

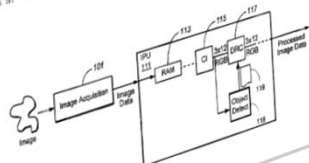


Patent Owner's Hearing Demonstratives

IPR2018-01250, -1251

U.S. Patent No. 8,447,132

October 10, 2019

[illegible](54) DYNAMIC RANGE CORRECTION BASED ON
IMAGE CONTENT

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(US)

(21) Appl. No.: 12/961,400

(22) Filed: **Dec. 6, 2010**

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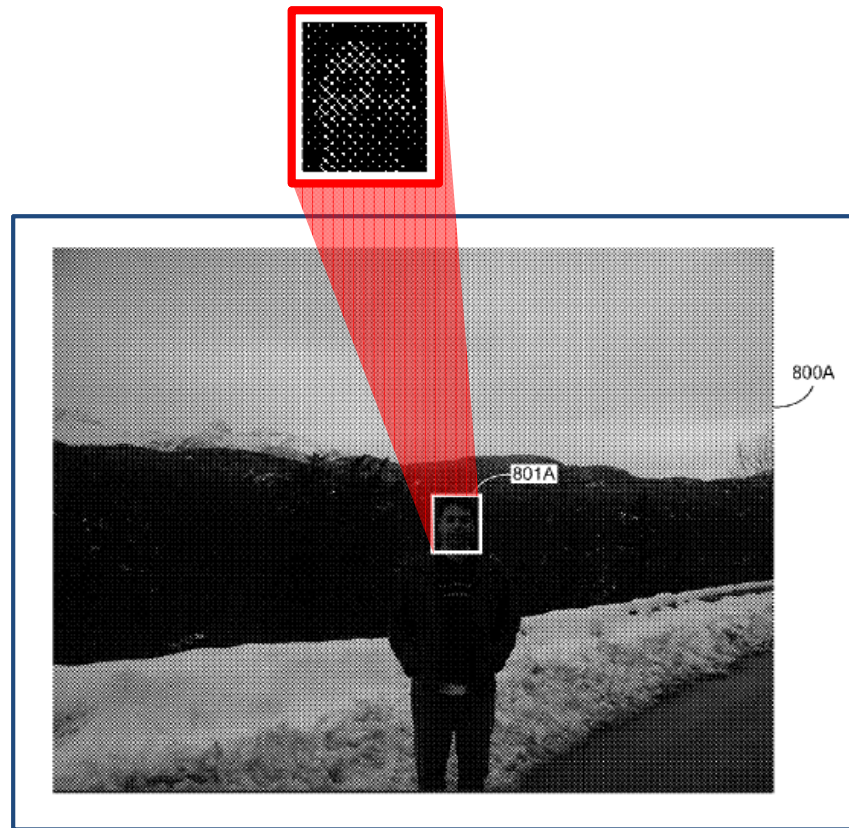
'132 Patent – Technology Overview

Problem:

Most digital images encode only a small fraction of the intensities that a person can see in a real scene. **Detail visible to the human eye tends to be lost in dark and bright portions of an image due to the limited dynamic range of the image sensor and/or the display device.** For example, current image sensors provide contrast ratios in the range of 200:1, i.e., a dynamic range of about 46 dB, whereas the human visual cortex has a dynamic range approaching 80 dB.

Dynamic range limitations are particularly notable in digital cameras (both still and video). Consider the situation of taking a digital picture of a person standing in a dark portion of a room with a bright open window in the background. In this situation the image sensor may not be able to acquire both the details of the bright view coming through the window and the details of the person's face. In situations like this, it is desirable to compensate for the lack of sufficient dynamic range. Conventionally this is done by adjusting the exposure time and/or employing dynamic range compression/enhancement methods. However, these methods, while providing some improvement, still tend to produce images that lack details which are important to the end user.

'132 Patent at 1:19-39



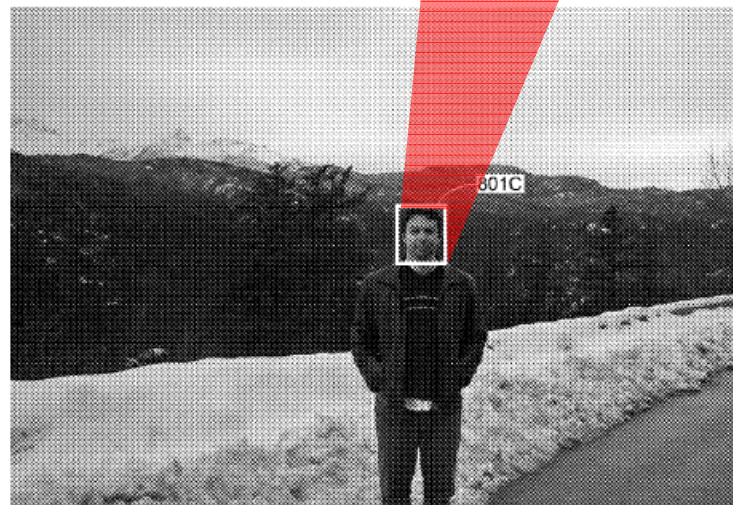
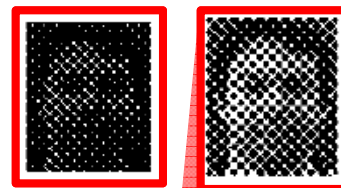
'132 Patent at Fig. 8A

'132 Patent – Technology Overview

Patented Solution:

The technique introduced here identifies important content in an image, such as faces. The location of the content (e.g., faces) is then used to determine the type and/or amount of an adjustment, such as dynamic range correction (DRC), to apply. For example, using the location of a dark face to determine the exposure time, the exposure can be adjusted so that the face is bright and visible. Another example is adjusting dynamic range compression parameters so that a gain applied to a face is increased digitally. In that case, the face can be made bright and visible without causing loss of information in the bright areas of the image (saturation).

