

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

3D SYSTEMS CORPORATION AND 3D SYSTEMS, INC.,

Petitioner,

v.

INTREPID AUTOMATION, INC.,

Patent Owner

IPR2025-01241

U.S. Patent No. 11,014,301

PATENT OWNER'S RESPONSE

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PATENT OWNER'S EXHIBIT LIST

Exhibit	Description
2015	Declaration of David Rosen, Ph.D. (“Rosen Decl.”)
2016	Transcript of March 10, 2026 Deposition of Dr. Yong Chen (with errata) (“Chen Dep.”)

I. INTRODUCTION

U.S. Patent No. 11,014,301 (“the ’301 Patent”) (Ex. 1001) claims a novel multiple image projection system for additive manufacturing. The invention of the ’301 Patent uses multiple image projectors, each of which projects a sub-image, where the sub-images are blended to a composite image on the build area, thereby enabling large illumination areas with high pixel density and high energy density suitable for large-scale, high-speed 3D printing. Ex. 1001, 3:56-63. As one of ordinary skill in the art would have known, there are a number of issues with projector systems that can cause the projected light to be distorted, because the formation of a seamless composite image from light projected from multiple sources requires the manipulation of light intensity in various and often conflicting ways, and because the reaction dynamics of resin is much different and less tolerant to deviations than the human eye, which is the audience for prior art multiple projection display systems. Ex. 1001, 5:8-27. To develop a DLP multiprojection 3D printer capable of repeatedly producing commercially viable parts in a production environment, a system was needed to manage and precisely adjust the properties of the light projected by the n projectors in a multiple projection system.

The '301 Patent claims a novel, non-obvious solution to the light management problem inherent in multiple-projector additive manufacturing. The ’301 Patent claims a “stack” or “set” of four types of digital filters overlayed upon a base source

file to adjust the light projected by the plurality of projectors in different ways. The stack or set of filters comprises a warp correction filter, which performs geometric correction (adjusting the placement of the pixels incident on the surface to account for distortions) and three separate filters that all manage the intensity of the projected light in different ways to accomplish different purposes: (i) an irradiance mask that normalizes radiant power per unit (i.e., irradiance) across a sub-image or composite image; (ii) a gamma adjustment mask that remaps pixel-intensity levels to an addressable range of energy for curing the resin and thereby reducing aliasing artifacts; and (iii) and a blending bar filter on one or more of the sub-image edges, allowing edges of the sub-image that overlap with other sub-images to be faded out so as to “blend” the transition between sub-images.

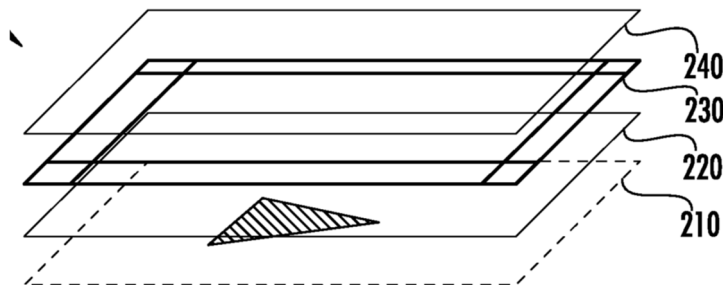


FIG. 2A

Importantly, the '301 Patent's stack of digital filters work as a set – each adjustment has a cascading effect on the other properties. Further, the '301 Patent's filter-based approach is designed for production-scale deployment. Unlike prior art

systems, the '301 Patent's adjustments do not require modification of the base source file. Instead, the '301 Patent's digital filters are applied (or overlaid) to a base file (i.e., part of the instructions used to define the geometry of a part to be printed by the system) rather than changing the base file itself, which is advantageous because different filters can be used in different situations, or changed periodically, without changing the base source file. Ex. 1001, 4:23-32.

Petitioner proposes three grounds for unpatentability, all of which disclose a multi-projector 3D printer with some form of geometric adjustment and some form of light intensity control. However, none of the proposed combinations disclose all four types of light management, let alone the use of a stack or set of four digital filters to do so. Petitioner's proposed grounds do not invalidate any claim of the '301 Patent because the prior art in each ground fails to disclose at least one of the following limitations of the challenged independent claims 1 and 11:

- “a stack of filters configured to adjust the properties of each sub-image in the array” / “adjusting properties and aligning a position of each sub-image in the array using a set of filters”;
- “an irradiance mask configured to normalize irradiance” / “an irradiance mask that normalizes irradiance”;
- “a gamma adjustment mask configured to adjust sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing resin of the resin pool, thereby reducing aliasing artifacts

of curved or smooth surfaces” / “a gamma adjustment mask that adjusts sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing the resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces”;

Furthermore, Petitioner’s reliance on the Sekine reference (Ex. 1005) as primary reference in connection with Ground 2 relies on the combination of multiple discrete embodiments without showing that one of ordinary skill in the art would be motivated to combine the various embodiments in the manner described by the Petition. Finally, Petitioner fails to show that many of the dependent claims are anticipated or rendered obvious by the relied-upon prior art, for reasons in addition to those set forth with respect to the independent claims.

II. PERSON OF ORDINARY SKILL IN THE ART

Petitioner proposes that a POSITA at the time of the claimed invention would have had a master’s degree in mechanical engineering, industrial engineering, optics, or a similar field, with industry experience in additive manufacturing; or a bachelor’s degree with a subset of that course work and 2-3 years of additive manufacturing experience. Pet. at 18-19. Patent Owner applies that description of a POSITA herein.

III. CLAIM CONSTRUCTION

Petitioner proposes that “[f]or purposes of this Petition, Petitioner applies plain-and-ordinary meaning to all terms.” Patent Owner herein applies the plain-and-ordinary meaning, as understood by a POSITA in accordance with the

specification and the prosecution history. *Phillips v. AWH Corp.*, 415 F.3d 1030, 1303 (Fed. Cir. 2005). Patent Owner does not believe construction of any term is necessary to resolve the issues set forth herein. However, Patent Owner notes that Petitioner does not appear to have applied the plain and ordinary meaning of “normalizing irradiance” advanced by its own expert declarant. To the extent this term requires construction, Patent Owner believes that “normalizing irradiance” should be given its plain and ordinary meaning, which is “causing the image to have a uniform irradiance range across the entire image.” *See* Declaration of David Rosen, Ph.D. (“Rosen Decl.”) (Ex. 2015) ¶¶ 54-59.¹

IV. PETITIONER’S PROPOSED INVALIDITY GROUNDS FAIL

A. Ground 1 Fails

In Ground 1, Petitioner contends that claims 1-20 of the ’301 Patent are anticipated by U.S. Patent No. 8,666,142 (“Shkolnik”) (Ex. 1004). As shown below, Petitioner has failed to satisfy its burden of showing that Shkolnik discloses all claimed limitations of claims 1-20. *See* 37 C.F.R. § 42.104(b)(4) (a petition for *inter*

¹ Petitioner’s declarant, Dr. Yong Chen, describes the plain and ordinary meaning of an irradiance mask that normalizes irradiance as being applied such that the image has a uniform irradiance range across the entire image. *See* Chen Decl. (Ex. 1003) ¶¶ 49-50; Chen Dep. (Ex. 2016) 44:11-45:21.

partes review “must identify how the construed claim is unpatentable under the statutory grounds on which the petitioner challenges the claims, and must specify where each element of the claim is found in the prior art patents or printed publications relied upon.”) As shown below, Petitioner has failed to satisfy its burden of showing that Shkolnik discloses all claimed limitations of claims 1-20.

