



(51) International Patent Classification:

G02C 7/02 (2006.01) G02C 7/06 (2006.01)
G02C 7/04 (2006.01)

(21) International Application Number:

PCT/IB2021/051962

(22) International Filing Date:

09 March 2021 (09.03.2021)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

16/854,058 21 April 2020 (21.04.2020) US

(71) Applicant: **JOHNSON & JOHNSON VISION CARE, INC.** [US/US]; 7500 Centurion Parkway, Jacksonville, Florida 32256 (US).

(72) Inventors: **NANKIVIL, Derek Dean**; 7500 Centurion Parkway, Jacksonville, Florida 32256 (US). **WOOLEY, Benjamin**; 7500 Centurion Parkway, Jacksonville, Florida 32256 (US).

(74) Agent: **SHIRTZ, Joseph F.** et al.; Johnson & Johnson, One Johnson & Johnson Plaza, New Brunswick, New Jersey 08933 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW,

(54) Title: MULTI-LENS SYSTEM FOR PRESBYOPIA

Example power profiles of a comparative three lens system

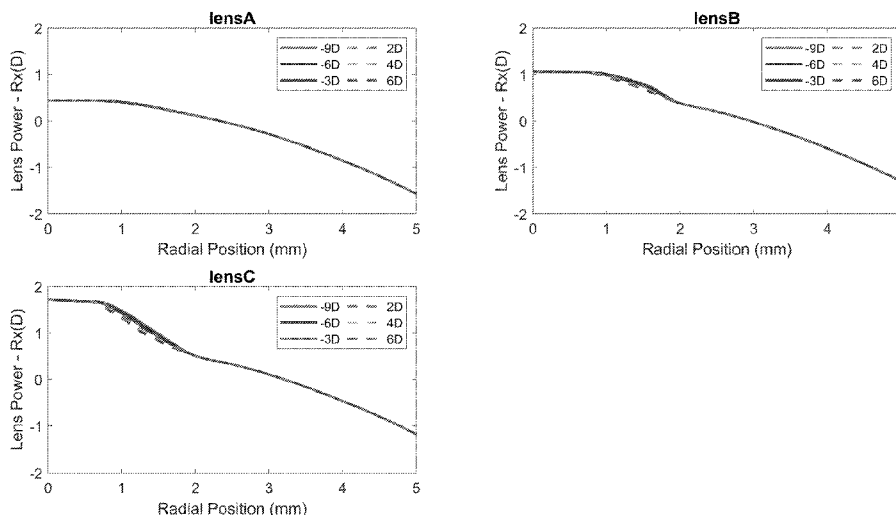


FIG. 1

(57) Abstract: Described herein are systems and/or methods for designing a system of contact lenses with interocular refractive disparity (i.e. anisometropia) for presbyopes. An example method may comprise a step of determining a plurality of lenses for inclusion in a system of contact lenses for treating presbyopes. Each of the plurality of lenses may be configured for an optical correction and may have a power profile associated therewith. The plurality of lenses may be grouped based on the optical correction. Each of the lenses in a particular group may have a different power profile. The example method may comprise a step of creating, based at least on the plurality of lenses and an add need, a fit guide. The fit guide may provide an interocular disparity of effective add. The interocular disparity of effective add may be determined by optimizing cyclopean performance across a range accommodative demands and light levels.



SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

- (84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*
- *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

MULTI-LENS SYSTEM FOR PRESBYOPIA

BACKGROUND

[0001] In general, multifocal or extended depth of focus (EDOF) lenses significantly mitigate the effects of presbyopia, but they require performance trade-offs. Typically, peak distance vision is sacrificed to deliver improved near visual performance. Despite the outstanding visual performance of some of the market leading multifocal simultaneous vision lens systems (Multifocal (MF)), simulations suggest that there is opportunity to improve performance across a range of accommodative demands, particularly at the near.

SUMMARY

[0002] The present lenses, lens system, and methods provide a superior trade-off regarding overall visual performance across a range of accommodative demands over MF. This may be achieved by leveraging the capacity of the visual system to tolerate interocular refractive disparity (i.e. anisometropia) to further increase the cyclopean depth of focus (DOF). Alternatively, or in addition, differing from MF, this design employs more add power, more variation in design across stock keeping units (SKUs), where each SKU distinguishes a different prescription (Rx), and a visual performance manifold optimized fit/refit prescription (e.g., fitting guide).