'132 Patent at 2:7-17



'132 Patent at Fig. 8C

'132 Patent – Technology Overview

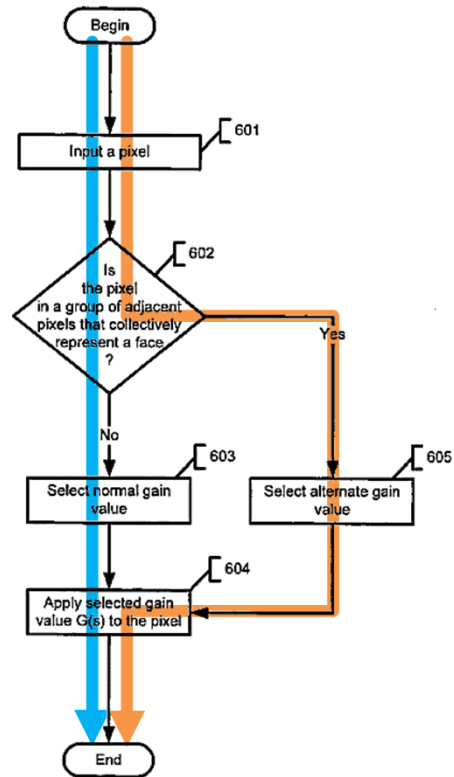
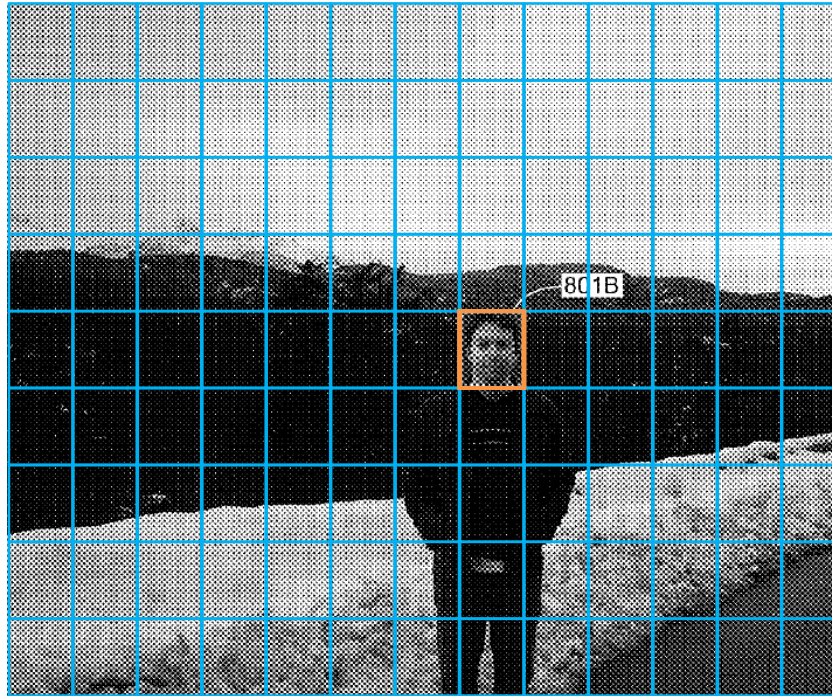
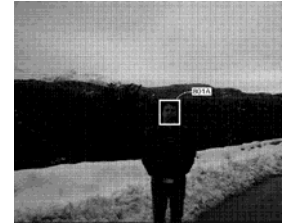


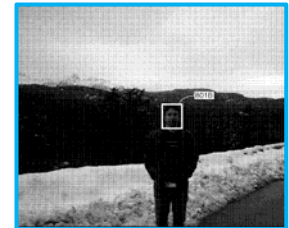
Fig. 6



Original



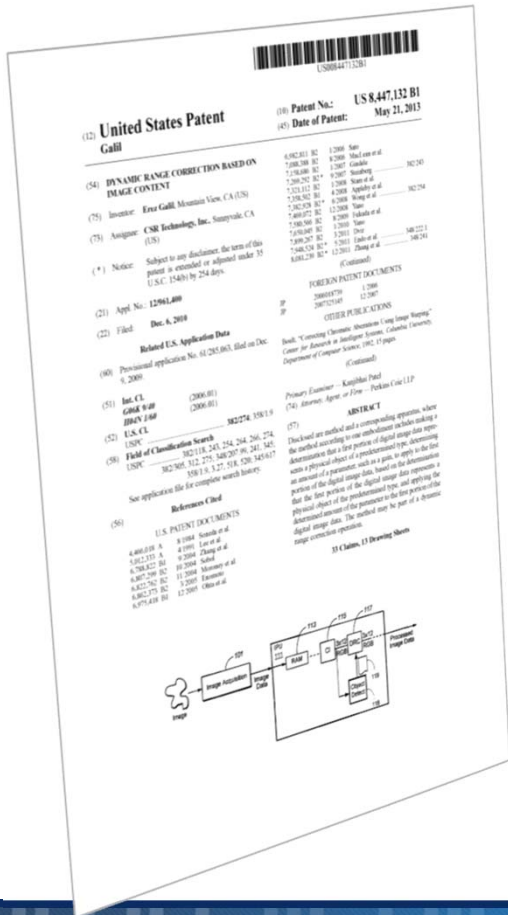
Normal gain



Alternate gain



'132 Patent – Independent Claim 1



1. A method comprising:

determining whether a first portion of digital image data represents a physical object of a predetermined type;

determining a correction to apply to the first portion of the digital image data, based on a determination that the first portion of the digital image data represents a physical object of the predetermined type, wherein the determined correction is matched to the predetermined type;

applying the determined correction to the first portion of the digital image data to enhance a visual characteristic of the first portion of the digital image data, by applying a first amount of the correction to the first portion of the digital image data; and

applying a second amount of the correction to a second portion of the digital image data, wherein the first amount differs from the second amount, and wherein the first amount corresponds to a physical object of the predetermined type.

1250 Claim Construction | GAIN (challenged claims 7, 8, 11, 14)

“determining the amount of gain to apply to the first portion of the digital image data so as to maintain local contrast of the first portion” (claim 8)

- “an attribute that relates to brightening or darkening a region of an image”
 - 1250 Villasenor Decl. (EX2001), ¶ 107 (cited in 1250 POR at 8)
- “a gain applied to a face is increased ... the face can be made bright and visible without causing loss of information in the bright areas of the image ”
 - APPLE-1001, 2:14-16 (cited in 1250 POR at 8)
- “selectively modifying the gain $G(s)$ to increase the intensity of darker portions of an image, such as the face of a person standing in a shadow.”
 - APPLE-1001, 5:56-59 (cited in 1250 POR at 8)

1250 Claim Construction | GAIN (challenged claims 7, 8, 11, 14)

Gain relates to brightening or darkening, not other corrections. 1250 POR at 25-46; 1250 Sur-Reply at 1-2.

107. Claim 13 depends from claim 7, which recites “determining a different amount of gain to apply to the second portion than an amount of gain determined for the first portion.” The claimed “gain” refers to an attribute that relates to brightening or darkening a region of an image. For example, the ‘132 Patent refers to performing processing “so that a gain applied to a face is increased digitally. In that case, the face can be made bright and visible without causing loss of information in the bright areas of the image.” (APPLE-1001 at 2:14-17.) Other

1250 Ex. 2001 at ¶ 107 (cited in 1250 POR at 46)

Note that the content-based technique introduced here is not necessarily limited to determining a gain adjustment or to DRC. For example, other types of corrections or adjustments can be made based on image content as described herein, such as contrast enhancement, color manipulation, sharpness adjustment, noise reduction, skin smoothing, etc.

APPLE-1001 at 3:59-64 (cited in 1250 Sur-Reply at 1)

Altering input image pixel chromaticity (color balance) can be done separately, or in combination with, overall pixel gain adjustment to further enhance the appearance of image details in regions of the image close to positive (the highlight regions) or negative (the shadow regions) saturation.

APPLE-1001 at 3:54-58 (cited in 1250 Sur-Reply at 1-2)

Claim Construction | GAIN (challenged claims 7, 8, 11, 14)

Gain relates to brightening or darkening, not other corrections. 1250 POR at 25-46; 1250 Sur-Reply at 1-2.

Irrelevant:

is I need more time. And so a person of ordinary skill in the art would have known that, you know, they would -- they would have to do some investigation if someone said, you know, use Figure 2 -- the architecture of Figure 2B for smoothing. You know, they'd -- they would think about it a bit and may be able to come up with something, but it depends on the constraints whether they could or not.