1. Shkolnik does not disclose “an irradiance mask configured to normalize irradiance” (Claims 1-10) or “an irradiance mask that normalizes irradiance” (Claims 11-20)

Independent claim 1 recites “an irradiance mask configured to normalize irradiance.” Similarly, independent claim 11 recites “an irradiance mask that normalizes irradiance.” As the ’301 Patent explains, irradiance masks are applied to an image such that the image has a uniform irradiance range across the entire image:

Another example of a type of digital filter that can be used to adjust an image is an irradiance masking filter, where the filter applies a normalizing irradiance mask to an image (or each sub-image in a composite image) such that the image (or composite image) has a uniform irradiance range (i.e., from zero exposure to a maximum exposure limit) across the area.

Ex. 1001, 11:22-28 (emphasis added); Ex. 2015 ¶ 57. The ’301 Patent also presents a specific example of the irradiance mask:

Example 1: Irradiance Mask

In this example, an image projector outputs across its projected area a solid white image where, when measured (e.g., by a calibration fixture described herein), the pixels in the top left corner are 5% less bright (i.e., 5% lower irradiance) than elsewhere in the field of view. An irradiance mask is applied that acts as a “burn filter” (i.e., a filter that decreases or increases the irradiance in a pattern, locally, or uniformly across an image). The irradiance mask, when applied to the solid white image, brings the 100% bright pixels elsewhere in the image down to 95% in order to create a uniform irradiance across the whole image.

Ex. 1001, 23:10-23 (emphasis added).

Shkolnik, however, does not disclose the use of an irradiance mask to normalize irradiance across an image. Citing Dr. Chen, Petitioner claims that “Shkolnik teaches **adjusting** sub-image **irradiance** to an ‘ideal,’ ‘standard,’ ‘**compensation**,’ level, of which a POSITA would recognize as normalizing irradiance or intensity.” Pet. at 27 (emphasis in original); *see also* Ex. 1003 ¶ 144 (“Shkolnik specifically teaches adjusting irradiance to match an ‘ideal,’ ‘standard,’ ‘compensation,’ or ‘normalized’ irradiance—all of which the POSITA would treat as meaning the same thing.”). This statement is demonstrably false.

First, Shkolnik does not specifically teach adjusting irradiance to match an “ideal,” “standard,” or “normalized” irradiance. Shkolnik typically uses the term “ideal” with regard to performing geometric correction, and never in connection

adjusting irradiance to match an “ideal irradiance.” *See, e.g.*, Ex. 1004, 5:38-54; Ex. 2016, 120:2-121:2 (admitting Shkolnik does not use the term “ideal irradiance”); Ex. 2015 ¶¶ 64-66. Shkolnik uses the term “standard” three times, and only once with respect to intensity. But this mention of “standard” intensity refers not to irradiance normalization but to edge-blending, reducing the output of the portion of a sub-image that overlaps with another sub-image “so that the *combined* intensity is standard.” Ex. 1004, 34:15-28; *see also id.*, 12:28-40 (using “standard” twice to refer to standard file types); Ex. 2016, 72:16-73:14 (admitting Shkolnik does not use the term “standard irradiance”); Ex. 2015 ¶ 67. This disclosure relates to the functionality of the ’301 Patent’s “blending bar,” not its “irradiance mask that normalizes irradiance.” Ex. 2015 ¶ 67. Shkolnik uses “normalization” only once to refer to normalizing the thickness of the *resin* within a 3D printer, not intensity of light. Ex. 1004, 35:27-3 (“The photopolymer may be laid, the thickness normalized, and transported to a moveable platform/support plate 112.”); Ex. 2016, 72:16-73:14 (admitting Shkolnik does not use the term “normalized irradiance”); Ex. 2015 ¶ 68. None of these references disclose *irradiance normalization* to a POSITA. Ex. 2015 ¶ 69.

Contrary to Petitioner’s argument, Shkolnik’s disclosure of “intensity compensation” does not disclose irradiance normalization. Shkolnik discloses that

one can use a pattern correction map to perform generic and unexplained “intensity compensation,” in addition to specifically-described geometric correction:

This pattern correction map may include **positional compensation** (e.g., to adjust linear and nonlinear distortions) and may also provide for intensity compensation. In general, the compensation may include **X and Y positional offsets** for each pixel associated with a bitmap. The **positional offsets** are added to the original **bitmap coordinates** to generate the corrected bitmap pattern.

Ex. 1004, 5:42-53. The pattern correction map is described with specificity as it relates to geometric (i.e., “positional”) corrections such as positional offsets. *Id.* The specification goes on to provide, in great detail, positional corrections that can be made with a pattern correction map and how to perform them. *See e.g.*, Ex. 1004, 7:10-37, 14:32-15:25; Ex. 2015 ¶¶ 70-76. The reference to “may also provide for intensity compensation” is an add-on; Shkolnik does not disclose what type of intensity adjustments can be performed or how one can use a pattern correction map to make those adjustments. Ex. 2015 ¶ 65.

Indeed, the phrase “intensity compensation” is a general term that can refer to any number of adjustments related to the intensity of light projected by a projector. Dr. Chen admits that the term “intensity” as used in Shkolnik is a high-level term that means “the ‘brightness’ of light striking a given pixel or voxel . . . either alone or in combination with the exposure time of the pixel or voxel.” Ex. 1003 ¶ 144. As

Dr. Chen acknowledged in deposition, the term “intensity compensation” *can* encompass a wide array of adjustments, including (i) manipulating intensity of the pixels of the portions of each sub-image within an overlap region (the ’301 Patent’s blending bar) (Ex. 2016, 53:6-54:6); (ii) manipulating individual pixel intensity values to ensure an even, uniform irradiance range across the image (the ’301 Patent’s irradiance mask) (Ex. 2016, 84:21-85:22); and (iii) “grayscale” (Ex. 2016, 90:9-91:10). Thus, the general reference to “intensity compensation” encompasses any change to the brightness levels of projected pixels; the term does not require or even suggest irradiance normalization. Ex. 2015 ¶¶ 65-69, 75-76.

Petitioner’s citations further underscore that Shkolnik does not disclose the use of an irradiance mask that normalizes irradiance. Petitioner argues that “Shkolnik teaches adjusting sub-image irradiance to an ‘ideal,’ ‘standard,’ ‘compensation,’ level, of which a POSITA would recognize as normalizing irradiance or intensity. EX1004, 16:5-13.” Pet. at 27. The cited passage from Shkolnik has nothing to do with irradiance uniformity and indeed does not use the terms “ideal” or “standard,” only a general and unexplained reference to “compensation methods.”

In step **1220**, imager **106** captures the pattern generator calibration pattern **412, 414** and the image may be communicated to controller **120**. However, other systems may be involved in the calibration/correction

methods and compensation methods, and as discussed herein, controller **120** is used to indicate a processor having processing methods that may be distributed to other components within or outside of machine **100**.

Ex. 1004, 16:5-13. Nothing in this passage discloses, suggests, or even hints to one of ordinary skill to apply a normalizing irradiance mask. Ex. 2015 ¶¶ 75-76.

Other citations to Shkolnik describe various different uses of intensity compensation, none of which are the normalization of irradiance across a sub-image. Shkolnik, 10:7-14 discusses modifying intensity and exposure time, “together or separately,” to “produce the desired total exposure value.” Ex. 2015 ¶¶ 62-63. Shkolnik, 9:47-51 discusses that “intensity is typically expressed as an integer number (e.g., 0 . . . 255)” and that “the intensity value may be compensated or adjusted before being sent to the pattern generator, or may be compensated or adjusted at the pattern generator or both.” Ex. 2015 ¶¶ 62-63. But at no point does Shkolnik reference or suggest normalizing the irradiance range across the image. Ex. 2015 ¶¶ 61-76.

