 14:15-35 (claim 1) (emphasis added).

Similar to claim 1, independent claims 21 and 23 of the '469 Patent each recite, in relevant part, "update the model parameters *based on a*

distance metric computed between the transmit radio signal and a received signal that is obtained from the one or more radio receivers, the received signal corresponding to the transmit output radio signal that was transmitted to the one or more radio receivers.” *Id.*, 17:18-23 (claim 21) (emphasis added); 18:18-23 (claim 23). Relatedly, independent claim 8 recites, in relevant part, “determining updated values for the set of model parameters of the nonlinear pre-distortion machine learning model that *minimize the distance metric computed between the candidate transmit radio signal and the received radio signal* to correct for one or more sources of alteration of the candidate transmit radio signal in the transmitting radio signal processing system.” *Id.*, 15:40-46 (claim 8) (emphasis added).

Accordingly, per the challenged claims, the distance metric computed between the transmit radio signal and the received radio signal is used to update the model parameters used to process the transmit radio signal and generate a pre-distorted radio signal. These claimed features are neither disclosed nor rendered obvious by the asserted art.

III. THE BOARD NEED NOT REACH ANY CLAIM CONSTRUCTION ISSUES TO DENY THE PETITION

The Petitioner identifies no terms as requiring constructions. Pet., 13 (Petitioner submits that “[n]o claim term requires construction to resolve the patentability challenges here.”). Without waiving its right to submit constructions

in a Patent Owner Response, Patent Owner submits that the Board need not engage in any pre-institution claim construction. For the substantive reasons presented in Section IV below, Petitioner's grounds include fundamental flaws and fail to establish the disclosure of every claimed element in each independent claim. These findings do not require the Board to conduct any construction of the above-identified terms.

IV. PETITIONER'S CHALLENGES FAIL ON THE MERITS

Petitioner asserts two grounds in its Petition, but only Ground 1 applies to the independent claims (claims 1, 8, 21, and 23).

Ground 1 contends that claims 1-8, 10, 12-15, and 17-24 are obvious over Jüschke in view of Holt. Pet., 13-77. Ground 2 contends that claims 2, 22, and 24 are obvious over Jüschke in view of Holt and Dzierwa.⁴ Pet., 78-83.

However, Petitioner's challenges suffer from extensive flaws, including Petitioner's hindsight-based recreation of the challenged claims in a manner not taught or suggested by the asserted references. Specifically, as discussed in more detail below, Jüschke fails to disclose computing a distance metric between a transmit radio signal and a received radio signal in order to update model parameters for the pre-distortion machine learning model used to process the transmit radio signal and generate a pre-distorted radio signal.

⁴ Ex. 1007, U.S. Patent No. 10,122,479 to Dzierwa ("Dzierwa").

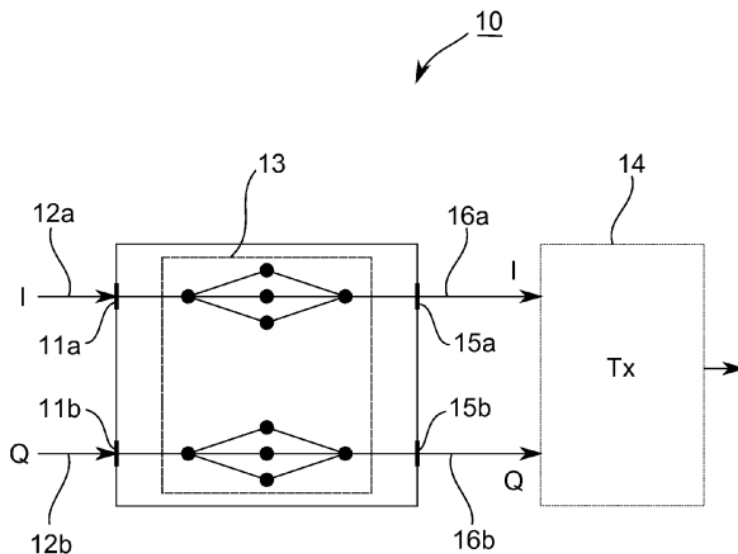
Further, while Petitioner relies on Holt to remedy the deficiencies of Jüschke, Petitioner ignores that Holt's encoder and decoder models are trained to process a signal for a particular communication channel, and not to account for distortions in a radio signal processing system. Additionally, Holt's "backpropagation" to an encoder does not occur when dealing with an actual communication channel. Instead, when dealing with an actual communication channel, Holt discloses making adjustments to the receiver/decoder model only, not to the encoder or a transmit radio signal. As such, neither reference discloses or suggests using a received radio signal to compute a distance metric for updating model parameter values for the pre-distortion machine learning model that is then used for processing the transmit radio signal to generate a pre-distorted radio signal.