APPLE-1021 at 124:16-125:1 (cited in 1250 Sur-Reply at 2)

Claim Construction | MATCHED (challenged claim 1)

“wherein the determined correction is matched to the predetermined type”

- “predetermined or assigned to’ an object type”
 - 1250 POR at 14; 1250 PO Sur-Reply at 4 (citing EX2001, ¶51; APPLE-1001, 3:12-27, 5:52-60, 5:65-67; 6:22-25)

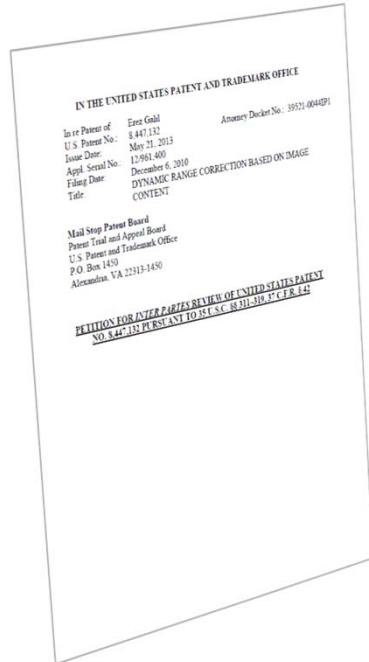
“wherein the determined correction is matched to the predetermined type”

- Petition at 14:

“Thus, Needham teaches determining the correction parameter and the feature weight corresponding to (i.e., matched to) the detected image feature, based on a feature description (which includes the feature type and feature location) corresponding to the detected image feature.”
- “‘predetermined or assigned to’ an object type”
 - 1250 POR at 14; 1250 PO Sur-Reply at 4 (citing EX2001, ¶51; APPLE-1001, 3:12-27, 5:52-60, 5:65-67; 6:22-25)

1250 Proceeding | Petitioner's Grounds

- 1250 Petition at 2:



Ground	'132 Patent Claims	Basis for Rejection
Ground 1A	1, 5-7	§102 and/or §103 – Needham alone and/or Needham in view of Nonaka
Ground 1B	8	§103 – Needham in view of Dvir and/or Needham in view of Nonaka and Dvir
Ground 1C	13	§103 – Needham in view of Gallagher and/or Needham in view of Nonaka and Gallagher

Needham Doesn't Match

Needham Doesn't Match Correction to Object Type (1250 POR at 11-17)

features detected from the input image 110. The operational parameter(s) may also specify that different occurrences of a same image feature type (e.g., different human faces) in an image receive a differing correction operation. For example, the intensity dynamic range used for correcting a particular human face may be determined according to the size of the face detected. The larger the face (e.g., closer to the camera), the larger the dynamic range that may be used (so that the face can be seen more clearly).

APPLE-1004 at ¶ 27 (cited in 1250 POR at 12)

Ex. 2004 at 112:3-16 (cited in 1250 POR at 12)

Q. In paragraph 22, Needham doesn't say that it's applying an intensity dynamic range correction to the face and the building because there's a face in the image; does it?

A. I don't think that Needham is saying that the example that begins with "for instance" in paragraph 22 requires that the input image have faces in it. They may or may not.

Q. And in paragraph 22, Needham doesn't say that it's applying an intensity dynamic range correction to the face and the building because there's a building in the image; does it?

A. I think the algorithm would be applied whether or not there's a building in the image. You know, and keep in mind, it's just a "for instance" here.

Q. Would that algorithm also be applied whether or not there's a face in the image?

A. I already said that. Yeah. There's nothing

Needham Doesn't Match

Needham Doesn't Match Correction to Object Type (1250 POR at 11-17)

- Petition at 14: “Thus Needham teaches determining the correction parameter and the feature weight *corresponding to (i.e., matched to) the detected image feature*” (no citation).

51. Needham also does not disclose that the “determined correction is matched to the predetermined type” as required by claim 1. A POSITA would understand that “matched” in this context means that a particular type of correction is predetermined or assigned to a particular image feature. The fact that in one instance a contrast adjustment is applied to a face is not evidence that a contrast adjustment is matched to faces. Needham describes the use of correction parameters for corrections applied to image features. (APPLE-1004 at 19-20, 24, 26-27, 31, 35.) Needham never discloses a predetermined mapping that each image feature of a particular type will receive a matched correction. Needham’s

Ex. 2001 at ¶ 51 (cited in 1250 POR at 114-15)

Needham Doesn't Match

Needham Doesn't Match Correction to Object Type (1250 POR at 11-17)

- Addressing Needham at ¶ [0026]:

matching. Needham's paragraph [0026] describes that "based on the feature description 260, the feature-based correction unit 270 performs one or more specified correction operations according to the correction parameter(s) 240." However, there is no disclosure of these correction parameter(s) being matched.

Ex. 2001 at ¶ 51 (cited in 1250 POR at 12)

- Addressing Needham at ¶¶ [0031],[0035]:

building or the face. Needham's paragraph [0031] describes generally the construct of a correction parameter, but no matching. Needham's paragraph [0035] describes generically applying correction operations on various image features, but not that a particular image feature is matched to a correction. This

Ex. 2001 at ¶ 51 (cited in 1250 POR at 12)

Needham Doesn't Match

Needham Doesn't Match Correction to Object Type (1250 POR at 11-17)

- Addressing Needham at ¶ [0027]:

Needham's paragraph [0027] describes that "the statistical properties of the detected features may be used to determine how the overall correction may be performed." However, this is too vague to indicate that the overall correction is matched to a detected feature as in claim 1 because in one example scenario the detected features may include two features (e.g., a building and a face), and if the overall correction is determined from the combined statistical properties of the building and the face, then the overall correction is not matched to either the building or the face. Needham's paragraph [0031] describes generally the

Ex. 2001 at ¶ 51 (cited in 1250 POR at 12)

Needham Doesn't Apply Different Amounts of a Matched Correction

Needham Doesn't Differentially Apply a Matched Correction as Claimed (1250 POR at 17-23).

[0022] Different image features may also be considered with different importance. For example, human faces may be considered as more important than buildings in the input image 110. To accomplish this for example, weights may be assigned to different image features to specify their relative importance. Such weights may be used to control the correction parameter(s) during the correction. For instance, if the correction operation of maximizing intensity dynamic range is applied to both human faces and buildings and a human face feature has a higher weight than a building feature, the intensity dynamic range used for correcting human faces in an image may be larger (corresponding to higher contrast) than that used for correcting buildings in an image. In this way, the human faces may be corrected so that they become more visible than buildings.

- Weights \neq corrections
- No disclosure of actual corrections

1250 POR at 17-23.

APPLE-1004 at ¶ [0022] (cited in Petition at, e.g., 18, 21, 25, 26)

Needham Doesn't Apply Different Amounts of a Matched Correction

Needham Doesn't Differentially Apply a Matched Correction as claimed (1250 POR at 17-23).

- Weights \neq corrections

forming feature-based image correction. Such configuration parameters may include one or more feature types 220, one or more feature weights 230, and one or more correction parameters 240. The feature type(s) 220 specifies the type of image feature(s) to be detected. The feature weight(s) 230 indicates the relative importance of specified image feature types. The correction parameter(s) 240 defines the correction operation(s) and the operational parameter(s) used during the correction operation(s).

“These ‘weights’ are different from an amount of a determined correction to apply to two different regions of the image.” Ex. 2001 at ¶ 41 (cited in 1250 POR at 20)

APPLE-1004 at ¶ [0024] (cited in 1250 POR at 20)

Needham Doesn't Apply Different Amounts of a Matched Correction

Needham Doesn't Differentially Apply a Matched Correction as claimed (1250 POR at 17-23).