2. **Shkolnik does not disclose a “gamma adjustment mask configured to adjust sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces” (Claims 1-10) or “a gamma adjustment mask that adjusts sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing the resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces” (Claims 11-20)**

Independent claim 1 recites, as one of the stack of digital filters configured to adjust the properties of each sub-image in the array, a “gamma adjustment mask configured to adjust sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces.” Similarly, independent claim 11 recites, as part of a set of filters, “a gamma adjustment mask that adjusts sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing the resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces.” As the ’301 Patent explains, “[t]he reactivity of the resin can change based on the resin composition (e.g., pigments, photo-initiators, photo-initiator concentrations, etc.).” Ex. 1001, 12:2-4. Furthermore, “resins tend to have nonlinear response curves with respect to energy.” *Id.*, 12:4-6. The gamma adjustment mask “provides **resin reactivity levelling** and **enables correct smoothing (and/or antialiasing)** of pixels by **mapping the pixel intensity**

range to the minimum and maximum reactivity characteristics of the pixel.”

Id., 12:6-10.

The '301 Patent further illustrates a number of examples of resin-specific gamma adjustment calculations of varying complexity that can be used in a gamma adjustment mask.² The '301 Patent discloses determining resin-specific minimum effective energy values (E_0) and maximum effective energy values ($E_{\max}$), noting that the latter may relate to a physical constraint of the system. Ex. 1001, 12:47-61. Ex. 2015 ¶¶ 79-80. The '301 Patent discloses various formulae that can be used to map the pixel intensity to a power per unit area in the build plane “which takes advantage of the full dynamic range of pixel intensity levels that will yield cured resin.” *Id.*, 13:10-19. Fig. 14 shows a flowchart of how an exemplary gamma correction calculation for use in a gamma adjustment mask can be determined:

² The '301 Patent discloses various types of gamma correction relationships, including logarithmic functions, continuous functions (e.g., a polynomial or asymptotic function), a piece-wise continuous function (e.g., containing different polynomials or logarithmic functions for different regions of the relationship), or can be non-analytical (e.g., can be based on a look-up table). Ex. 1001, 13:30-38.

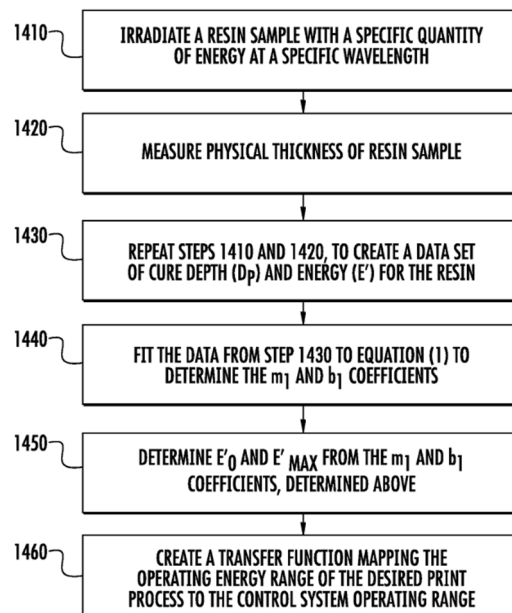


FIG. 14

The claimed gamma adjustment mask remaps the pixel intensity values (e.g., 0-255) to the addressable range of reactivity for curing a resin in order to increase “the number of gray-scale levels available which is beneficial to minimize aliasing artifacts from curved or smooth surfaces being produced on an inherently square-pixel based projection system.” Ex. 1001, 23:26-32. “Before gamma correction, therefore, the full range of pixel intensities (e.g., 0-255 in this example) cannot be achieved.” *Id.*, 24:50-52. After the gamma correction of the non-limiting example, the minimum energy per unit required to produce a minimum cure depth now corresponds to a pixel intensity of 0 and the pixel intensity required to produce a maximum cure depth is 255. *Id.*, 24:60-65. “In other words, the above gamma correction methods enable the full dynamic range of pixel values to be achieved

(and/or, a higher fidelity of pixel values to be achieved.)” *Id.*, 24:65-25:1. This gamma adjustment mask takes maximum advantage of the grayscaling offered by the intensity value range to maximize fabrication accuracy. Ex. 2015 ¶ 83.

Shkolnik discloses “reducing aliasing artifacts of curved or smooth surfaces,” specifically a positional correction to account for smooth surfaces which, in part, uses adjusted sub-image energy, but does not disclose “mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing resin of the resin pool.” While Shkolnik identifies the problem that gamma correction is designed to fix (namely, the non-linear, non-uniform reactivity of resin), Shkolnik provides no solution to the problem. Ex. 2015 ¶¶ 84-86.

Shkolnik discusses the problem of 3D printing smooth or curved surfaces, namely (i) the projector cannot manipulate light intensity at the sub-pixel level; and (ii) pixels are square.³ Shkolnik discusses “grayscaling,” utilizing pixel intensities that are neither fully on (e.g., 255 pixel intensity) or fully off (e.g., a 0 pixel intensity), but somewhere in between. Ex. 2015 ¶¶ 86. Shkolnik discloses the use

³ Shkolnik discusses this issue in the context of voxels, instead of pixels. Voxels are just 3D pixels, adding additional information (such as pixel intensity or duration of cure) to the x-y coordinates of the pixel. Where pixels are square, voxels are cuboid, leading to the same issue with smoothed surfaces. Ex. 2015 ¶ 87.

of grayscaled pixels – with pixel intensity values determined based on the extent of overlap between the part and the voxel at the x-y coordinate – to allow the system to perform a **positional correction** to mitigate the jagged edges problem. *See generally*, Ex. 1004 Fig. 1MA-MG and 23:54-25:60; Ex. 2015 ¶¶ 87-95.

Shkolnik's use of grayscaling in this "voxelized construction" process is not gamma adjustment, nor does it disclose gamma adjustment. Ex. 2015 ¶ 87-95. As Petitioner's expert explains, gamma adjustment relates to adjustments that are made to account for the reactivity of resin:

[T]he general concept of gamma adjustment/correction/calibration at a high level relates to making adjustments to a photocuring process **to account for the unique chemistry and physics of a specific photocurable resin** (e.g., with reference to that resin's working curve), particularly with respect to the light exposure. Gamma adjustment or correction thus occurs any time a photocuring process parameter (e.g., curing time or irradiance) is selected **based on the specific resin used**.

Ex. 1003 ¶ 55 (emphasis added).

However, Shkolnik's voxelized construction process is **resin agnostic, determined by volumetric overlap without any regards to resin reactivity**. Ex. 2015 ¶¶ 84, 94. As illustrated in Figs. 1MA to 1MG, Shkolnik's antialiasing technique is a **geometric correction**, using grayscale pixels to (i) identify the boundary area; (ii) determine the orientation or direction of the boundary area; (iii)

calculate a boundary offset; (iv) provide a geometric correction to move the boundary; and (v) determine new intensity values for the boundary pixels, again using the **volumetric overlap to assign the intensity values**. Ex. 2015 ¶¶ 87-95.

Importantly, Shkolnik uses the initial intensity values as a signal to help the system identify a boundary. “Figure 1MA is an example of an original voxel data set **180** having intensity information for each voxel. Four voxels {**G21**, **G22**, **G23**, **G24**} are shown as having intensities {210, 30, 21, 255} respectively.” Ex. 1004, 23:54-57. Figure 1MB shows an example of making a boundary determination for a component using the intensity voxel in each data set. “For example, where there are numerous full intensity voxels (e.g., an intensity of 255 on a 0-255 scale) these sections may be deemed to be part of the inner body portion of the component. Similarly, where there are voxels with less than full intensity, these voxels may be deemed as voxels that may define the boundary of the component (e.g., the inner/outer features or the inner/outer surface of the component). Using the gray scale information from original voxel data set **180**, the boundary can be determined.” Ex. 1004, 23:65-24:5. The intensity values are determined based on the overlap between the component and the voxel:

In general, when using a voxelized construction process, the intensity of a voxel corresponds to the volume that the component will occupy in the voxel volume at a predetermined depth. The intensity of the voxel

(corresponding to a curing depth for that voxel) may thus be related to the cuboid shaped volume (e.g., of the voxel) that the work piece will occupy.

Ex. 1004, 24:14-20. The intensity values allow the system to reconstruct the component “for later use in the geometric correction methods.” *Id.*, 24:31-34.