For the reasons discussed below, Ground 1 is facially deficient in establishing the unpatentability of any challenged independent claim, and Ground 2 does not remedy the deficiencies of Ground 1. For these reasons, the Petition should be denied without institution.

A. Jüschke

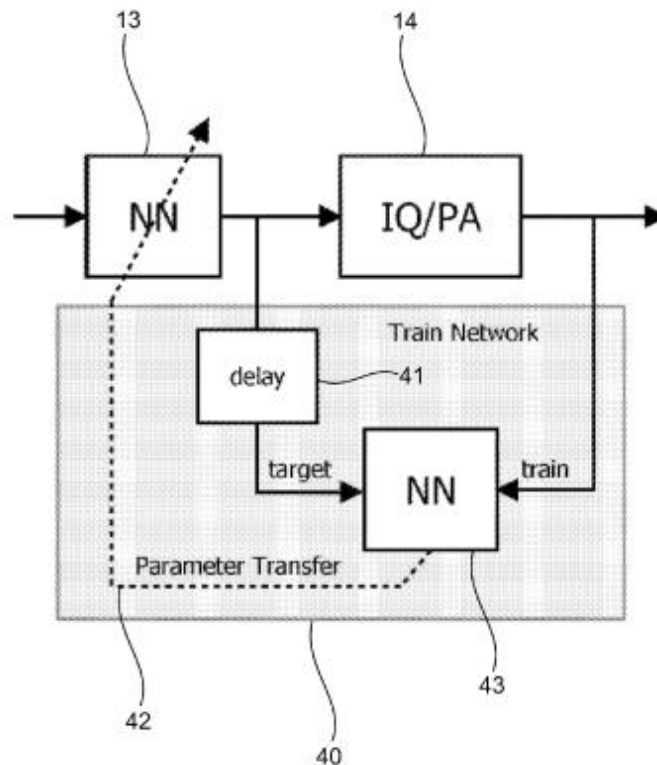
In FIG. 1, reproduced below, Jüschke discloses an apparatus (10) having an input (11a, 11b) for I and Q components of a signal (12a, 12b), a pre-distortion

neural network processor (13) to obtain a pre-distorted digital baseband signal (16a, 16b), and a transmitter device (14). Jüschke, FIG. 1; Abstract.