- Weights \neq corrections

Ex. 2004 at 18:5-6 (cited in 1250 POR at 20-21)

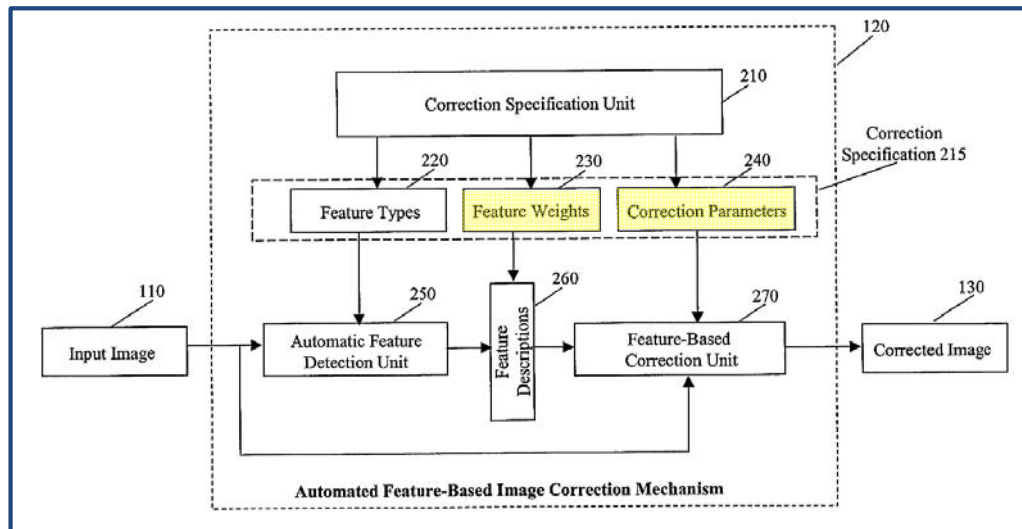
immediately what somebody means. If I say "image correction" to a colleague, they'll say, "Correcting what? What do you mean? What's the context? What

“[A] correction fixes an image portion of [an] image rather than weights a portion of an image based on user preferences.” Ex. 2001 at ¶ 41 (cited in 1250 POR at 20-21)

Needham Doesn't Apply Different Amounts of a Matched Correction

Needham Doesn't Differentially Apply a Matched Correction as Claimed (1250 POR at 17-23).

- No disclosure of actual corrections



- Ex. 2001 at ¶ 41 (cited in 1250 POR at 21): “Needham does not disclose an algorithm for how to determine an amount of correct to be applied from the weights, and ... Needham has several other factors that may affect the correction.”

APPLE-1004 at FIG. 2 (cited in 1250 POR at 21)

Needham Doesn't Apply Different Amounts of a Matched Correction

Needham Doesn't Differentially Apply a Matched Correction as Claimed (1250 POR at 17-23).

45. Needham's disclosure that "the intensity dynamic range used for correcting human faces in an image may be *larger* (corresponding to higher contrast) than that used for correcting buildings in an image" is ambiguous in light of the Needham disclosure in the very same sentence describing "maximizing intensity dynamic range." If the result of the dynamic range correction is that the post-correction dynamic range is maximized, it is only possible to know the amount of the correction if the pre-correction dynamic range and the relationship of that range to the weights is known—something which is not addressed in Needham beyond ambiguous statements such as those cited above.

Ex. 2001 at ¶ 45 (cited in 1250 POR at 21-22)

Petitioner Attempts to Combine Distinct Needham Approaches

Needham's Distinct Approaches (1250 POR at 11-13; 1250 Sur-Reply at 7-11)

- Petitioner purports to find a correction mapping in Needham's ¶ [0020] process and differential application of that correction in Needham's distinct ¶ [0022] process. 1250 Sur-Reply at 11.

[0020] One or more types of correction operations may also be defined for each image feature. For example, both contrast and brightness may be corrected for a specific image feature such as a human face. Further, when one or more correction operations are applied to individual image features, different types of correction operations may be applied to different image features. For example, maximizing the intensity dynamic range (i.e., enhance the contrast) may be performed on a human face image feature and a different correction operation that increases the brightness may be applied to the image feature that represents the sky.

APPLE-1004 at ¶ [0020] (cited in 1250 Sur-Reply at 11)

[0022] Different image features may also be considered with different importance. For example, human faces may be considered as more important than buildings in the input image 110. To accomplish this for example, weights may be assigned to different image features to specify their relative importance. Such weights may be used to control the correction parameter(s) during the correction. For instance, if the correction operation of maximizing intensity dynamic range is applied to both human faces and buildings and a human face feature has a higher weight than a building feature, the intensity dynamic range used for correcting human faces in an image may be larger (corresponding to higher contrast) than that used for correcting buildings in an image. In this way, the human faces may be corrected so that they become more visible than buildings.

APPLE-1004 at ¶ [0022] (cited in 1250 Sur-Reply at 11)

Nonaka Doesn't Match

Nonaka Doesn't Match Correction to Object Type (1250 POR at 26-27).

the darkness cannot be seen. In this state, the face detecting section 11 cannot detect the face. In such a backlight scene, to detect the face, the optimization processing section 5b and the exposure control section 12a perform processing and control so as to brighten the dark part as described later in detail.

APPLE-1005 at ¶ [0042] (cited in 1250 POR at 26)

Q. Paragraph 42 says if a face is not found in the dark area, then the optimization processing section 5b performs the optimization processing section on the dark area; correct?

A. It says that, yeah.

Ex. 2004 at 155:22-153:1 (cited in 1250 POR at 26)

Purported Motivation to Combine Needham and Nonaka?

Petitioner's Reasons for Combining Needham and Nonaka (1250 Petition at 9-10)

- “[T]o apply ... dynamic range correction, enabling both the person and landscape portions of an image to be more easily distinguished and perceived.”
- “Needham and Nonaka both relate to digital image processing ... [and each] include[s] a camera.”

Needham Already Addresses Purported Motivation

Petitioner's Reasons for Combining Needham and Nonaka (1250 POR at 27-32)

- “[T]o apply ... dynamic range correction, enabling both the person and landscape portions of an image to be more easily distinguished and perceived.”

77. Additionally, a POSA would have no reason to modify Needham's image correction techniques with Nonaka's image correction techniques because both Needham and Nonaka are directed to backlight control and improving dynamic range as described above, and yet Needham already maximizes the dynamic range of an image. With Needham already maximizing the dynamic range, there is no reason to add any further processing or change any processing in Needham based on Nonaka's techniques. That is, with dynamic range already maximized there is no reason to further improve dynamic range.

Ex. 2001 at ¶ 77 (cited in 1250 POR at 28-29)

[0019] Correction operations may also be defined on individual image features. For example, a correction operation that maximizes the intensity dynamic range may be defined as the correction operation to be performed on the entire input image according to the contrast of detected human faces. Similar correction operations may also be applied only to the detected human faces.

APPLE-1004 at ¶ (cited in 1250 POR at 299)

Already Solved.

Purported Motivation to Combine Needham and Nonaka?

Petitioner's Reasons for Combining Needham and Nonaka (1250 Petition at 9-10)

- “Needham and Nonaka both relate to digital image processing ... [and each] include[s] a camera.”

Ex. 2001 at ¶¶ 70-71 (cited in 1250 POR at 28-29)

70. Given these differences, I disagree with the assertion in the Bovik Declaration that “[d]esign incentives would also have prompted a POSITA to look to Nonaka to improve the camera of Needham.” (APPLE-1003 at 63). In my opinion, “design incentives” would have taught *away* from such a combination.

The fact that Nonaka pertains to a camera and Needham lists a camera as an example of a “computing device” is not sufficient to provide design incentives favorable to the combination.

71. Rather, it is necessary to look at the functionality and architecture of the respective references. As noted above, Nonaka is directed to an architecture aimed at enabling differential processing for two copies of an image signal at the time of image capture. By contrast, Needham is directed to processing occurring after an image has already been captured. Thus, design incentives would lead a POSITA away from such a combination, as the result of the combination would be a redundant system that unnecessarily provides for more image correction than is needed and in more places in the processing chain than is needed.

Needham and Nonaka Alternate, Not Complementary

No Motivation to Combine Needham and Nonaka (1250 POR at 27-32)

- Needham and Nonaka disclose alternate—not complimentary—processing paths.