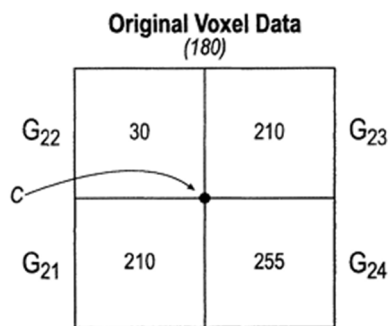


FIG. 1MA

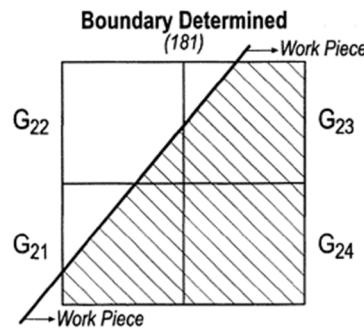
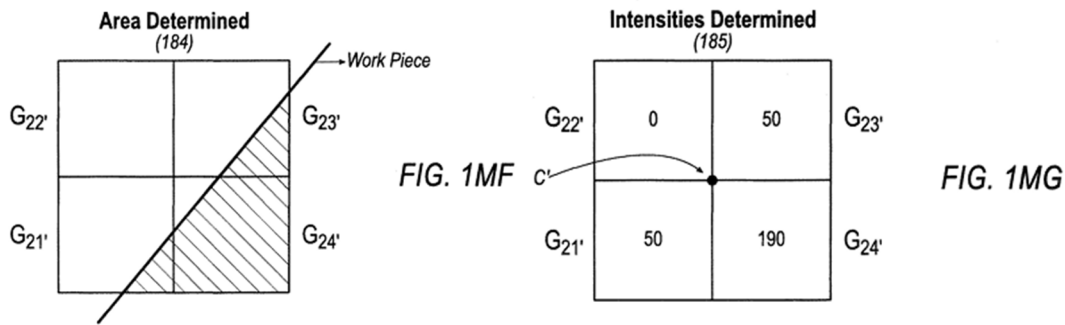


FIG. 1MB

Figures 1MC through 1ME, and the corresponding disclosure, set forth a geometric correction technique which determines a boundary offset and shifts the voxels either by full voxel or by fractional portions (e.g., where voxelized construction is used).

Figures 1MF and 1MG show the determination and assignment of corrected intensity for each voxel. As with the initial intensity values, the corrected intensity values “are based on the area covered by the component at the boundary.” Ex. 1004, 25:25-33.



These corrected voxel data set (including the new positional information and new intensity information) is then sent to the pattern generators at the appropriate time. *Id.*

Notably absent from Shkolnik's disclosure is any method or technique to account for the reactivity of the resin within the resin tub. Shkolnik acknowledges that resin reactivity curves are non-linear and material dependent but does not disclose any specific method, let alone the claimed method, for accounting for these properties. Ex. 2015 ¶¶ 86, 94.

In sum, Shkolnik identifies the problem, known to one of ordinary skill, that resin reactivity curves are material specific and tend to be non-linear. But Shkolnik fails to provide a mechanism for addressing the problem, much less the claimed gamma adjustment mask. Ex. 2015 ¶¶ 84, 94.

Even if one assumes (as Petitioner essentially asks this panel to do) that the system described in Shkolnik performs some resin-specific adjustment in connection

with its geometric gray scaling correction. such adjustment is made offstage and off of the page. There is simply no suggestion that any resin-specific adjustment is done, let alone utilizing a **stack of filters** which includes a gamma adjustment **mask** configured to adjust sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing resin of the resin pool. Ex. 2015 ¶ 86.

3. **Shkolnik does not disclose “wherein the gamma adjustment mask further comprises a transfer function that maps an operating energy range of a printed layer to a control system operating range, wherein the control system operating range is a quantized set of values” (Claims 3 and 13)**

Claim 3, which is a dependent claim of claim 1, and claim 13, which is a dependent claim of claim 11, are not anticipated for the same reasons that claims 1 and 11 are not anticipated. *See* Sections IV.A.1, IV.A.2, *supra*. In addition, because Shkolnik does not disclose a gamma adjustment mask that “further comprises a transfer function that maps an operating energy range of a printed layer to a control system operating range, wherein the control system operating range is a quantized set of values,” claims 3 and 13 are not anticipated.

4. **Shkolnik does not disclose “wherein the gamma adjustment mask comprises a logarithmic relationship between a cure**

depth of the resin and energy per unit area in the build area” (Claims 4 and 14)

Claim 4, which is a dependent claim of claim 1, and claim 14, which is a dependent claim of claim 11, are not anticipated for the same reasons that claims 1 and 11 are not anticipated. *See* Sections IV.A.1, IV.A.2, *supra*. In addition, because Shkolnik does not disclose a gamma adjustment mask that “comprises a logarithmic relationship between a cure depth of the resin and energy per unit area in the build area,” claims 4 and 14 are not anticipated.

Moreover, Petitioner misapprehends the claim language when it argues that this claim limitation is inherently disclosed. Petitioner contends that “for any photocurable resin, the relationship between a cure depth of the resin and energy per unit area is always logarithmic.” Pet. at 33; Ex. 1003 ¶ 165. Claims 4 and 14 do not claim a resin that has a logarithmic relationship between its cure depth and energy per unit area; rather, claims 4 and 14 claim a gamma adjustment mask that has such a logarithmic relationship. The '301 Patent expressly discloses several non-logarithmic gamma correction methods that may be employed:

For example, rather than logarithmic, the relationship between cure depth (DO) and the energy per unit area (E') can follow another continuous function (e.g., a polynomial, or asymptotic function), a piece-wise continuous function (e.g., containing different polynomials or logarithmic functions for different regions of the relationship), or can be non-analytical (e.g., can be based on a look-up-table). Similar

relationships as those shown in FIGS. 5A-5B and equations (1)-(7) will still apply in these situations, and the same gamma correction concepts, systems and methods as those described herein can be used.

Ex. 1001, 13:32-42.

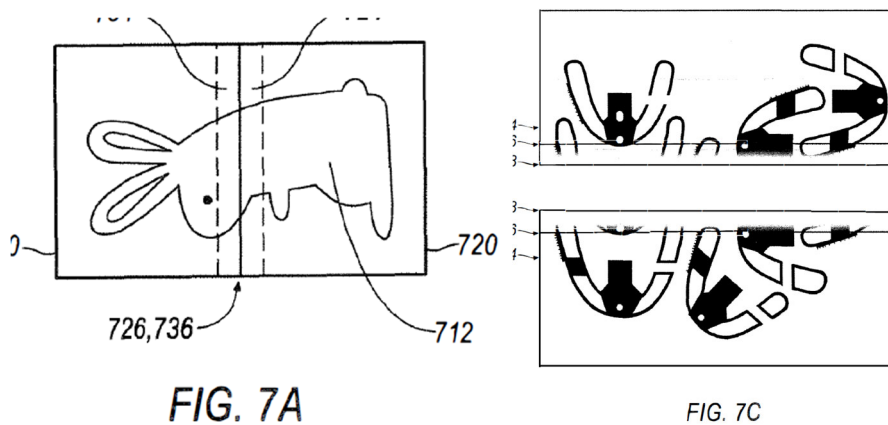
In any event, since Shkolnik does not disclose a gamma adjustment mask, let alone a gamma adjustment mask that “comprises a logarithmic relationship between a cure depth of the resin and energy per unit area in the build area,” claims 4 and 14 are not anticipated.

5. Shkolnik does not disclose “wherein adjacent sub-areas overlap by a percentage of their areas, wherein the percentage is from 50% to 100% to increase a local power within the composite image” (Claims 7 and 17)

Claim 7, which is a dependent claim of claim 1, and claim 17, which is a dependent claim of claim 11, are not anticipated for the same reasons that claims 1 and 11 are not anticipated. *See* Sections IV.A.1, IV.A.2, *supra*. In addition, Shkolnik lacks a disclosure “wherein adjacent sub-areas overlap by a percentage of their areas, wherein the percentage is from 50% to 100% to **increase a local power** within the composite image.”