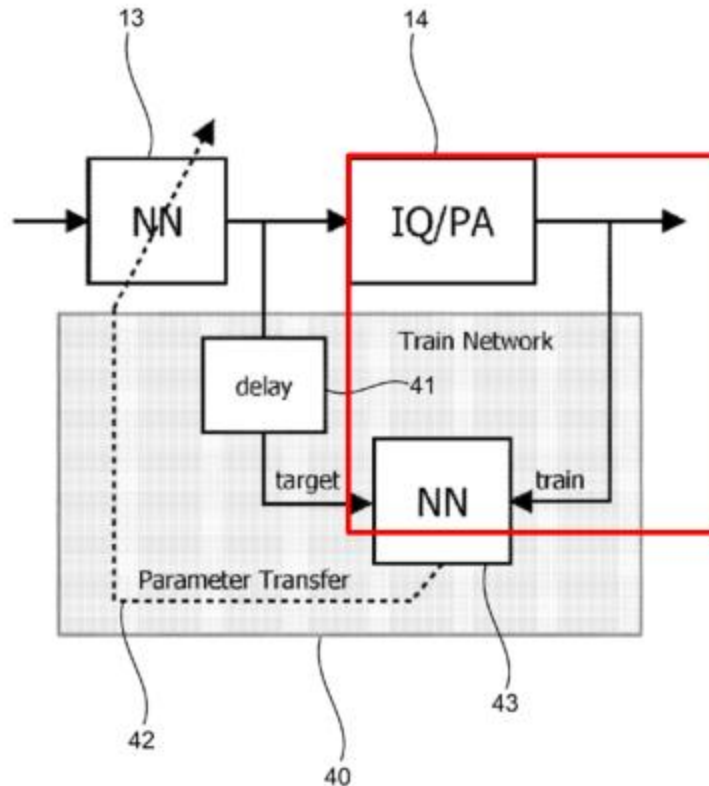
According to Jüschke, the neural network processor 13 is used “to mitigate the IQ imbalance, which may lead to undesired RF signal images.” Jüschke, ¶13. Jüschke explains that the “neuron is an information-processing unit,” and “the basic elements of the neuronal model are a set of synapses or collecting links, each of which is characterized by a weight was drawings of its own [sic].” Jüschke, ¶14. A “signal x_j at an input of synapse j connected to neuron k is multiplied by the synaptic weight w_{kj} .” *Id.* “An adder sums up the input signals, weighted by the respective synaptic weights.” *Id.* “An activation function” is then applied to the “the weighted sum of the inputs ... plus a bias term b_k .” *Id.*

Per Jüschke, the training of the neural network processor is designed to accommodate the distortion resulting from the transmitter device 14 only. Jüschke explains that the “post-distortion neural network processor may be used to identify the inverse transfer function of the nonideal transmitter device’s transfer function using supervised learning.” Jüschke, ¶18. “As the training of the post distortion neural network processor converges, its response or transfer function will *approximate the inverse transfer function of the non-ideal transmitter device’s transfer function.*” Jüschke, ¶19. Indeed, Jüschke’s training loop for the non-ideal transmitter device 14 exists purely on the transmission side, as illustrated in Jüschke’s Fig. 4:



As illustrated, Jüschke's training loop begins at the output of the non-ideal analog transmitter device 14. Jüschke, ¶48. This training loop passes to the "input later of the post distortion neural network." *Id.* "Undistorted, and, hence, ideal digital baseband IQ samples 12a, 12b may [also] be provided to the post distortion neural network 43 as target output values." *Id.* The neural network 43 therefore approximates the inverse of the transfer or distortion function of the analog transmitter device 14, to compensate for the analog transmitter device 14's distortion. As Jüschke once again explains and confirms, "As the response of the post distortion neural network 43 converges, its response will essentially be the inverse of the transfer or distortion function of the analog transmitter device 14." *Id.* Further, "[a]fter convergence of the post distortion neural network 43, the trained weight (w_{kj}) and/or bias parameters (b_k) of the post distortion neural network 43 may be transferred to the pre-distortion neural network processor 13, as is indicated by the dashed line 42."

Petitioner concedes that Jüschke's training loop exists purely on the transmission side, as Petitioner annotates Fig. 4 and describes the loop initiating from the "transmit output radio signal" rather than from any signal received at one or more radio receivers. Pet., 44.



Pet., 44.⁵

Jüschke also expressly discloses that “[a]s the training of the post distortion neural network processor converges, its response or transfer function will approximate the inverse transfer function of the non-ideal *transmitter device’s* transfer function.” Jüschke, ¶19 (emphasis added). Thus, Jüschke is focused on using the output of the transmitter device 14 to correct for distortion that results at

⁵ Oddly, Petitioner alleges that a “POSITA would have understood that a transmit output radio signal being from transmitter device 14 would be the same signal received by a radio receiver.” Pet., 44. This faulty allegation ignores all the distortion, noise, and interference that could disturb the signal between the output from the transmitter device 14 and the radio receiver. Notably, this is a distinction that the ’469 Patent recognizes and corrects for, while Jüschke does not.

the transmitter device. Jüschke does not train the post distortion neural network processor based on any received signal from one or more radio receivers, or on a distance metric computed between Jüschke's "transmit radio signal and a received signal that is obtained from the one or more radio receivers." Thus, Jüschke alone plainly fails to disclose or suggest every feature of the challenged claims.