[0003] Described herein are systems and/or methods for designing a system of contact lenses with anisometropia for presbyopes. An example method may comprise a step of determining a plurality of lens types for inclusion in a system of contact lenses for treating presbyopes. The lens system may comprise at least three lens types (lens A, a lens B, and a lens C designation). The lens types may vary by effective add or DOF, or both. Each of the plurality of lenses may be configured for an optical correction and may have a power profile associated therewith. The plurality of lenses may be grouped based on the optical correction. Each of the lenses of a particular type may have a different power profile. The optical correction normalized power profile across a range of optical corrections for each of the lens designations may be varied to improve performance considering: [1] Rx, age and accommodation dependence of ocular spherical aberration, and/or [2] Rx, age and luminance

dependence of entrance pupil diameter. Other combinations of performance factors may be used and may include single, discrete factors. The example method may comprise a step of creating, based at least on the plurality of lenses and an add need, a fit guide indicating which of the plurality of lenses to be worn on the dominant eye and non-dominant eye. The fit guide may provide an interocular disparity of effective add.

[0004] Described herein are systems and/or methods for designing a system of contact lenses with anisometropia for presbyopes. An example method may comprise a step of determining a plurality of lenses for inclusion in a system of contact lenses for treating presbyopes. Each of the plurality of lenses may be configured for an optical correction and may have a power profile associated therewith. The plurality of lenses may be grouped based on the optical correction. Each of the lenses in a particular group may have a different power profile. The example method may comprise a step of creating, based at least on the plurality of lenses and an add need, a fit guide indicating which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye. The fit guide may provide an interocular disparity of effective add.

[0005] Disclosed herein are methods and/or systems of contact lenses with anisometropia for presbyopes. An example system may comprise a plurality of lens types for treating presbyopes. The lens system may comprise at least three lens types (lens A, a lens B, and a lens C designation). Each of the plurality of lenses may be configured for an optical correction and may have a power profile associated therewith. The plurality of lenses may be grouped based on the optical correction. Each of the lenses of a particular type may have a different power profile. The optical correction normalized power profile across a range of optical corrections for each of the lens designations may be varied to improve performance considering [1] prescription (Rx), age and accommodation dependence of ocular spherical aberration, [2] Rx, age and luminance dependence of entrance pupil diameter. The example system may comprise a fit guide indicating which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye. The fit guide provides an interocular disparity of effective add.

[0006] Described herein are systems and/or methods for customizing a system of contact lenses with anisometropia for presbyopes. An example method may comprise a step of determining (e.g., selecting) a fit (e.g., profile) associated with at least one user exhibiting

presbyopia. The example method may comprise a step of selecting (e.g., simulating), based on the fit, one or more visual performance manifolds. Each of the visual performance manifolds may be generated based on lens designs, an eye model, and environmental conditions. The example method may comprise a step of selecting, based on one or more visual performance manifolds, a plurality of lenses for inclusion in a system of contact lenses for treating presbyopia or for alterations in lens fit given subjective feedback. Each of the plurality of lenses may be configured for an optical correction and may have a power profile associated therewith. The plurality of lenses may be grouped based on the optical correction. Each of the lenses in a particular group may have a different power profile. The example method may comprise a step of creating, based at least on the plurality of lenses and an add need, a fit guide indicating which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye. The fit guide may provide an interocular disparity of effective add.

[0007] The plurality of lenses may be grouped based on the optical correction such that a lens group is associated with a specific optical correction level or designation such as between -20D and +20D. For example, a lens system may comprise a plurality of lenses grouped based on an optical correction of -6D. However, there may be an add need of the user, and a fit guide may be used to select which of the lenses in the group/system should be worn on which eye of the user for preferred performance. Each lens group may comprise at least three center near continuous multifocal lenses. Each group of lenses may comprise three lenses. Each group of lenses may comprise four lenses. Each group of lenses may comprise five lenses.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The following drawings show generally, by way of example, but not by way of limitation, various examples discussed in the present disclosure. In the drawings:

[0009] FIG. 1 shows example power profiles of a comparative three lens system.

[0010] FIG. 2 shows example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 0.75D.

[0011] FIG. 3 shows example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 1.00D.

[0012] FIG. 4 shows example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 1.25D.

[0013] FIG. 5 shows example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 1.50D.

[0014] FIG. 6 shows example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 1.75D.

[0015] FIG. 7 shows example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 2.00D.

[0016] FIG. 8 shows example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 2.25D.

[0017] FIG. 9 shows example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 2.50D.

[0018] FIG. 10 shows example power profiles and fit guides for a lens system in accordance with the present disclosure.

[0019] FIG. 11 shows example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 0.75D.

[0020] FIG. 12 shows example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 1.00D.

[0021] FIG. 13 shows example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 1.25D.

[0022] FIG. 14 shows example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 1.50D.

[0023] FIG. 15 shows example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 1.75D.

[0024] FIG. 16 shows example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 2.0D.

[0025] FIG. 17 shows example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 2.25D.