Shkolnik discusses intensity compensation in areas of overlap between two or more sub-images, but Shkolnik’s disclosure is focused on minimizing the overlap area. Shkolnik teaches that **reducing the overlap area** is desirable. Ex. 1004, 1:40-41 (“The pattern generators may be aligned to **reduce** gaps, voids, or **excessive**

overlap of pattern generation.”); Ex. 1004, 34:7-10 (“Due to the potential for overexposure of reactive material 118, a **reduced number of pixels for overlap pixel region** 726, 736 account for the sensitivity of reactive material 118.”). All of the figures in Shkolnik that address intensity compensation within the overlap region depict a narrow overlap region. For example, the overlap regions in Figures 7A and 7C are much less than 50% (and likely less than 10%).



Moreover, Shkolnik does not teach an enlarged overlap region in order to increase intensity within the overlap area. Shkolnik teaches the opposite, to **reduce intensity in the overlap region** to avoid overexposure of the resin. Ex. 1004, 34:10-14 (“Alternatively, the intensity of the pixels from pattern generators 102, 104 that account for overlap pixel region 726, 736 may be reduced in intensity (e.g., 50% from each pattern generator 102, 104) to reduce over-exposure of reactive material 118 at overlap portions 728, 738.”). In contrast, claims 7 and 17 of the ’301 Patent require using the overlapping region to increase the local power. Ex. 2015 ¶ 96.

Petitioner misleadingly suggests that the reduction of overexposure disclosed in Shkolnik is somehow optional. Pet. at 35 (“When both pattern generators are used to generate an overlap region, Shkolnik teaches that the effect of the overlap can be local ‘over exposure,’ and such over exposure, if desired, can be mitigated (or not) by reducing the intensity output ‘so that the combined intensity is standard.’”) (emphasis added). Nowhere in Shkolnik is there any suggestion that overexposure is desirable, nor is there any disclosure of strategic use of the overlap area to increase local power. Ex. 2015 ¶¶ 97-99.

B. Ground 2 Fails

In Ground 2. Petitioner contends that claims 1-20 of the ’301 Patent are obvious in view of WO 2017/154564 A1 (“Sekine”) (Ex. 1005) together with U.S. Patent Application Publication No. 2017/0102679 (“Greene”) (Ex. 1006). As shown below, Petitioner has failed to satisfy its burden of showing that the combination of Sekine together with Greene discloses all claimed limitations of claims 1-20.

- 1. The system of the proposed combination does not disclose “a stack of filters configured to adjust the properties of each sub-image in the array” (Claims 1-10) or “adjusting properties and aligning a position of each sub-image in the array using a set of filters” (Claims 11-20)**

The ’301 Patent claims the use of a stack of four types of digital filters to adjust the properties of each sub-image in the array of projectors. These filters are “applied (or overlaid) to a base source file (i.e., part of the instructions used to define

the geometry of a part to be printed by the system), rather than changing the base source file itself.” Ex. 1001, 4:23-26. The use of filters is advantageous because different filters can be used in different situations, or changed periodically, without changing the base source file. *Id.*, 4:26-29. The ’301 Patent provides, by way of example, that the same base source file can be used with different resins by applying different gamma correction filters (associated with each different resin) to the unchanged base source file. *Id.*, 4:29-32. As a person of ordinary skill would appreciate, it was common practice in single-projector DLP systems to have the base source files modified offline to generate new source files, with the modified source files then uploaded to the projector system for printing. Ex. 2015 ¶ 51. The ’301 Patent’s four-fold digital filter approach thus departs from the practice of a POSITA at the relevant time. Ex. 2015 ¶ 52.

In contrast, Sekine discloses nine numbered “Embodiments,” none of which disclose a stack or set of digital filters. Embodiment 1, which is described from paragraph [0013] through paragraph [0060], provides an overall description of a 3D printing device that uses 25 projectors arranged in a 5x5 configuration. Ex. 1005 at [0013]. Importantly, in Embodiment 1, adjustment of the overlapping regions of the projected images is made only mechanically. *Id.*; *see also* Ex. 1005 at [0038]-[0057] (describing the use of actuators to mechanically adjust the position of the image forming element to correct positional displacement and tilt).

Unlike the set of filters described and claimed in the '301 Patent, the embodiments described in Sekine are not designed to work together. Some embodiments, such as Embodiments 2 and 3, discuss the modification of the exposure images to make adjustments instead of through mechanical means. *See, e.g.*, Ex. 1005 at [0061] (“In Embodiment 1, the position and tile of the image forming element 23 were mechanically adjusted to adjust the boundary region of the adjacent projection regions. In contrast, in embodiment 2, the image forming element 23 is not moved, and the position of the shaped product 30 on the exposure image on the image forming element 23 is corrected.”). That is, Embodiments 2 and 3 propose alternative means of exposure image adjustment that are not intended to work together. Further, as one of ordinary skill would understand, modification of exposure images is not the same thing as employing a digital filter. Ex. 2015 ¶ 109.

Petitioner, however, cobbles together various aspects from different embodiments in Sekine in a hodgepodge manner, entirely ignoring the fact that the disclosed embodiments in Sekine are in many instances incompatible with each other. For example, regarding the “stack of filters” limitation, Dr. Chen states:

The '301 Patent refers to these correction mechanisms as “filters” or “masks.” The translation of Sekine from the original Japanese describes these mechanisms using different terms, such as “illuminance correction control” or “alignment control.” *See, e.g.*, Sekine (EX1005), [0042], [0073]. However, the concept is exactly the same.

Ex. 1003 ¶ 226.

However, Dr. Chen's reference here to "alignment control" comes from paragraphs [0042]-[0049] of Sekine, which is directed to embodiment 1 and describes a **mechanical adjustment** of the image forming element, physical moving and tilting the image forming element:

As illustrated in FIG. 4B, by moving the image forming element 23 in the XY plane, the projection image TG moves in the plane of the image formation position 28. By **tilting the image forming element** 23 in the XY plane, the projection image TG is adjusted for tilt angle in the plane of the image formation position 28.

Ex. 1005 at [0048]. And to the extent that "alignment control" were being performed in other Embodiments in Sekine, any such alignment control is performed through modification of exposure images, and not through a digital filter. Therefore, Sekine does not disclose the stack or set of filters claimed in the '301 Patent.

Petitioner relies on Greene as a secondary reference specifically as it relates to a gamma adjustment mask. Petitioner does not suggest that Greene discloses the use of "a stack of filters configured to adjust the properties of each sub-image in the array" or "adjusting properties and aligning a position of each sub-image in the array using a set of filters." It does not.

Accordingly, Petitioner has failed to show that the proposed combination discloses this "stack of filters" or "set of filters" claim limitation.

2. The system of the proposed combination does not disclose “an irradiance mask configured to normalize irradiance” (Claims 1-10) or “an irradiance mask that normalizes irradiance” (Claims 11-20)

The irradiance mask of the '301 Patent is configured to **normalize** irradiance. As the '301 Patent explains, irradiance masks are applied to an image such that the image has a uniform irradiance range across the entire image. Ex. 1001, 11:22-28 (filter applies a normalizing irradiance mask to an image such that the image “has a uniform irradiance range (i.e., from zero exposure to a maximum exposure limit) across the area”); Ex. 1001, 23:10-23 (irradiance mask creates “a uniform irradiance across the whole image.”).

Sekine does not disclose an irradiance mask that normalizes irradiance for three reasons. First, Sekine discloses an adjustment to the brightness difference between adjacent sub-images, teaching an illumination control method that does not attempt to normalize the irradiance range within an area. Second, the use of Sekine's method would not correct the irradiance non-uniformity problem addressed by the irradiance mask of the patent and, indeed, would potentially create additional problems. Third, Sekine's illumination control method teaches away from the use of a mask or digital filter, instead teaching modification of the underlying source file or adjustment of the light source.