66. Another reason a POSITA would not have been led to modify Needham in view of Nonaka is that a POSITA would recognize that Nonaka discloses a system that is both more complex than and incompatible with Needham. Nonaka discloses a system in which the image processing goals associated with displaying a scene while monitoring that scene for potentially photographing it are different than the image processing goals associated with capturing the image. More specifically, Nonaka is directed to using a different amount of correction for a captured image than for a monitored image. In order to accomplish this, Nonaka includes complex hardware and control paths, such that these two different types of corrections can be implemented at the appropriate times and places.

Ex. 2001 at ¶ 66 (cited in 1250 POR at 29-30)

A. So, I mean, Nonaka is describing a wave of, you know, doing image correction which uses an ancillary image.

Ex. 2004 at 135:23-25 (cited in 1250 POR at 30).

69. The POSITA would understand that, by contrast, in Needham the “input image” has already been captured, and that Needham discloses post-processing techniques that are to be performed in a computing device (such as a “personal computer, a laptop, a hand held device, or a camera” (APPLE-1004 at 15)) after capture of the input image.

Ex. 2001 at ¶ 66 (cited in 1250 POR at 29-30).

No Motivation to Combine Needham and Nonaka

No Motivation to Combine Needham and Nonaka (1250 POR at 27-32)

- Needham and Nonaka disclose alternate—not complimentary—processing paths.

“To modify Needham to incorporate [Nonaka’s] architectures would require a very **substantial amount of reengineering** ... relating to the two different processing approaches.” Ex. 2001 at ¶ 68 (cited in 1250 POR at 29-30).

“[T]he result of the combination would be a **redundant system** that unnecessarily provides for **more image correction than is needed** and **in more places in the processing chain than is needed**.” *Id.* at ¶ 71 (cited in 1250 POR at 29-30).

“There would be no reason to bring into Needham an entire extra processing chain that would generate **an output that was never needed or used**. This would be a use of resources that would be **wasteful**.” *Id.* at ¶ 73 (cited in 1250 POR at 29-30).

Design Disincentives / Lack of Reasonable Expectation of Success

Design Disincentives/Lack of Reasonable Expectation of Success: Oversaturation (1250 POR at 32-35)

Nonaka Requires “Pre-Brightening”

the darkness cannot be seen. In this state, the face detecting section 11 cannot detect the face. In such a backlight scene, to detect the face, the optimization processing section 5b and the exposure control section 12a perform processing and control so as to brighten the dark part as described later in detail.

APPLE-1005 at ¶ [0042] (cited in 1250 POR at 33-34)

“[W]ithout [] pre-brightening[,] Nonaka faces may not be detected.” Ex. 2001 at ¶ 74 (cited in 1250 POR at 33-35)

Q. Okay. Hypothetically, if the blackened image of paragraph 42 were run through the steps of paragraph 58, Nonaka wouldn't be able to detect the face; would it?

A. I mean, we started out with "hypothetically," which means I'm stepping outside the embodiment. In any such hypothetical thing, it's a different embodiment. I don't know what's going to happen. Okay. I don't know, for example, what the threshold for darkness is. Okay?

Ex. 2004 at 170:7-14 (cited in 1250 POR at 34-35)

Design Disincentives / Lack of Reasonable Expectation of Success

Design Disincentives/Lack of Reasonable Expectation of Success: Oversaturation (1250 POR at 32-35)

“Pre-Brightening” Would Negatively Impact Needham

The use of these gains on any image that would be processed by Needham would produce unknown results because the pre-brightening does not exist in Needham's system. For example, without the pre-brightening of Nonaka faces may not be detected on which to apply matched corrections. Dr. Bovik appears to agree about the need for pre-brightening. Bovik at 170:7-14.

regions of the image. One consequence of this is the possibility of saturation—that is, of amplifying intensities so that they are clipped by the maximum value that can be represented in the system at issue. This is a very significant drawback for image quality, as it results in the loss of ability to distinguish details that are “washed out” by the saturation process. In fact, these gain values from Nonaka are dependent on

Ex. 2001 at ¶ 74 (cited in 1250 POR at 32-35)

Claim 7: Needham-Nonaka Doesn't Determine Diff. Amounts of Gain

Needham and Needham-Nonaka Don't Disclose Determining Different Amounts of Gain to Apply to Image Portions (POR at 38-39)

- Needham: Weights are not gains and no disclosure of actual corrections (*supra*).
- Needham and Needham-Nonaka:

[0001], [0005]; APPLE-1003, ¶73. Needham and the Needham-Nonaka combination provide a system for dynamic range correction of an image, but does not explain in detail any particular technique for determining the amount of gain to apply. Dvir describes a technique for dynamic range correction that uses a cascade

Petition at 25 (cited in 1250 POR at 39)

Claim 8: Dvir Doesn't Determine Gains, Much Less for Local Contrast

“Dvir [] does not disclose determining gains, let alone determining gains that maintain a local contrast” (POR at 40-41)

No explanation from Petitioner, Dr. Bovik, or Dvir

95. Neither the Petition nor the Bovik Declaration provide rationale connecting the “local contrast” control in Dvir at paragraph 33 with the claim language of “determining the amount of gain” in claim 8. This connection is a key aspect of the claim—the gain determination must be done “so as to” maintain local contrast. The only non-conclusory section of the **Petition** in relation to claim 8 is found on page 27. That page is **silent on gain**. The **Bovik Declaration** addresses the Dvir combination in paragraphs 69 through 74 but **never mentions “gain”** in this section.

Ex. 2001 at ¶ 95 (cited in 1250 POR at 41)

96. The portion of Dvir that mentions “local contrast” (i.e., par 33 and 34) **makes no mention at all of gain**. The disclosure in Dvir of low pass filters (indicated by “LPF” in paragraph 33), other than conveying that the filters would act to reduce or eliminate certain higher spatial frequencies, **does not convey anything specific about gain, or a relationship between determining a gain and maintaining local contrast**. Furthermore, the disclosure in Dvir that “the local

Ex. 2001 at ¶ 96 (cited in 1250 POR at 41)

Claim 8: Dvir Doesn't Determine Gains, Much Less for Local Contrast

“Dvir [] does not disclose determining gains, let alone determining gains that maintain a local contrast” (POR at 40-41)

The '132 Patent and Dvir Are Not the Same (Sur-Reply at 21-22)

Embodiments described below employ a cascade of non-linear edge preserving filters, and nonlinear pixel point operations, to calculate pixel gain or other pixel characteristics (e.g., chromaticity) in order to make object edge detail more visible, i.e., to improve local contrast. Note, however, that other embodiments of the technique introduced here might not use cascaded filters or nonlinear pixel point operations.

APPLE-1001 at 3:28-32 (cited in 1250 Sur-Reply at 22)



[0012] The methods presented below use a cascade of non-linear edge preserving filters, and nonlinear pixel point operations, to calculate the pixel gain or other pixel characteristics, such as chromaticity, that can be employed to make image detail more visible. It suggests a new non-linear combination

APPLE-1007 at ¶ 12 (cited in 1250 Sur-Reply at 22)

Claim 8: Dvir Doesn't Determine Gains, Much Less for Local Contrast

“Dvir [] does not disclose determining gains, let alone determining gains that maintain a local contrast” (POR at 40-41)

[0033] The general embodiment of FIGS. 3 and 4 can include 2 or more cascaded stages. The particular number of active sections in the cascade can be adaptively selected using measurements from the whole image or from sub image block, so that a number sections ranging from one to all of the available sections are applied to the image. In the exemplary embodiments, each section contains a linear filter whose window support length increases with the section number; that is, again referring to FIG. 4, the LPF of section n+1 has larger support than LPF of section n. Since a narrow support filter can track changes more locally than a filter with wider support, the local contrast may be controlled by selectively using various sections in cascade.