[0026] FIG. 18 shows example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 2.5D.

[0027] Figure 19 shows a plot of visual performance as a function of vergence (viewing distance) to illustrate depth of focus (DOF) and effective add (E. Add).

[0028] Figure 20 illustrates plots of location of peak (LoP) visual acuity of the comparative lens system of Figure 1 for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers.

[0029] Figure 21 illustrates plots of location of peak visual acuity of the comparative lens system of Figure 1 for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers.

[0030] Figure 22 illustrates plots of depth of focus of the comparative lens system of Figure 1 for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers.

[0031] Figure 23 illustrates plots of depth of focus of the comparative lens system of Figure 1 for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers.

[0032] Figure 24 illustrates plots of location of peak visual acuity of a lens system in accordance with the present disclosure and an example of which is shown in Figure 10 for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers.

[0033] Figure 25 illustrates plots of location of peak visual acuity of a lens system in accordance with the present disclosure and an example of which is shown in Figure 10 for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers.

[0034] Figure 26 illustrates plots of depth of focus of a lens system in accordance with the present disclosure and an example of which is shown in Figure 10 for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers.

[0035] Figure 27 illustrates plots of depth of focus of a lens system in accordance with the present disclosure and an example of which is shown in Figure 10 for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers.

[0036] Figure 28 illustrates comparative plots of a difference in location of peak visual acuity between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater

effective add for prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0037] Figure 29 illustrates comparative plots of a difference in location of peak visual acuity between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater effective add for comparative lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0038] Figure 30 illustrates comparative plots of a difference in depth of focus between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater DOF for prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0039] Figure 31 illustrates comparative plots of a difference in depth of focus between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater DOF for prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0040] Figure 32 illustrates comparative plots of a difference in location of peak visual acuity between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a dominant eye in mid luminance (luminance = 20cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater effective add for prior art lenses such as shown in Figure 1 and above the line indicates a

greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0041] Figure 33 illustrates comparative plots of a difference in location of peak visual acuity between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a non-dominant eye in mid luminance (luminance = 20cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater effective add for prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0042] Figure 34 illustrates comparative plots of a difference in depth of focus between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a dominant eye in mid luminance (luminance = 20cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater DOF prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0043] Figure 35 illustrates comparative plots of a difference in depth of focus between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a non-dominant eye in mid luminance (luminance = 20cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater DOF for prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0044] Figure 36 illustrates comparative plots of a difference in location of peak visual acuity between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a dominant eye in higher luminance (luminance = 400cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater effective add for prior art lenses such as shown in Figure 1 and above the line indicates a

greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0045] Figure 37 illustrates comparative plots of a difference in location of peak visual acuity between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a non-dominant eye in higher luminance (luminance = 400cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater effective add for prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0046] Figure 38 illustrates comparative plots of a difference in depth of focus between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a dominant eye in higher luminance (luminance = 400cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater DOF for prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

[0047] Figure 39 illustrates comparative plots of a difference in depth of focus between the comparative lens system of Figure 1 and the lens system in accordance with the present disclosure, an example of which is shown in Figure 10, for a non-dominant eye in higher luminance (luminance = 400cd/m^2) across various Add powers. The dashed line is a reference representing zero difference, below the line indicates a greater DOF for prior art lenses such as shown in Figure 1 and above the line indicates a greater effective add for lenses in accordance to the present disclosure such as shown in Figure 10.

DETAILED DESCRIPTION

[0048] Described herein are systems and/or methods for customizing a system of contact lenses with interocular disparity for presbyopes. An example method may comprise a step of determining a fit associated with at least one user exhibiting presbyopia. Determining a fit may comprise optimizing a treatment plan for the particular user.

Optimizing may comprise using one or more visual performance manifolds, as shown and described herein.

[0049] Described herein are systems and/or methods for designing and implementing a system of contact lenses with interocular disparity for presbyopes. An example system may comprise a plurality of lens types for treating presbyopes. The lens system may comprise at least three lens types (lens A, a lens B, and a lens C designation). The lens types may vary by one or more of effective add or DOF. Each of the plurality of lenses may be configured for an optical correction and may have a power profile associated therewith. The plurality of lenses may be grouped based on the optical correction. Each of the lenses of a particular type may have a different power profile. The optical correction normalized power profile across a range of optical corrections for each of the lens designations may be varied to improve performance considering [1] prescription (Rx), age and accommodation dependence of ocular spherical aberration, [2] Rx, age and luminance dependence of entrance pupil diameter.