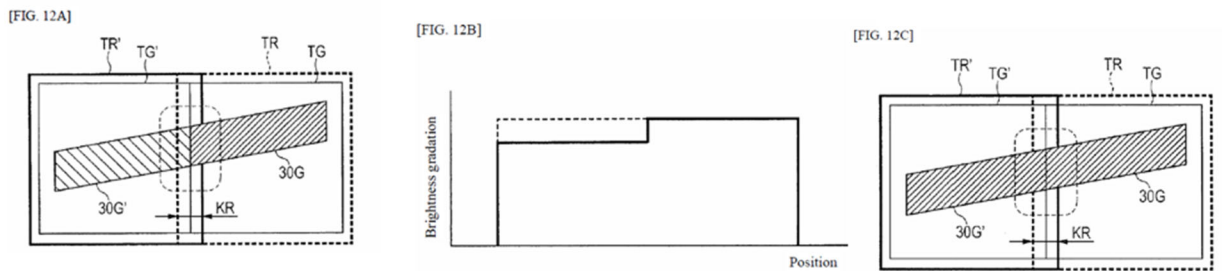
The irradiance masking filter of the '301 Patent “applies a normalizing irradiance mask to an image (or each sub-image in a composite image) such that the image (or composite image) has a **uniform irradiance range (i.e., from zero exposure to a maximum exposure limit) across the area.**” Ex. 1001, 11:25-28. The Patent provides an example in which the pixels in the top left corner of a projected are 5% less bright than the pixels across the image. An irradiance mask is applied to “**bring the 100% bright pixels elsewhere in the image down to 95% to create a uniform irradiance across the image.**” Ex. 1001, 23:10-23. As explained, the irradiance mask filter can decrease or increase the irradiance “in a pattern, locally, or uniformly across an image.” *Id.* The key feature of the irradiance mask of the patent is that it *normalizes* the irradiance range, i.e., creates a uniform irradiance across the whole image, whether sub-image or composite image. *Id.*

The illuminance control method of Sekine, however, does not attempt to create a uniform irradiance across the whole image. Instead, Sekine, and specifically Embodiment 3 relied upon by Petitioner, concerns itself with reducing streak patterns by adjusting the illuminance or brightness difference between adjacent sub-images in the boundary region between the two images. Ex. 1005 at [0070]. The prefatory paragraphs introducing Embodiment 3 includes broad language that, considered in isolation and divorced from discussion of Sekine’s actual disclosure, may sound like irradiance normalization; however, a skilled artisan reviewing

Sekine's Embodiment 3 as a whole would understand that Sekine discloses a method to minimize differences near the boundary of adjacent sub-images without regards to non-uniformities across the sub-image or composite image.⁴ Ex. 2015 ¶ 114.

Sekine's Embodiment 3 discloses an illuminance correction method, illustrated by Figure 12A (before correction), Figure 12B (brightness correction), and Figure 12C (after correction). Sekine's illuminance correction is focused entirely on the difference between brightness in the boundary region of adjacent sub-images to the detriment of irradiance normalization across either image.

⁴ Embodiment 3 spans Paragraphs 70-80 with discussion of Figures 11 and 12[a-c]. Petitioner cites only the introduction to Embodiment 3 (paragraphs [0070]-[0071]) and Fig. 11, a high-level flowchart which identifies the step of "calculate brightness difference of adjacent projection images S44" and "correct exposure image S45," but does not identify the illuminance adjustment is calculated and implemented. Neither Petitioner nor its expert Dr. Chen discuss the operation of Embodiment 3 (paragraphs [0073]-[0080]) or Figures 12[a-c] which illustrate how Sekine's illuminance adjustment is calculated and implemented.



Sekine detects “the **portion located in the boundary region KR**” of the product projection image spanning two projection images and the illuminance correction amount is determined. Ex. 1005 at [0075]. The CPU compares the **average illuminance** of the **portions in the boundary region** of projection images 30G and 30G’ “to determine the illumination correction amount.” Ex. 1005 at [0077]. Sekine then “modifies the exposure images RG of each layer . . . so that the brightness gradation of the shaped product in the original exposure image RG changes by **exactly the illuminance correction amount.**” Ex. 1005 at [0078].

A skilled artisan would understand that Sekine’s method minimizes brightness discrepancies in the boundary region of adjacent sub-images without normalizing irradiance. Sekine’s method ignores non-uniformity of irradiance across the sub-image or the composite image. As Dr. Rosen explains, the use of Sekine’s method to minimize brightness differences in the overlap would not normalize irradiance.

To illustrate that the Sekine method does not normalize irradiance, Dr. Rosen compares the effect of applying the Sekine method to two adjacent projectors that each project an image with an irradiance distribution like the one described in

Example 1 of the '301 Patent, where the pixels in the upper left corner of the image are 5% dimmer than the rest of the image. *See* Ex. 2015 ¶¶ 119-120. As Dr. Rosen explains, because the Sekine method only evaluates the average irradiance in the boundary region to calculate the “illuminance correction amount,” any nonuniform irradiance distribution in the boundary region persists after the Sekine “illuminance correction amount” is applied. Ex. 2015 ¶¶ 121-125 and Illustrations 4a-4d.

Dr. Rosen notes that similar problems arise with the Sekine method if the two projected images each has a different non-uniform irradiance distribution. Again, the Sekine method fails to normalize the images because the application of an “illuminance correction amount,” a constant, does not resolve the non-uniform distribution of a projected image. *See* Ex. 2015 ¶¶ 126-128 and Illustrations 5a-5c.

Finally, whatever illumination control Sekine teaches, it does not disclose that its method be performed using an irradiance mask. Sekine teaches away from the use of a digital filter to provide illuminance control, instead disclosing that the base source files (e.g., a bitmap file) be modified or that the intensity of the light source be adjusted.

Sekine teaches that the “CPU **modifies the exposure images RG of each layer** used for subsequent shaping of the shaped product 30 so that the brightness gradation of the shaped product in the original exposure image RG changes by exactly the illuminance correction amount.” Ex. 1005 at [0079]. A person of

ordinary skill, reviewing Sekine Embodiment 3 in its entirety, would understand Sekine's reference to modifying the "exposure images" to mean modifying the layer data itself (e.g., the individual bitmap or png files).

Note, as Petitioner cites without explanation, Sekine further explains that "it is also possible to adjust the illuminance of the entire projection image TG by **changing the output of the light source.**" Ex. 1005 at [0080]; *see also* Ex. 1005 at [0073] (referring to the light source 21 as "one example of adjustment means"). One of ordinary skill in the art would understand that changing the output of the light source is contrary to the use of an irradiance mask. Ex. 2015 ¶ 129.

Petitioner relies on Greene as a secondary reference specifically as it relates to a gamma adjustment mask. Petitioner does not suggest that Greene discloses the use of a "an irradiance mask configured to normalize irradiance." It does not.

3. The system of the proposed combination does not disclose "wherein adjacent sub-areas overlap by a percentage of their areas, wherein the percentage is from 50% to 100% to increase a local power within the composite image" (Claims 7 and 17)

Claim 7, which is a dependent claim of claim 1, and claim 17, which is a dependent claim of claim 11, are not obvious for the same reasons that claims 1 and 11 are not obvious. *See* Sections IV.B.1, IV.B.2, *supra*. In addition, Sekine lacks a disclosure "wherein adjacent sub-areas overlap by a percentage of their areas,

wherein the percentage is from 50% to 100% to **increase a local power** within the composite image.”