APPLE-1007 at ¶ [0033] (cited in 1250 POR at 41)

maintaining local contrast. Furthermore, the disclosure in Dvir that “the local contrast may be controlled” refers to the local contrast at the output of the processing. By contrast, to “maintain” local contrast requires specific consideration of the contrast before the processing as well as affirmative steps to ensure a similar output contrast—something that is not discussed in Dvir.

Ex. 2001 at ¶ 96 (cited in 1250 POR at 41)

Claim 8: POSITA Would Not Combine Needham and Dvir

A POSITA wouldn't have combined Needham and Dvir (POR at 41-43)

“In my experience, edge preserving have **mixed results**—that is, sometimes they can lead to **significant degradations** ... because... [they] create[] changes in non-edge portions of an image.” Ex. 2001 at ¶ 86 (cited in 1250 POR at 42)

Generically “achieve [**unexplained**] superior image quality.” Petition at 24.



For edge-preserving filters “it can be **very hard** to identify suitable parameter choices,” and such choices need to be tailored to “**particular image[s]**.” *Id.* (cited in 1250 POR at 42).

For some images, “there is **no good parameter choice** that can avoid unwanted image degradation.” *Id.* (cited in 1250 POR at 42).

Adding edge-preserving filters to Needham would have required “**reengineering** ..., additional **processing burden**...[, and] additional **complexity**.” *Id.* at ¶ 85 (cited in 1250 POR at 42).

Gallagher's "gain map" is not the claimed gain map (1250 POR at 45-46)

- "Gain" in the '132 Patent is related to the brightening or darkening of an image region. *Supra*.

Returning to FIG. 1, the image $i(x,y)$ is passed into the gain map generator 2. The purpose of the gain map generator 2 is to create a map indicating the gain of the sharpening operation on a pixel-by-pixel or region-by-region basis based on semantic labels derived from pattern recognition. The gain map is a control signal used to determine the level of sharpening to apply on a pixel-by-pixel basis. U.S. Ser.

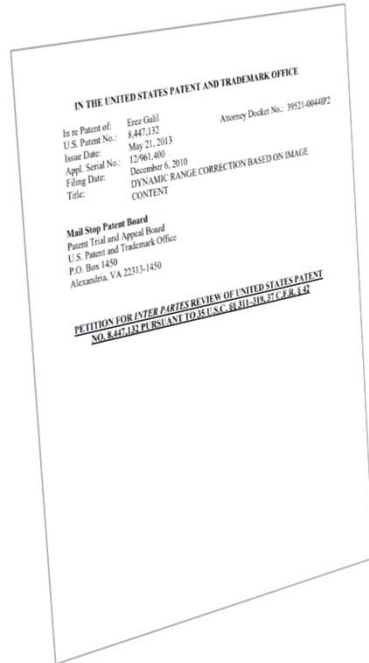
APPLE-1006 at 6:26-31 (cited in 1250 POR at 46)

Ex. 2001 at ¶ 109 (cited in 1250 POR at 46)

109. Unsharp masking, the goal of Gallagher, is a technique I have taught many times in my Digital Image Processing graduate course at UCLA, and is a method aimed at making edges more visible. The "gain" in unsharp masking determines the extent to which the processing aims to enhance edge visibility. This is accomplished through processing that is structured in a way that avoids either brightening or darkening regions of the image, and is instead with the specific goal of making edges more visible. Thus, while the term "gain" is used in association with unsharp masking, in that context it has a different meaning than used in claim 13.

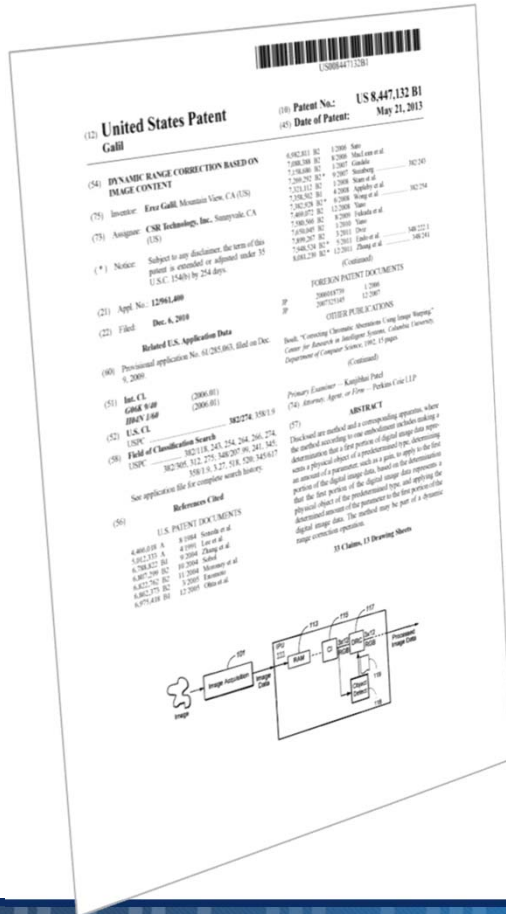
1251 Proceeding | Petitioner's Grounds

- 1251 Petition at 2:



Ground	'132 Patent Claims	Basis for Rejection
Ground 2A	1, 6	§103 – Zhang in view of Konoplev
Ground 2B	5, 7, 8	§103 – Zhang in view of Konoplev and Nonaka
Ground 2C	11, 14	§103 – Zhang in view of Konoplev, Nonaka, and Gonzalez

'132 Patent – Independent Claim 1



1. A method comprising:

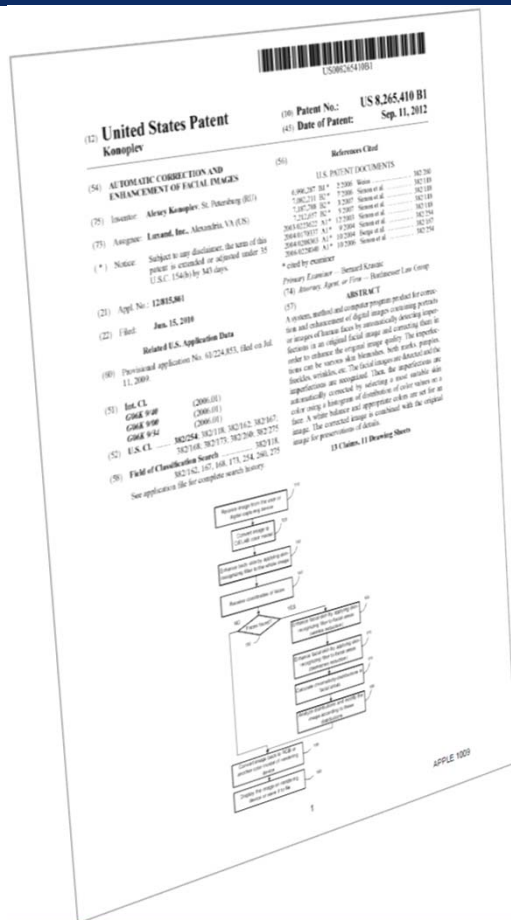
determining whether a first portion of digital image data represents a physical object of a predetermined type;

determining a correction to apply to the first portion of the digital image data, based on a determination that the first portion of the digital image data represents a physical object of the predetermined type, wherein the determined correction is matched to the predetermined type;

applying the determined correction to the first portion of the digital image data to enhance a visual characteristic of the first portion of the digital image data, by applying a first amount of the correction to the first portion of the digital image data; and

applying a second amount of the correction to a second portion of the digital image data, wherein the first amount differs from the second amount, and wherein the first amount corresponds to a physical object of the predetermined type.