[0050] The example method may comprise selecting a fit associated with at least one user exhibiting presbyopia. The method may comprise simulating, based on the fit profile, one or more visual performance manifolds, wherein each of the visual performance manifolds is generated based on lens designs, an eye model, and environmental conditions. The method may comprise selecting, based on the selected one or more visual performance manifolds, a plurality of lenses for inclusion in a system of contact lenses for treating presbyopia, or for alterations in lens fit given the visual performance achieved, wherein each of the plurality of lenses is configured for an optical correction and has a power profile associated therewith, wherein the plurality of lenses are grouped based on the optical correction and wherein each of the lenses in a particular group has a different power profile. The method may comprise creating, based at least on the plurality of lenses and an add need, a fit guide indicating which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye, wherein the fit guide provides an interocular disparity of effective add.

[0051] An example method may comprise a step of determining a plurality of lens types for inclusion in a system of contact lenses for treating presbyopes. The lens system may comprise at least three lens types (lens A, a lens B, and a lens C designation). Although other groupings and numbers of lens types may be used. Each of the plurality of lenses may

be configured for an optical correction and may have a power profile associated therewith. The plurality of lenses may be grouped based on the optical correction. Each lens group may comprise at least three center-near continuous multifocal lenses. Each group of lenses may comprise three lenses. Each group of lenses may comprise four lenses. Each group of lenses may comprise five lenses. The power profile may be between -20D and +20D. Determining a plurality of lens groups may comprise determining a visual performance manifold for one or more of the lenses in the plurality of lens groups.

[0052] Each of the lenses of a particular type may have a different power profile. However, the optical correction normalized power profile across a range of optical corrections for each of the lens designations may be varied to improve performance considering prescription (Rx) and accommodation dependence of ocular spherical aberration and Rx, age and luminance dependence of entrance pupil diameter. In other words, a variation of the normalized power profile across SKU (e.g., optical correction levels) may be increased compared to variation in conventional lenses or lens systems. The disclosed lens systems and methods permit a superior trade-off regarding overall through focus visual performance over conventional lenses and lens systems. As an illustrative example, such performance improvement may be achieved by leveraging the capacity of the visual system to tolerate interocular refractive disparity to further increase the cyclopean depth of focus (DOF). Additionally or alternatively, the disclosed lens designs employ more add power, more variation in design across SKU, and a visual performance manifold optimized fit/refit prescription, as compared to conventional lenses or lens systems.

[0053] A fit guide may be created and/or used. The fit guide may be created based at least on the plurality of lenses and an add need. The fit guide may be customized for a user or users. Various fit guides may be created and compared for optimal performance for a user or users. A fit guide may indicate which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye. An example fit guide may comprise one or more of the following example fit guides. Although designations for a particular fit guide application is shown, this is for illustration and should not necessarily be limited, as such.

Initial lens selection:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
-------------------------	-------------	----------	-------------	------------	-------------	----------	-------------	------------

Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

Lens change if required for distance complaint:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensB +0.25D	lensB +0.25D	lensB +0.50D	lensB +0.50D	lensB +0.50D

Lens change if required for near complaint:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB +0.25D	lensB +0.25D	lensB +0.25D	lensC +0.25D	lensC +0.25D	lensC +0.50D	lensC +0.50D	lensC +0.50D

Lens change if required for second distance complaint:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB

Non-Dominant	lensA +0.25D	lensA +0.25D	lensA +0.25D	lensC -0.25D	lensC -0.25D	lensC	lensC	lensC
---------------------	-----------------	-----------------	-----------------	-----------------	-----------------	-------	-------	-------

Lens change if required for second near complaint:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

[0054] The fit guide or guides may provide an interocular disparity of effective add. Figure 19 shows a plot of visual performance as a function of vergence (viewing distance). The effective add may be defined as the shift between 0 vergence (distance vision) and the vergence of peak performance. The interocular disparity of effective add is the difference in effective add between the dominant and non-dominant eyes.

[0055] DOF is a 3-line drop from peak performance. The plot in Figure 19 may be illustrative in describing each lens and the resulting disparity. Such disparity in the present disclosure may be different from 0, which is the disparity of the fit guide for the conventional lenses such as MF in low and mid add needs. Other fit guides may be used. Optimization may be based on the use of additional fit guides for distance and/or near adjustments and based on patient reported performance. Although various techniques may be used, fit optimization may be conducted by the doctor with feedback from the patient. The alternative fit guide(s) may be determined using visual performance manifolds to obtain the alternatives that provide the best visual performance in the event of certain complaints from the patient.

[0056] As a comparison, the following tables show effective add for a conventional MF lens system and a lens system in accordance with the present disclosure.