Sekine discloses that “when overlapping of the optical images of the pattern occurs, regions set for ultraviolet light incidence overlap, resulting in a local exposure amount that is doubled.” Ex. 1005 at [0072]. However, Sekine describes this doubling of the local exposure amount as something to be avoided, as it causes streak patterns in the shaping direction. *Id.* (“the degree of polymerization of the resin material 10 in that part increases, or pattern dimensions become thicker, causing streak patterns in the shaping direction.”). Instead of using this increase in local power, Sekine teaches the desirability of “lower[ing] the illumination of the ultraviolet light so that the total irradiation amount from both adjacent regions equals that of the non-overlapping region.” *Id.* Nowhere in Sekine is there any suggestion that overexposure is desirable, nor is there any disclosure of strategic use of the overlap area to increase local power. *See* Ex. 2015 ¶¶ 136-140.

4. The system of the proposed combination does not disclose “warp correction filter corrects skew in projected images that are caused by variation in alignment within the build area” (Claims 8, 18)

Claim 8, which is a dependent claim of claim 1, and claim 18, which is a dependent claim of claim 11, are not obvious for the same reasons that claims 1 and 11 are not obvious. *See* Sections IV.B.1, IV.B.2, *supra*. In addition, Sekine does

not disclose a warp correction filter where the “warp correction filter corrects skew in projected images that are caused by variation in alignment within the build area.”

Regarding claims 8 and 18, Petitioner simply states:

As noted above for claim 1, Sekine discloses multiple types of sub-image adjustments, where multiple adjustment types can be used in the same print job to correct multiple types of errors. EX1005, [0042], [0073]. With respect to corrections caused by variation in alignment within the build area, Sekine provides a detailed description at [0108]-[0111], for example. Chen ¶264.

Pet. at 66 (claim 8); *see also* Pet. at 71 (claim 18, citing Pet. at 66).

Curiously, while Petitioner cites paragraphs [0108]-[0111] of Sekine, Petitioner neglects to include any quotations from Sekine at all in support of its claim – and for good reason. The “correction” described in Sekine is not a digital filter; instead, Sekine describes a **mechanical adjustment** to the projectors.

Paragraphs [0106]-[0112] of Sekine relate to “Embodiment 7,” which discloses the calibration of a 3D printing device. Ex. 1005 at [0106] (“Embodiment 7 describes the calibration of the three-dimensional shaping device 100.”). Paragraph [0107] describes the use of a camera 130 and a projector 20 in the calibration process of Embodiment 7. The camera 130 is mounted on an XY stage 72, while the projector 20 is mounted on an XY stage 74. Control unit 110 **operates the XY stages** 72 and 74, thereby allowing the control unit to adjust the positions of

the camera 130 and projector 20. Ex. 1005 at [0107] (“In calibration, the control unit 110 operates the XY stages 72 and 74 to **adjust the positions of the camera 130 and projector 20.**”). This is a mechanical adjustment, not a digital filter. Ex. 2015 ¶¶ 142-144.

Paragraphs [0108]-[0111] of Sekine describe this calibration in more detail, with the use of an “alignment reference plate” to calibrate the 3D printing device. Again, the projectors of the 3D printing device, which are mounted on XY stage 74, are mechanically positioned:

The control unit 110 processes the captured image to determine the positional displacement amount and tilt amount between the positioning image IG and the indicators IM. Then, the **XY stage 74 is operated to adjust the positional displacement amount and tilt amount**, and to adjust the magnification of the projector 20.

Ex. 1005 at [0111] (emphasis added). Paragraph [0112], which Petitioner ignores, further confirms that this is a mechanical adjustment. Ex. 1005 at [0112] (“Note that calibration is preferably performed, from the perspective of workability and **mechanical adjustment accuracy**, in a state where the resin material 10 is removed from the container 11, as illustrated in FIG. 18.”) (emphasis added).

Petitioner relies on Greene as a secondary reference specifically as it relates to a gamma adjustment mask. Petitioner does not suggest that Greene discloses the use of a warp correction filter where the “warp correction filter corrects skew in

projected images that are caused by variation in alignment within the build area.” It does not.

Accordingly, for this additional reason, Petitioner has failed to show that claims 8 and 18 are disclosed by the combination of Sekine and Greene.

5. The system of the proposed combination does not disclose “warp correction filter corrects skew in projected images that are caused by variation in projector optics” (Claims 9, 19)

Claim 9, which is a dependent claim of claim 1, and claim 19, which is a dependent claim of claim 11, are not obvious for the same reasons that claims 1 and 11 are not obvious. *See* Sections IV.B.1, IV.B.2, *supra*. In addition, Sekine does not disclose a warp correction filter where the “warp correction filter corrects skew in projected images that are caused by variation in projector optics.”

Similar to its argument on claims 8 and 18, Petitioner glibly states the following with respect to claims 9 and 19:

As noted above for claim 8, Sekine discloses multiple types of sub-image adjustments. EX1005, [0042], [0073]. It is well understood that variation in projector optics can cause illuminance and/or alignment errors, and the correction of such errors is discussed at great length in Sekine, including in paragraphs [0108]-[0111]. *See also* EX1005, Figure 2 and [0038]-[0041]. Chen ¶265.

Pet. at 66 (claim 98); *see also* Pet. at 71 (claim 19, citing Pet. at 66).

Here, Petitioner again cites Sekine [0108]-[0111]. As argued above with respect to claims 8 and 18, Sekine [0108]-[0111] describes a **mechanical adjustment**, not a digital warp correction filter. Ex. 2015 ¶¶ 142-144. Petitioner also cites Sekine [0038]-[0041], again without any quotations from Sekine. Here, Dr. Chen admits that the disclosure in Sekine [0038]-[0041] involves the use of actuators to make a **mechanical adjustment** to the image forming element 23:

266. As another example, Sekine teaches that various actuators of the system of Sekine (EX1005) (e.g., actuators denoted as 41-48 and 51-53) can be used to adjust optical elements of individual projectors to correct for displacement and angle errors, for instance. See Figure 2 and [0038]-[0041] of Sekine (EX1005), which are reproduced below for convenience.

Ex. 1003 ¶ 266. Indeed, Sekine makes clear that the adjustment referenced by Petitioners here is not accomplished with the use of a digital warp correction filter, but by the operation of actuators to **physically move** the image forming element 23 into a desired position:

The control unit 110 can adjust the relative position at the boundary region KR of the two adjacent projection images TG by controlling the actuators 41 to 48. The actuators 41, 42, 43, and 44 can move the image forming element 23 in a Y direction by combining their respective expansions and contractions. The actuators 45, 46, 47, and 48 can move the image forming element 23 in an X direction by combining their respective expansions and contractions. The actuators 41, 42, 43, 44,

45, 46, 47, and 48 can rotate the image forming element 23 in a XY plane to adjust the angle, by combining their respective expansions and contractions.

Ex. 1005 at [0039] (emphasis added).

Petitioner relies on Greene as a secondary reference specifically as it relates to a gamma adjustment mask. Petitioner does not suggest that Greene discloses the use of a warp correction filter where the “warp correction filter corrects skew in projected images that are caused by variation in projector optics.” It does not.

Accordingly, Petitioner has failed to show that claims 9 and 19 are disclosed by the combination of Sekine and Greene.

6. Petitioner Has Not Shown that a POSITA Would Be Motivated to Combine Disparate Embodiments of Sekine

An obviousness determination requires finding both “that a skilled artisan would have been motivated to combine the teachings of the prior art . . . and that the skilled artisan would have had a reasonable expectation of success in doing so.” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367-68 (Fed. Cir. 2016).

Although a motivation to combine frequently is raised in the context of combining multiple references, the same analysis applies when a petitioner relies on disparate embodiments within the same piece of prior art. As the Federal Circuit has

explained, the motivation to combine and reasonable expectation prongs apply when “combining multiple embodiments from a single reference”:

Whether a rejection is based on combining disclosures from multiple references, combining multiple embodiments from a single reference, or selecting from large lists of elements in a single reference, there must be a motivation to make the combination and a reasonable expectation that such a combination would be successful, otherwise a skilled artisan would not arrive at the claimed combination.