B. Holt

The Petition proposes to modify Jüschke with Holt. In particular, Petitioner relies upon Holt to disclose "adaptive training of a channel coding model including an encoder model, a channel model..., and a decoder model." Pet., 10 (quoting Holt, Abst.). As Holt explains, Holt discloses a "computing device 100" that can perform the "creation and/or use of a channel coding model 110 that includes an encoder model 112, a channel model 114 and a decoder model 116."

Holt confirms that the channel model 114 is not a communication channel, but rather a model of a communication channel.⁶ Holt's "channel model 114 can

⁶ Without discussion or explanation, the Petition alleges that an "actual communication channel' can also be used." Pet., 11 (quoting Holt, 18:1-2); *see also id.*, 20. This is not accurate. Holt's disclosure explains that the decoder model 212 can "decode data coming out of the channel model 208" and also be "trained ... to learn how to decode data coming out of the communication channel 302 (e.g., the actual communication channel 302 used to train the channel model 208, as depicted in FIG. 5)." Holt, 17:62-18:3. Holt does not disclose or suggest a wholesale substitution of an actual communication channel with the communication model throughout Holt's disclosure, and Petitioner makes no attempt to explain why such a wholesale substitution would be obvious or why it would reasonably expected to be successful.

be trained to emulate a communication channel according to the techniques described by the present disclosure.” Holt, 10:2-4. The “role of the channel model 114 is to faithfully emulate the communication channel.” Holt, 10:47-49. The “model trainer 118 can train channel model 114 using a loss function that describes a difference between an output of channel model 114 and an output of a communication channel, when a same set of input data is provided to both the communication channel and the channel model 114.” Holt, 10:56-60.

Describing the encoder model, Holt discloses that the “encoder model 112 can be trained to encode input data for transmission over a communication channel according to the techniques described by the present disclosure.” Holt, 9:58-61. Holt also discloses that the “decoder model 116 can be trained to learn how to decode data coming out of a communication channel back into the original input data provided to the encoder model 112 and/or to the communication channel” Holt, 10:17-20. On one hand, Holt notes that “FIGS. 3-4, 6-7, and 10-11 variously include some aspects associated with *training a decoder* model 116.” Holt, 10:22-23 (emphasis added). On the other hand, Holt discloses that “FIGS. 3, 4 and 7 variously include some aspects associated with *training an encoder* model 112.” Holt, 9:61-63 (emphasis added). Therefore, a POSITA faced with Holt *would not* have had reason to look to Holt’s Figures 6 or 11 for teachings on training an encoder model.

Petitioner specifically looks to Holt's disclosure of the loss functions, and proposes to incorporate the loss function feature into Jüschke. Pet., 19-21.

Petitioner points to Holt's Figure 3 to exemplify "a first loss function 216 from an encoder model input 204 and decoder model output 214 with channel model 208 in between." Pet., 20. However, Petitioner acknowledges that Holt's Figure 3 is directed to computing a first loss function based on a channel model 208, not an actual channel, and does not involve any "received signal." Pet., 20 (annotating Holt's Figure 3). Therefore, this first loss function is based on a modeled channel, and is not computed between a "transmit radio signal and a received signal that is obtained from the one or more radio receivers."

Moreover, Holt's first loss function is first "backpropagated through the decoder model while modifying the decoder model to train the decoder model, for example, by modifying at least one weight associated with the decoder model." Holt, 5:67-6:3. Any error remaining in the first loss function is then "backpropagated through the encoder model while modifying the encoder model to train the encoder model, for example, by modifying at least one weight associated with the encoder model." Holt 6:8-12. Thus, the backpropagation of the first loss function through the decoder model means that Holt adjusts for the difference between the output from the channel model (Holt's second set of outputs 210) and the output from the decoder model (Holt's third set of outputs 214) at the decoder

model. Only the remaining error, after the decoder model is trained, would be backpropagated through the encoder model. Holt's Figure 3 does not disclose a process whereby only the encoder model is adjusted based on a difference between Holt's inputs 204 and outputs 214.