Effective Add Tables

MF, Rx = -3 D

Lens	Effective Add @ 2.5 cd/m²	Effective Add @ 120 cd/m²	Effective Add @ 400 cd/m²
Lens A	0.25 D	0.30 D	0.30 D
Lens B	0.60 D	0.85 D	0.90 D
Lens C	0.80 D	1.25 D	1.40 D

Lens Fit (MF, Rx = -3 D)								
Add Need / Eye	0.75 D	1.00 D	1.25 D	1.50 D	1.75 D	2.00 D	2.25 D	2.50 D
Dom	A	A	A	B	B	B	B	B
Non	A	A	A	B	B	C	C	C
Interocular Disparity of Effective Add								
Add Need / Luminance	0.75 D	1.00 D	1.25 D	1.50 D	1.75 D	2.00 D	2.25 D	2.50 D
2.5 cd/m²	0.00 D	0.00 D	0.00 D	0.00 D	0.00 D	0.20 D	0.20 D	0.20 D
120 cd/m²	0.00 D	0.00 D	0.00 D	0.00 D	0.00 D	0.40 D	0.40 D	0.40 D
400 cd/m²	0.00 D	0.00 D	0.00 D	0.00 D	0.00 D	0.50 D	0.50 D	0.50 D

New Optic, Rx = -3 D			
Lens	Effective Add @ 2.5 cd/m²	Effective Add @ 120 cd/m²	Effective Add @ 400 cd/m²
Lens A	0.05 D	0.10 D	0.10 D
Lens B	0.25 D	0.70 D	0.75 D
Lens C	1.00 D	1.15 D	1.15 D
Lens C+	1.25 D	1.40 D	1.40 D

Lens Fit (New Optic, Rx = -3 D)								
Add Need / Eye	0.75 D	1.00 D	1.25 D	1.50 D	1.75 D	2.00 D	2.25 D	2.50 D
Dom	A	A	A	B	B	B	B	B
Non	B	B	B	C	C	C+	C+	C+
Interocular Disparity of Effective Add								
Add Need / Luminance	0.75 D	1.00 D	1.25 D	1.50 D	1.75 D	2.00 D	2.25 D	2.50 D
2.5 cd/m²	0.20 D	0.20 D	0.20 D	0.75 D	0.75 D	1.00 D	1.00 D	1.00 D
120 cd/m²	0.60 D	0.60 D	0.60 D	0.45 D	0.45 D	0.70 D	0.70 D	0.70 D
400 cd/m²	0.65 D	0.65 D	0.65 D	0.40 D	0.40 D	0.65 D	0.65 D	0.65 D

[0057] Figures 28-39 illustrate comparison of the effective add and DOF between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure.

[0058] As a further example, fit guides may be based on one or more visual performance manifolds. As such, a fit guide may be customized for a user or group of users based on comparative testing or optimizing visual performance manifolds for the user or users.

[0059] As an illustrative example, lens design optimization procedure may be based on visual performance. A metric of monocular visual performance is given by:

$$\varphi_{eye} = \int MTF(v)^2 NCSF(v)^2 dv$$

, where MTF is the modulation transfer function of the lens + eye combination, NCSF is the neural contrast sensitivity function for a given pupil size and luminance and v is spatial frequency.

[0060] Binocular visual performance is obtained using a vectorial model:

$$\varphi_{bin} = \sqrt{\varphi_{dom}^2 + \varphi_{non}^2 - \alpha \varphi_{dom} \varphi_{non}}$$

where the subscripts dom and non refer to the dominant and nondominant eye, respectively, and α is a constant.

[0061] Optimization of visual performance is obtained across a range of eye models (spanning the age and add need range typical of a presbyopic population) by minimization:

$$\min \left[\sum \varphi_{ideal} - \varphi_{bin} \right]$$

where φ_{ideal} is obtained using diffraction limited binocular visual performance.

[0062] Figure 20 illustrates plots of location of peak visual acuity of the comparative lens system of Figure 1 for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. Figure 22 illustrates plots of depth of focus of the comparative lens system of Figure 1 for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. Figure 24 illustrates plots of location of peak visual acuity of a lens system in accordance with the present disclosure and an example of which is shown in Figure 10 for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. Figure 26 illustrates plots of depth of focus of a lens system in accordance with the present disclosure and an example of which is shown in Figure 10 for a dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. In low light conditions, MF uses more effective add in the dominant eye, and the example lens system of the present disclosure uses more DOF for the mid and high adds.