In re Stepan Co., 868 F.3d 1342, 1345-46 n. 1 (Fed. Cir. 2017).

Here, Petitioner’s reliance on Sekine creates a Frankenstein’s monster, combining no fewer than 5 disparate embodiments described in Sekine in an attempt to identify three of the four filters of the ’301 Patent.⁵ Petitioner relies on:

- Embodiment 1, a system consisting of 25 projectors arranged in a 5X5 array, which discloses **mechanical means of adjustments** to perform geometric correction. *See* Pet. at 44-45, 47-51, 56, 59, 63-64, 66 (citing Embodiment 1, Ex. 1005 at [0013]-[0060]).

⁵ Petitioner does not assert that Sekine discloses the claimed gamma adjustment mask. Petitioner claims that the claimed gamma adjustment mask is disclosed in Greene. Pet. at 52-55; *see also* Ex. 1003 ¶ 122 (acknowledging that Sekine does not disclose gamma adjustment).

- Embodiment 2, a system consisting of 25 projectors arranged in a 5X5 matrix, in which a positional “displacement of the image pattern at the boundary of the adjacent projector images TG can be resolved by **correcting or deforming the individual exposure images RG.**” *See* Pet. at 57-58, 64-65 (citing Embodiment 2, Ex. 1005 at [0061]-[0069]).
- Embodiment 3, a system consisting of 2 adjacent projectors in which streaks are minimized by illumination control is performed based on a comparison of the average intensities of the portion of each image in the boundary region and **modifying the exposure images** based on the difference between the two average intensities. *See* Pet. at 50-51, 60, 65-66 (citing Embodiment 3, Ex. 1005 at [0070]-[0080]).
- Embodiment 6, a system consisting of 2 adjacent projectors, in which the pixel intensity in the overlap region is controlled by **modifying the exposure images** in a linear ramp, decreasing the intensity of each sub-image in the overlap region so that the combined intensity between the two sub-images stays constant. *See* Pet. at 59-60, 64, 66-67 (citing Embodiment 6, Ex. 1005 at [0099]-[0105]).
- Embodiment 7, which discloses the calibration of a 3D printing device, including a plane position adjustment mechanism and an alignment reference plate, describes the use of a camera and a projector to **mechanically adjust** the position of the projector during the calibration process. Ex. 1005 at [0107] (“In calibration, the control unit 110 operates the XY stages 72 and 74 to **adjust the positions of the camera 130 and projector 20.**”). *See* Pet. at 66 (citing Embodiment 7, Ex. 1005 at [0106]-[0112]).

Notably, Sekine itself expressly distinguishes Embodiment 2 from Embodiment 1. Ex. 1005 at [0061] (“In Embodiment 1, the position and [tilt] of the image forming element 23 were mechanically adjusted . . . In contrast, in Embodiment 2, the image forming element 23 is not moved”). Although Petitioner relies on a hypothetical combination and modification of Sekine’s Embodiments 1, 2, 3, 6, and 7, at no point does Petitioner explain how or why a POSITA would combine the various embodiments of Sekine (along with Greene) to arrive at the claimed invention. Instead, Petitioner simply claims that Sekine and Greene are directed to the same general field of improving precision and accuracy in the formation of 3D printed products formed by light projection. Pet. at 72.

Petitioner must explain why a POSITA would have combined the elements disclosed in the separate embodiments described in Sekine. *See KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 418 (2007) (“a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art”). That the elements are disclosed in separate embodiments of the same reference does not excuse this requirement. *In re Stepan*, 868 F.3d at 1345-46 n.1. Because Petitioner failed to address how or why a POSITA would combine the disparate embodiments of Sekine to arrive at the claimed invention, Ground 2 fails.

C. Ground 3 Fails

In Ground 3, Petitioner contends that claims 1-20 of the '301 Patent are obvious in view of Shkolnik together with Sekine. As Shkolnik was the sole reference for Ground 1 and Sekine was the primary reference for Ground 2, Ground 3 accordingly fails for the same reasons that Grounds 1 and 2 fail.

- 1. The proposed combination does not disclose “an irradiance mask configured to normalize irradiance” (Claims 1-10) or “an irradiance mask that normalizes irradiance” (Claims 11-20)**

As discussed in Section IV.A.1, *supra*, Shkolnik does not disclose an irradiance mask configured to normalize irradiance.

As discussed in Section IV.B.1, *supra*, Sekine does not disclose an irradiance mask that normalizes irradiance.

- 2. The proposed combination does not disclose a “gamma adjustment mask configured to adjust sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces” (Claims 1-10) or “a gamma adjustment mask that adjusts sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing the resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces” (Claims 11-20)**

As discussed in Section IV.A.2, *supra*, Shkolnik does not disclose a gamma adjustment filter configured to adjust sub-image energy by mapping a plurality of

pixel intensity levels to an addressable range of reactivity for curing resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces.

Petitioner does not contend that Sekine discloses a gamma adjustment mask configured to adjust sub-image energy by mapping a plurality of pixel intensity levels to an addressable range of reactivity for curing resin of the resin pool, thereby reducing aliasing artifacts of curved or smooth surfaces. Indeed, it does not.

3. The proposed combination does not disclose “wherein the gamma adjustment mask further comprises a transfer function that maps an operating energy range of a printed layer to a control system operating range, wherein the control system operating range is a quantized set of values” (Claims 3 and 13)

As discussed in Section IV.A.3, *supra*, Shkolnik does not disclose a gamma adjustment filter wherein the gamma adjustment mask further comprises a transfer function that maps an operating energy range of a printed layer to a control system operating range, wherein the control system operating range is a quantized set of values.

Petitioner does not contend that Sekine discloses a gamma adjustment mask, let alone one that further comprises a transfer function that maps an operating energy range of a printed layer to a control system operating range, wherein the control system operating range is a quantized set of values.

4. The proposed combination does not disclose “wherein the gamma adjustment mask comprises a logarithmic

relationship between a cure depth of the resin and energy per unit area in the build area” (Claims 4 and 14)

As discussed in Section IV.A.4, *supra*, Shkolnik does not disclose a gamma adjustment filter wherein the gamma adjustment mask comprises a logarithmic relationship between a cure depth of the resin and energy per unit area in the build area.

Petitioner does not contend that Sekine discloses a gamma adjustment mask, let alone a gamma adjustment mask that comprises a logarithmic relationship between a cure depth of the resin and energy per unit area in the build area.

5. Petitioner Has Not Shown that a POSITA Would Be Motivated to Combine Shkolnik With a Specific Embodiment of Sekine

As discussed in Section IV.B.6, *supra*, several disparate embodiments are disclosed in Sekine. Like with Ground 2, Petitioner simply claims in Ground 3 that Shkolnik and Sekine are directed to the same general field of improving precision and accuracy in the formation of 3D printed products formed by light projection. Pet. at 82.

Again, this is insufficient. Petitioner must explain why a POSITA would have combined the elements disclosed in Shkolnik specifically with Embodiment 3 described in Sekine. *See KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 418 (2007) (“a patent composed of several elements is not proved obvious merely by demonstrating

that each of its elements was, independently, known in the prior art”). Because Petitioner failed to address how or why a POSITA would have been motivated to make this specific combination, Ground 3 fails.

Dated: March 19, 2026

Respectfully submitted,

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Pursuant to 37 C.F.R. § 42.24(d), Patent Owner hereby certifies, in reliance on the word count of the word-processing system used to prepare this Paper, that the number of words in this Paper is 10,088. The word count excludes the table of contents, table of authorities, mandatory notices, certificate of service, certificate of word count, appendixes and any claim listings.

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CERTIFICATE OF SERVICE

I hereby certify that the foregoing PATENT OWNER'S RESPONSE was served on March 19, 2026 by filing this document through the Patent Trial and Appeal Case Tracking System (P-TACTS) and via electronic mail upon counsel of record for the Petitioner as follows:

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