Apparently realizing this defect of Holt's Figure 3, Petitioner looks to Holt's Figure 6, which unlike Figure 3, describes an "Actual Channel" 302 as it relates to Holt's "Fourth Loss Function." Pet., 20-21; *see also id.*, 11. Petitioner's annotation of Holt's Figure 6 is reproduced below:

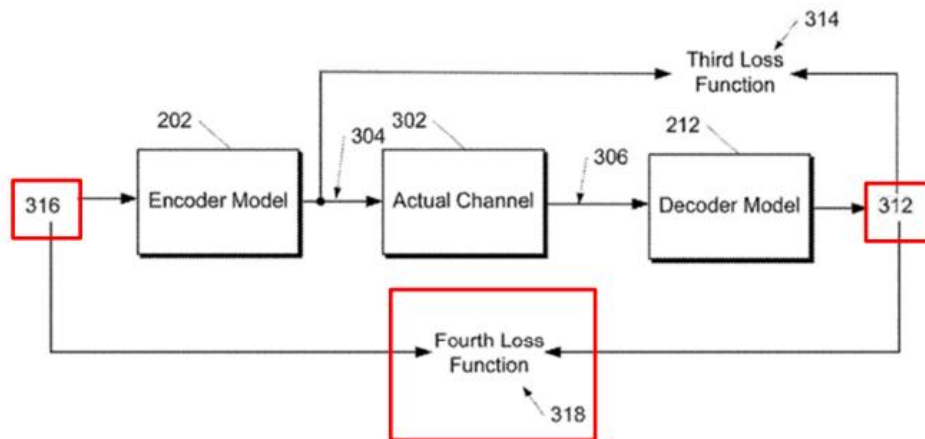


Figure 6

Pet., 21 (annotating Holt, Figure 6). Holt's Figure 6 is described also with respect to Holt's Figure 11. *See* Holt, 3:33-35 ("FIG. 6 depicts a block diagram of a fourth aspect of an example model training technique according to example embodiments of the present disclosure"); 3:51-54 ("FIG. 11 depicts a flow chart diagram of a

fourth additional aspect of an example method to perform machine learning according to example embodiments of the present disclosure”).

As already noted above, Holt's Figures 6 and 11 “include some aspects associated with training a *decoder model* 116.” Holt, 10:22-23 (emphasis added). Holt expressly discloses that the “fourth loss function 318 can describe a difference between the third set of inputs 316 and the sixth set of outputs 312,” and “can be backpropagated through the decoder model 212 while modifying the decoder model 212 *to train the decoder model* (e.g., *by modifying one or more weights associated with the decoder model 212*) to generate outputs that attempt to reconstruct the data provided to the encoder model 202.” Holt, 18:40-48. Similarly, describing Figure 11, Holt discloses “training the decoder model at 718 based on the fourth loss function involves backpropagating the fourth loss function through the decoder model to train the decoder model by modifying the decoder model (e.g., by modifying at least one weight associated with the decoder model).” Holt, 21:7-12.

Thus, Holt is abundantly clear in its disclosure that the use of an actual communication channel in Figures 6 and 11 is for training a decoder model only, not an encoder model. Just as Jüschke falls short, Holt does not train its encoder model, or any transmit signal, based on any received signal from one or more radio

receivers, or on a distance metric computed between a “transmit radio signal and a received signal that is obtained from the one or more radio receivers.”

C. Petitioner's Combination of References Fails to Render Any Challenged Claim Obvious

i. Even if Combined per the Petition, Jüschke in view of Holt Fails to Disclose Every Feature as Arranged in the Claims

Considered alone, neither Jüschke nor Holt discloses or suggests modifying a transmitter's nonlinear pre-distortion machine learning model to generate a pre-distorted radio signal based on a “distance metric computed between the transmit radio signal and a received signal that is obtained from” at least one radio receiver. Accordingly, their combination would also lack such a feature.

As explained above, Jüschke is focused on using the output of the transmitter device 14 to correct for distortion that results at the transmitter device. Jüschke does not train its pre or post distortion neural network processor based on any received signal from one or more radio receivers, or on a distance metric computed between Jüschke's “transmit radio signal and a received signal that is obtained from the one or more radio receivers.”