Konoplev Claim 1



1. A method for enhancing a facial image, the method comprising:
- (a) receiving an original image;
 - (b) converting the original image into a device-independent color model;
 - (c) processing the converted image through a skin recognition filter;
 - (d) detecting faces in the converted image;
 - (e) processing the converted image using wrinkle reducing parameters,
- wherein an initial filtering radius and a final filtering radius are set, and repeating steps (c)-(e) while the initial filtering radius is increased until the initial filtering radius reaches the final filtering radius;
- (f) reducing blemishes in the converted image;
 - (g) calculating at least one chromaticity distribution in a facial area of the converted image; and
 - (h) analyzing the chromaticity distribution and modifying the facial areas of the converted image based on the distribution analysis.

Konoplev Is Not Entitled to Priority – Wrinkle Reducing Parameters?

“processing the converted image using wrinkle reducing parameters.”

– APPLE-1009 at Cl. 1(e), 13(e); 1251 POR at 21-23; 1251 Petition at 5-6

Petition at 5-6 alleges supported in Konoplev Provisional (APPLE-1012) at:

- Paragraph [0025] (one sentence)
- Paragraph [0027] (one sentence)
- Paragraph [0044] (two sentences)
- Paragraph [0047] (two sentences)

Konoplev Provisional Fails to Support Wrinkle Reducing Parameters

“processing the converted image using wrinkle reducing parameters.”

APPLE-1012 at ¶ [0025]:

“In one aspect of the invention there is provided a method for automated enhancement of digital images containing portraits or images of human faces by correcting imperfections such as wrinkles, skin blemishes, freckles, pimples, etc.”

Dr. Villasenor (Ex. 2005 at ¶ 47*):

“The citation from paragraph 25 does not mention ‘wrinkle reducing parameters,’ and instead only generically mentions ‘correcting imperfections such as wrinkles.’ This fails to disclose either what the parameters are or how they are to be used in wrinkle reduction.

*cited in 1251 POR at 21-22

Konoplev Provisional Fails to Support Wrinkle Reducing Parameters

“processing the converted image using wrinkle reducing parameters.”

APPLE-1012 at ¶ [0025]

“... correcting imperfections such as wrinkles ...”

Dr. Bovik (Ex. 2004 at 115:10-14*):

Q. Is that sentence enough to inform a POSITA how to process a converted image using wrinkle-reducing parameters?

A. Well, no. It's not intended to. ... This is not an algorithm.

*cited in 1251 POR at 21-22

Konoplev Provisional Fails to Support Wrinkle Reducing Parameters

“processing the converted image using wrinkle reducing parameters.”

APPLE-1012 at ¶ [0027]

“Then, parts of the image containing human faces are processed through the smoothing filter using a different set of filtering parameters for wrinkle removal.”

Dr. Villasenor (Ex. 2005 at ¶48*):

“Paragraph 27 also contains only generic mentions of correcting wrinkles, stating that this is accomplished ‘through the smoothing filter using a different set of filtering parameters.’ This again fails to disclose either what the parameters are or how they are to be used in wrinkle reduction. A POSITA would need this information in order to be able to implement the processing without substantial experimentation.

*cited in 1251 POR at 22

Konoplev Provisional Fails to Support Wrinkle Reducing Parameters

“processing the converted image using wrinkle reducing parameters.”

APPLE-1012 at ¶ [0044]

“A level to which the pixel needs to be colored over is determined by the reverse proportion of a difference of a tone used for coloring over and the color of the pixel. The analogous parameters are used for wrinkle identification, while a higher level of the pixel coloring over is used.””

Dr. Villasenor (Ex. 2005 at ¶49*):

“Paragraph 44 mentions wrinkles only in association with wrinkle identification, which a POSITA would understand to be distinct from wrinkle reduction.”

*cited in 1251 POR at 22

Konoplev Provisional Fails to Support Wrinkle Reducing Parameters

“processing the converted image using wrinkle reducing parameters.”

APPLE-1012 at ¶ [0044]

“...The analogous parameters are used for wrinkle identification, while a higher level of the pixel coloring over is used.”

Dr. Villasenor (Ex. 2005 at ¶49*):

- “This distinction is supported, for example, by paragraph 47, which refers to a filter applied to *detected* areas, confirming that processing (such as to reduce wrinkles) on detected areas to change pixel values is distinct from the prior step of identifying the areas that are to be subjected to processing.”

*cited in 1251 POR at 22

Konoplev Provisional Fails to Support Wrinkle Reducing Parameters

“processing the converted image using wrinkle reducing parameters.”

APPLE-1012 at ¶ [0047]

“If faces are found in the image, the facial skin is enhanced by the skin recognition filter applied to detected facial areas of the image. The filter uses wrinkle reducing parameters.”

Dr. Villasenor (Ex. 2005 at ¶50*):

- “Paragraph 47 contains only the generic statement that enhancements are performed using a filter applied to ‘detected facial areas’ and that ‘[t]he filter uses wrinkle reducing parameters,’ which a POSITA would understand as failing to disclose either what the parameters are or how they are to be used in wrinkle reduction. Without this information, a POSITA would not be able to implement the processing without substantial experimentation.”

*cited in 1251 POR at 22

Konoplev Provisional Fails to Support Wrinkle Reducing Parameters

“processing the converted image using wrinkle reducing parameters.”

Wands Factors

- “significant amount of experimentation would be necessary” Ex. 2005 at ¶53*
- “high-level” and “conclusory” statements that “do[] not explain how to do the correction” and provide no “direction or guidance regarding how to specifically identify [wrinkle reducing factors].” Ex. 2005 at ¶54*
- “does not present any working examples at the level of detail that a POSITA would need to furnish the parameters” Ex. 2005 at ¶55*
- “many filtering options that can be used on an image. However, for a particular application, the identification of the right filter and the right parameters for that filter would be a complex and time consuming task.” Ex. 2005 at ¶56*

*cited in 1251 POR at 23-27

Konoplev Provisional Fails to Support Wrinkle Reducing Parameters

“processing the converted image using wrinkle reducing parameters.”

Wands Factors (cont.)

- “The impact of a specific choice of filter and parameters on an image would be hard for a POSITA to predict at the level of accuracy needed to know whether that choice is suitable. An additional complication is that the right choice of parameters for one image (or one region of an image) may not be the right choice for another image (or another region of the image). Ex. 2005 at ¶57*
- “wide latitude in the ways in which a POSITA could implement processing, and the parameters that could be used in that processing.” Ex. 2005 at ¶58*

*cited in 1251 POR at 23-27

Zhang + Konoplev – Zhang Does Not Correct the Face

Zhang does not apply a first amount of selected correction to the first portion corresponding to a face.

- “Zhang does not treat the transition region as part of the foreground, which Petitioner contends teaches the claimed ‘first portion.’”

1251 Institution Decision at 11-12

Zhang + Konoplev – Zhang Does Not Correct the Face

“Zhang does not treat the transition region as part of the foreground, which Petitioner contends teaches the claimed ‘first portion.’”