[0063] Figure 21 illustrates plots of location of peak visual acuity of the comparative lens system of Figure 1 for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. Figure 23 illustrates plots of depth of focus of the comparative lens system of Figure 1 for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. Figure 25 illustrates plots of location of peak visual acuity of a lens system in accordance with the present disclosure and an example of which is shown in Figure 10 for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. Figure 27 illustrates plots of depth of focus of a lens system in accordance with the present disclosure and an example of which is shown in Figure 10 for a non-dominant eye in low luminance (luminance = 2cd/m^2) across various Add powers. In low light conditions, MF uses more effective add in the non-dominant eye for the low add,

and the example lens system of the present disclosure uses more effective add in the mid and high add. The example lens system of the present disclosure uses more DOF in the low and mid add, and MF uses more DOF in high add myopes while the example lens system of the present disclosure uses more DOF in high add hyperopes.

[0064] Figure 28 illustrates a comparison of the effective add for various Add powers for a dominant eye in dim light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. Figure 30 illustrates a comparison of the DOF for various Add powers for a dominant eye in dim light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. In dim light conditions, MF uses more effective add in the dominant eye, and the example lens system of the present disclosure uses more DOF for the mid and high adds.

[0065] Figure 29 illustrates a comparison of the effective add for various Add powers for a non-dominant eye in dim light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. Figure 31 illustrates a comparison of the DOF for various Add powers for a non-dominant eye in dim light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. In dim light conditions, the example lens system of the present disclosure uses more effective add in the non-dominant eye for the mid and high adds. The example lens system of the present disclosure uses more DOF in the low and mid add, and MF uses more DOF in high add myopes while the example lens system of the present disclosure uses more DOF in high add hyperopes.

[0066] Figure 32 illustrates a comparison of the effective add for various Add powers for a dominant eye in moderate light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. Figure 34 illustrates a comparison of the DOF for various Add powers for a dominant eye in moderate light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. In moderate light conditions, MF uses more effective add in the dominant eye.

[0067] Figure 33 illustrates a comparison of the effective add for various Add powers for a non-dominant eye in moderate light conditions between the conventional

lenses/lens systems (MF) and a lens system in accordance with the present disclosure. Figure 35 illustrates a comparison of the DOF for various Add powers for a non-dominant eye in moderate light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. In moderate light conditions, the example lens system of the present disclosure uses more effective add in the non-dominant eye and more DOF in the low and mid add.

[0068] Figure 36 illustrates a comparison of the effective add for various Add powers for a dominant eye in bright light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. Figure 38 illustrates a comparison of the DOF for various Add powers for a dominant eye in bright light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. In bright light conditions, MF uses more effective add in the dominant eye.

[0069] Figure 37 illustrates a comparison of the effective add for various Add powers for a non-dominant eye in bright light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. Figure 39 illustrates a comparison of the DOF for various Add powers for a non-dominant eye in bright light conditions between the conventional lenses/lens systems (MF) and a lens system in accordance with the present disclosure. In bright light conditions, the example lens system of the present disclosure uses more effective add in the non-dominant eye in the low and mid add.

[0070] As illustrated, simulations indicate that the example lens system of the present disclosure provides comparable or superior distance and near performance and sacrifices a bit of intermediate performance in low light when compared to MF. In general, the example lens system of the present disclosure uses more effective add and provides more DOF in the non-dominant eye, while MF uses more effective add and the example lens system of the present disclosure provides more DOF in the dominant eye. However, in bright conditions where the pupil is small, cyclopean DOF with both designs are equivalent. Although the increased DOF of the example lens system of the present disclosure may be significant in low light conditions, the predominant difference between the two systems (from dim to bright light) is due to differences in the effective add. Therefore, the example

lens system of the present disclosure improves through-focus cyclopean visual performance by optimally leveraging the visual system’s tolerance of interocular disparity of effective add.

EXAMPLES

Power Profiles and Visual Performance Manifolds

[0071] For each design simulated, the power profiles of each lens in the lens system were plotted for refractive errors of -9, -6, -3, 2, 4 and 6D, and the visual performance manifold is presented. The fit guide is presented in tabular form for each design. The fit guide includes information about the lens design and the fit for both the dominant and non-dominant eyes. The fit is the difference between the power label of the fitted lens and the subject’s refraction. Visual performance is gray-level coded in units of $-10\log\text{MAR}$ from -2 to 0.5. Values above 0.5 saturate and remain dark gray while values below -2 saturate and are displayed as white.

Multifocal (MF)

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA (MF_A)	lensA (MF_A)	lensA (MF_A)	lensB (MF_B)	lensB (MF_B)	lensB (MF_B)	lensB (MF_B)	lensB (MF_B)
Non-Dominant	lensA (MF_A)	lensA (MF_A)	lensA (MF_A)	lensB (MF_B)	lensB (MF_B)	lensC (MF_C)	lensC (MF_C)	lensC (MF_C)

Example Lens System of the Present Disclosure

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB

Non-Dominant	lensB	lensB	lensB	lensC	lensC + 0.25	lensC + 0.25	lensC + 0.25	lensC + 0.25
--------------	-------	-------	-------	-------	-----------------	-----------------	-----------------	-----------------

[0072] Figure 10: Power profile of the 3 lens designs of an example lens system of the present disclosure.