As discussed above regarding Holt's Figure 3 and the “first loss function,” Holt's Figure 3 is directed to computing a first loss function based on a channel model 208, and Holt's first loss function is not computed between a “transmit radio signal and a received signal that is obtained from the one or more radio receivers.”

Additionally, Holt's first loss function is first "backpropagated through the decoder model while modifying the decoder model to train the decoder model, for example, by modifying at least one weight associated with the decoder model." Holt, 5:67-6:3. Any error remaining in the first loss function is then "backpropagated through the encoder model" Holt 6:8-12. Thus, any training at the encoder model only accounts for the remaining error that is not first accounted for at the decoder model. Holt's Figure 3 does not disclose a process whereby only the encoder model is adjusted based on a difference or distance metric computed between Holt's inputs 204 and outputs 214.

While Holt's Figure 6 shows a fourth loss function that "can describe a difference between the third set of inputs 316 and the sixth set of outputs 312," Holt's Figure 11 discloses that Holt's fourth loss function is used to "train the decoder model (e.g., by modifying one or more weights associated with the decoder model 212) to generate outputs that attempt to reconstruct the data provided to the encoder model 202." Holt's fourth loss function is not, however, used to train Holt's encoder model. Again, Holt expressly teaches that Figures 6 and 11 include aspects "associated with training a decoder model 116," (*see* Holt, 10:22-23), not Holt's encoder model.

Thus, even if combined, Jüscke in view of Holt still fails to disclose or suggest every feature of the challenged claims. This is because whether considered

alone or in combination, there is no distance metric computed between a transmit radio signal and a received radio signal that is used to update model parameters for the pre-distortion machine learning model used for processing the transmit radio signal and generating a pre-distorted radio signal. Jüschke uses a feedback loop at the transmitter to process a transmission signal, while Holt uses a fourth loss function to train a decoder model, not an encoder model.

ii. Petitioner’s Theory of Obviousness Fails to Recognize, or Remedy, these Shortcomings of Jüschke in view of Holt

As explained above, Jüschke differs dramatically from the challenged claims of the ’469 Patent. Indeed, Petitioner acknowledges that Jüschke fails to disclose “updating the model parameters based on a distance metric computed between the transmit radio signal and a received signal that is obtained from the one or more radio receivers,” and tacitly concedes that Jüschke does not compute a distance metric “between the transmit radio signal and a received signal that is obtained from the one or more radio receivers.” Pet., 39-40.

Therefore, Petitioner attempts to remedy the shortcomings of Jüschke by modifying Jüschke’s disclosures with Holt. Petitioner notes that “Holt trains and updates ML model parameters using loss functions,” and proposes to “combine Juschke with Holt’s loss function—which also uses input/output samples, feedback loops, and backpropagation—for training” Pet., 21; *id.*, 40. Petitioner alleges that “Holt uses actual receiver data as output data for training, and that this would

have improved training by sampling signals actually received and recovered by a receiver.” Pet., 22-23.

Petitioner's reliance on Holt to shore up the shortcomings of Jüschke is faulty, however. Petitioner points to Holt's “fourth loss function 318” in its reliance on Holt's disclosure. Pet., 40. Petitioner argues that a “POSITA would have understood that Holt modifies (*updates*) model parameters using a loss function that calculates the distance, and thereby a *distance metric*, between an ML model's predicted values at the decoder and the true values at the encoder input.” Pet., 40-41 (emphasis in original). Petitioner also argues that a “POSITA would have understood that Holt's loss function applied to encoders (transmitters) and decoders (receivers) teaches a *distance metric* that is *computed between the transmit radio signal and a received signal that is obtained from the one or more radio receivers*.” Pet., 42-43 (emphasis in original).