- APPLE-1008 at ¶¶27-30* (“a head transition region 43, which is an unknown region coupled to the head region and the background”)
- APPLE-1008 at ¶¶33-35* (“a body transition region 53, which is an unknown region coupled to the body and the background”)

*cited in 1251 POR at 38

Zhang + Konoplev – Petitioner’s Konoplev Theory Is Skin Smoothing

“face corresponds to the claimed ‘physical object of a predetermined type’”

1251 Petition at 24 (citing APPLE-1001 at 2:18-21, 2:65-3:3).

“determining a correction to apply to the first portion [face] of the digital image data ... was commonly known Konoplev teaches determining a correction (e.g., smoothing) to apply to a face portion of the digital image data”

“Because Konoplev describes the smoothing filter as being applied only to the detected face and skin areas to remove skin imperfections, this correction is matched to the face and skin areas.”

1251 Petition at 25-26 (emphasis added)

Zhang + Konoplev – Konoplev Does Not Fix Zhang

- **“a POSITA would have recognized that the predictable modification to Zhang as suggested by Konoplev would include smoothing the detected face and skin areas and blurring the background”**

1251 Petition at 28; APPLE- 1017 at ¶60 (cited in POR at 46)

- **“A POSITA would have understood that Konoplev’s skin smoothing and Zhang’s background blurring are different amounts of the same type of correction, and that Konoplev’s smoothing, being applied to only the face and skin areas, corresponds to the face and skin.”**

1251 Petition at 28.

Zhang + Konoplev – Dr. Bovik Explains Petitioner's Theory

“A POSITA would have understood that the skin smoothing applied in Konoplev and the background blurring applied in Zhang are different amounts of the same type of correction, and that Konoplev’s skin smoothing, being applied to only the face and skin areas, corresponds to the face and skin.”

APPLE-1017 at ¶ 60 (cited in Petition at 28, POR at 46).

“A POSITA would have also recognized that the filtering parameters applied in Konoplev to remove wrinkles and round spots are different than the filtering parameters applied in Zhang to blur the background.”

APPLE-1017 at ¶ 60 (cited in Petition at 28, POR at 46)

Zhang + Konoplev – Konoplev Does Not Fix Zhang

- Applying different smoothing parameters with respect to facial skin is not the claimed “*determining a correction to apply based on the determined object.*”
1251 POR at 42 (citing Ex. 2005 at ¶¶69-71)
- Not what the Petition asserts.
 - “The *detected skin areas are processed through a smoothing filter* using filtering parameters for removing skin imperfections.” 1251 POR at 42-43 (citing Petition at 25-26)
- Different.
 - “[N]othing in the disclosure of Konoplev to teach applying a first amount of any of the “different parameters” (e.g., noise removal, skin imperfection removal, or wrinkle reduction) to the first portion of the image (i.e., the face) and a differing amount of that same parameter of the “different parameters” to a second portion of the image (i.e., skin other than the face).
1251 POR at 43 (citing APPLE-1009 at 3:35-45; Ex. 2005 at ¶¶69-71)

Image Capture vs. Post-Processing

Zhang enhances focus during image capture; Konoplev filters in post-processing

81. A POSITA would understand that, when doing image capture, time is of the essence, in order to, as Zhang discloses, enable a portrait to be taken “quickly and effectively.” The POSITA would also understand that, in addition to the time pressure associated with image capture, there are processing power constraints and battery life considerations, particularly given the limited energy storage capability of mobile electronic devices.

82. Konoplev, by contrast is directed to *post-processing*; that is, the processing that can be performed on an image after it has already been captured. This is confirmed in multiple places. For example, the first block in Figure 1 of Konoplev is labeled “[r]eceive image from the user of digital capturing device,” making it clear that the subsequent processing is performed *after* the capturing process, not as part of that process. In addition, Figure 9 of Konoplev is shown below:

Image Capture vs. Post-Processing

Time of the Essence for Zhang's Image Capture; Must Be Fast and Power-Efficient

81. A POSITA would understand that, when doing image capture, time is of the essence, in order to, as Zhang discloses, enable a portrait to be taken “quickly and effectively.” The POSITA would also understand that, in addition to the time pressure associated with image capture, there are processing power constraints and battery life considerations, particularly given the limited energy storage capability of mobile electronic devices.

Ex. 2005 at ¶81 (cited in POR at 50)

Image Capture vs. Post-Processing

Konoplev's Post-Processing Is Computationally Complex, Impractical at Capture

84. A POSITA reading Konoplev would understand the operations disclosed in Konoplev are computationally complex and suited to after-the-fact digital enhancements that would have been impractical and unnecessary to implement at the moment of capture. The POSITA would further understand that the Konoplev disclosures were aimed at improving over the methods then available in “digital photo editor kits” (1:27), which were commonly known to be utilized after an image had been captured, and not as part of the initial capture process.

Ex. 2005 at ¶84 (cited in POR at 51)

Petition:

- “**face** corresponds to the claimed ‘physical object of a predetermined type’”
1251 Petition at 24 (citing APPLE-1001 at 2:18-21, 2:65-3:3).
- **BUT:** “Nonaka teaches applying different amounts of amplifying correction and contrast emphasis to the **person portion** (i.e., the first portion) of a digital image than the amounts applied to the landscape portion (i.e., the second portion) of the digital image”
1251 Petition at 35 (citing APPLE-1005 at ¶¶47-50)
- “[T]he luminance of an outdoor part (the landscape) rises from E0 to E1, and the luminance of an indoor part (**the person**) rises from F0 to F1.”
1251 POR at 56 (citing Ex. 2005 at ¶53)

Zhang + Konoplev + Nonaka – Destroys Functionality of Zhang

Petition:

- Incorporation of Nonaka's teachings further improves Zhang's system by providing functionality for improving visibility of a person in a backlit scene.
1251 Petition at 31
- **BUT:** "Nonaka teaches applying different amounts of amplifying correction and contrast emphasis to the person portion (i.e., the first portion) of a digital image than the amounts applied to the landscape portion (i.e., the second portion) of the digital image"

1251 Petition at 35 (citing APPLE-1005 at ¶¶47-50)

Zhang + Konoplev + Nonaka – Destroys Functionality of Zhang

Petition:

- “A POSITA would have recognized that the predictable modification to the Zhang-Konoplev combination would include **applying amplifying correction and contrast emphasis (i.e., dynamic range correction)** as suggested by Nonaka so that both the person and landscape portions of an image can easily be seen.”

1251 Petition at 31

- **BUT: “Modification of Zhang’s disclosed invention to employ different amounts of contrast emphasis in both image regions, as allegedly disclosed by Nonaka, would fail to enhance focus of the portrait, which is the stated purpose of Zhang, because the background would not be blurred.”**

1251 POR at 57 (citing APPLE-1005 at ¶¶99-102)

Purported motivations to add Gonzalez include

- “more detailed discussion of digital image fundamentals and the processing techniques utilized by the Zhang-Konoplev-Nonaka combination”
- “all relate to digital image processing”
- “The processing techniques described in [these references] include object detection, color/brightness/contrast adjustments, and smoothing filters”
- “design incentives ... [Gonzalez] is a useful resource for a POSITA ... describes different techniques that are available for contrast enhancement, smoothing, color balance, and object detection.”
- “expected results and is within the capability of a POSITA”

1251 Petition at 42-44

Gonzalez “motivations” are meaningless

116. With respect to the supposed value of adding Gonzalez, the above is **conclusory and overly generic**. The Bovik Declaration’s statement that “Gonzalez’s teachings provide a POSITA with a more detailed discussion of digital image fundamentals and the processing techniques utilized by Zhang and Konoplev” (Bovik Decl. at ¶85) **does not respond at all to any purported shortcomings** that a POSITA would identify with Zhang-Konoplev and seek to remedy by incorporating “a more detailed discussion of digital image fundamentals.”

Ex. 2005 at ¶116 (cited in POR at 63-64); *see also* Ex. 2005 at ¶¶114-120.