[0073] Figure 11: Visual performance manifold of an example lens system of the present disclosure for an add need of 0.75D.

[0074] Figure 12: Visual performance manifold of an example lens system of the present disclosure for an add need of 1D.

[0075] Figure 13: Visual performance manifold of an example lens system of the present disclosure for an add need of 1.25D.

[0076] Figure 14: Visual performance manifold of an example lens system of the present disclosure for an add need of 1.5D.

[0077] Figure 15: Visual performance manifold of an example lens system of the present disclosure for an add need of 1.75D.

[0078] Figure 16: Visual performance manifold of an example lens system of the present disclosure for an add need of 2D.

[0079] Figure 17: Visual performance manifold of an example lens system of the present disclosure for an add need of 2.25D.

[0080] Figure 18: Visual performance manifold of an example lens system of the present disclosure for an add need of 2.5D.

[0081] Although shown and described in what is believed to be the most practical and preferred embodiments, it is apparent that departures from specific designs and methods described and shown will suggest themselves to those skilled in the art and may be used without departing from the spirit and scope of the disclosure. The present disclosure is not restricted to the particular constructions described and illustrated but should be constructed to cohere with all modifications that may fall within the scope of the appended claims.

Claims

What is claimed is:

1. A method for designing a system of contact lenses with interocular refractive disparity for presbyopes, the method comprising the steps of:
 - determining a plurality of lens types for inclusion in a system of contact lenses for treating presbyopes, wherein the lens system comprises at least three lens types (lens A, a lens B, and a lens C designation),
 - wherein each of the plurality of lenses is configured for an optical correction and has a power profile associated therewith,
 - wherein the plurality of lenses are grouped based on the optical correction and wherein each of the lenses of a particular type has a different power profile, and
 - wherein the optical correction normalized power profile across a range of optical corrections for each of the lens designations is varied to improve performance based on at least [1] prescription (Rx), age and accommodation dependence of ocular spherical aberration, or [2] Rx, age, and luminance dependence of entrance pupil diameter; and
 - creating, based at least on the plurality of lenses and an add need, a fit guide indicating which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye, wherein the fit guide provides an interocular disparity of effective add.
2. The method of claim 1, wherein each lens group comprises at least three center-near continuous multifocal lenses.
3. The method of claim 1, wherein each group of lenses comprises three lenses.
4. The method of claim 1, wherein each group of lenses comprises four lenses.
5. The method of claim 1, wherein each group of lenses comprises five lenses.
6. The method of claim 1, wherein the optical correction is between -20D and +20D.
7. The method of claim 1, wherein determining a plurality of lens groups comprises determining a visual performance manifold for one or more of the lenses in the plurality of lens groups.

8. The method of claim 1, wherein the fit guide comprises one or more of:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC + 0.25	lensC + 0.25	lensC + 0.25	lensC + 0.25

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensB +0.25D	lensB +0.25D	lensB +0.50D	lensB +0.50D	lensB +0.50D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB +0.25D	lensB +0.25D	lensB +0.25D	lensC +0.25D	lensC +0.25D	lensC +0.50D	lensC +0.50D	lensC +0.50D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensA +0.25D	lensA +0.25D	lensA +0.25D	lensC -0.25D	lensC -0.25D	lensC	lensC	lensC

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

9. A system of contact lenses with interocular disparity for presbyopes, the system comprising:
- a plurality of lens types for treating presbyopes, wherein the lens system comprises at least three lens types (lens A, a lens B, and a lens C designation),
 - wherein each of the plurality of lenses is configured for an optical correction and has a power profile associated therewith,
 - wherein the plurality of lenses are grouped based on the optical correction and wherein each of the lenses of a particular type has a different power profile, and
 - wherein the optical correction normalized power profile across a range of optical corrections for each of the lens designations is varied to improve performance based on at least [1] prescription (Rx), age and accommodation dependence of ocular spherical aberration, [2] Rx, age, and luminance dependence of entrance pupil diameter; and
 - a fit guide indicating which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye, wherein the fit guide provides an interocular disparity of effective add.