As already introduced above, Petitioner makes the bold assertion that “POSITA would have understood that a *transmit output radio signal* being from transmitter device 14 would be the same signal received by a *radio receiver*.” Pet., 44 (emphasis in original); *see also* n.5, *supra*. Based on Petitioner's technically incorrect statement, Petitioner concludes that a “POSITA would have understood that feedback from a *transmit output radio signal* transmitted to a *radio receiver* would *correspond to the transmit output radio signal that was transmitted to the*

one or more radio receivers.” Pet., 44-45 (emphasis in original). In essence, Petitioner is relying on Juschke's transmit output signal to disclose the claimed “received signal that is obtained from the one or more radio receivers.” This is wrong. As explained above in footnote 5, Petitioner's faulty correlation of the output signal from non-ideal analog transmitter device 14 to a “received signal that is obtained from the one or more radio receivers” ignores all the distortion, noise, and interference that affects the signal between the output from the transmitter device 14 and the radio receiver. This is distinction that the '469 Patent recognizes and corrects for, while Juschke does not.

Petitioner seemingly recognizes this flaw in its argument because Petitioner next looks to Holt for a signal “received by a receiver.” Pet., 45. Referring to Holt's Figure 2, Petitioner points to “client computing device 150 with transmitter 159 transmits a signal over network 142.” Pet., 45. Petitioner notes that this transmitted signal “can be received and processed at computing system 160” and “client computing device 180 with receiver 189 and decoder model 176.” Pet., 45. Petitioner then alleges that a “POSITA would have understood that Holt's disclosure of transmitted and received communication data received by a decoder model implemented in a receiver device teaches a *received signal corresponding to the transmit output radio signal that was transmitted to the one or more radio receivers.*” Pet., 45 (emphasis in original).

What Petitioner completely overlooks is that Holt's use of a signal that is received from an *actual communication channel* is used to compute its fourth loss function, which only trains a "decoder model ... implemented by a receiver device." Holt, 4:33-37. Holt does not use a received signal passing through an actual communication channel to train an "encoder model ... implemented by a transmitter device." *Id.* On page 40 of the Petition, Petitioner relies on Holt's "fourth loss function 318" as an example of a loss function calculated "by comparing encoder model inputs to decoder model outputs." Pet., 40. Petitioner quotes Holt, which states, "fourth loss function 318 can be backpropagated through the decoder model 212 while modifying the decoder model 212 to train the decoder model (e.g., by modifying one or more weights associated with the decoder model 212) to generate outputs that attempt to reconstruct the data provided to the encoder model 202." Holt, 18:42-48; Pet., 40. But as discussed above, Holt notes that the fourth loss function is used to "train the decoder model," not an encoder model. *See* Holt, Figure 11 (block 718); 21:2-7.

Even in its reliance on Holt, Petitioner points to no instance where a distance metric is computed based in part on a signal received via an actual communication channel, and then used for updating "model parameters" that are used to "process[] the transmit radio signal using a nonlinear pre-distortion machine learning model" at the transmitter side "to correct radio signal distortion" as claimed. Petitioner

also points to no teaching or suggestion in either Jüschke or Holt to use a received signal for training an encoder model. The sole basis for this proposed modification to the Jüschke/Holt combination is Petitioner's hindsight bias, which is improper.

For all these reasons, the Petition should be denied without institution because Jüschke and Holt, even if combined as asserted, fail to render any challenged claim obvious.

D. Ground 2 Does Not Remedy the Shortcomings of Jüschke

Once again, the Petition does not rely on Dzierwa to remedy the shortcomings of Jüschke and Holt, as addressed in Section IV.A above. Instead, Petitioner relies upon Dzierwa only for features of dependent claims 2-4, 22, and 24. Pet., 78-83. Therefore, Ground 2 does not establish any likelihood of success as to independent claims 1, 8, 21, and 23.

V. CONCLUSION

For the reasons presented above, the Petition should be denied, and no *inter partes* review should be instituted.

IPR2025-00049 Patent Owner's Preliminary Response

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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing PATENT OWNER'S PRELIMINARY RESPONSE complies with the type-volume limitation in 37 C.F.R. § 42.24(b)(1). According to the word-processing system's word count, the brief contains 5,758 words, excluding the parts of the brief exempted by 37 C.F.R. § 42.24(a).

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CERTIFICATE OF SERVICE

Petitioner has consented to e-mail service in this proceeding. Pursuant to 37 C.F.R. §42.6, the undersigned certifies that on this date, a copy of the foregoing document was served by email upon the following counsel at the below email addresses:

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