- 10. The system of claim 9, wherein each lens group comprises at least three center near continuous multifocal lenses.
- 11. The system of claim 9, wherein each group of lenses comprises three lenses.
- 12. The system of claim 9, wherein each group of lenses comprises four lenses.
- 13. The system of claim 9, wherein each group of lenses comprises five lenses.
- 14. The system of claim 9, wherein the power profile is between -20D and +20D.
- 15. The system of claim 9, wherein the fit guide is dependent on a visual performance manifold for one or more of the lenses in the plurality of lens groups.
- 16. The method of claim 9, wherein the fit guide comprises one or more of:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC + 0.25	lensC + 0.25	lensC + 0.25	lensC + 0.25

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensB +0.25D	lensB +0.25D	lensB +0.50D	lensB +0.50D	lensB +0.50D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB +0.25D	lensB +0.25D	lensB +0.25D	lensC +0.25D	lensC +0.25D	lensC +0.50D	lensC +0.50D	lensC +0.50D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensA +0.25D	lensA +0.25D	lensA +0.25D	lensC -0.25D	lensC -0.25D	lensC	lensC	lensC

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

17. A method for designing a system of contact lenses with interocular refractive disparity for presbyopes, the method comprising the steps of:

determining a plurality of lenses for inclusion in a system of contact lenses for treating presbyopes, wherein each of the plurality of lenses is configured for an optical correction and has a power profile associated therewith, wherein the plurality of lenses are grouped based on the optical correction and wherein each of the lenses in a particular group has a different power profile; and

creating, based at least on the plurality of lenses and an add need, a fit guide indicating which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye, wherein the fit guide provides an interocular disparity of effective add.

18. The method of claim 17, wherein each group of lenses comprises three lenses.

- 19. The method of claim 17, wherein each group of lenses comprises four lenses.
- 20. The method of claim 17, wherein each group of lenses comprises five lenses.
- 21. The method of claim 17, wherein the power profile is between -20D and +20D.
- 22. The method of claim 17, wherein determining a plurality of lenses comprises determining a visual performance manifold for one or more of the lenses.
- 23. The method of claim 17, wherein the fit guide comprises one or more of:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC + 0.25	lensC + 0.25	lensC + 0.25	lensC + 0.25

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensB +0.25D	lensB +0.25D	lensB +0.50D	lensB +0.50D	lensB +0.50D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB +0.25D	lensB +0.25D	lensB +0.25D	lensC +0.25D	lensC +0.25D	lensC +0.50D	lensC +0.50D	lensC +0.50D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensA +0.25D	lensA +0.25D	lensA +0.25D	lensC -0.25D	lensC -0.25D	lensC	lensC	lensC

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

24. A method for customizing a system of contact lenses with interocular refractive disparity for presbyopes, the method comprising the steps of:

- determining a fit associated with at least one user exhibiting presbyopia;
- simulating, based on the fit, one or more visual performance manifolds, wherein each of the visual performance manifolds is generated based on lens designs, an eye model, and environmental conditions;

selecting, based on the simulated one or more visual performance manifolds, a plurality of lenses for inclusion in a system of contact lenses for treating presbyopia, wherein each of the plurality of lenses is configured for an optical correction and has a power profile associated therewith, wherein the plurality of lenses are grouped based on

the optical correction and wherein each of the lenses in a particular group has a different power profile; and

creating, based at least on the plurality of lenses and an add need, a fit guide indicating which of the plurality of lenses to be worn on a dominant eye and a non-dominant eye, wherein the fit guide provides an interocular disparity of effective add.

- 25. The method of claim 24, wherein each group of lenses comprises three lenses.
- 26. The method of claim 24, wherein each group of lenses comprises four lenses.
- 27. The method of claim 24, wherein each group of lenses comprises five lenses.
- 28. The method of claim 24, wherein the optical power is between -20D and +20D.
- 29. The method of claim 24, wherein determining a fit profile comprises optimizing a treatment plan for the particular user.
- 30. The method of claim 29, wherein the optimizing comprises using one or more visual performance manifolds.
- 31. The method of claim 24, wherein the fit guide comprises one or more of:

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC + 0.25	lensC + 0.25	lensC + 0.25	lensC + 0.25

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensB +0.25D	lensB +0.25D	lensB +0.50D	lensB +0.50D	lensB +0.50D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensB +0.25D	lensB +0.25D	lensB +0.25D	lensC +0.25D	lensC +0.25D	lensC +0.50D	lensC +0.50D	lensC +0.50D

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensA	lensA	lensA	lensB	lensB	lensB	lensB	lensB
Non-Dominant	lensA +0.25D	lensA +0.25D	lensA +0.25D	lensC -0.25D	lensC -0.25D	lensC	lensC	lensC

Add Need (D)	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Dominant	lensB -0.25D	lensB -0.25D	lensB -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D	lensC -0.25D
Non- Dominant	lensB	lensB	lensB	lensC	lensC	lensC +0.25D	lensC +0.25D	lensC +0.25D

Example power profiles of a comparative three lens system

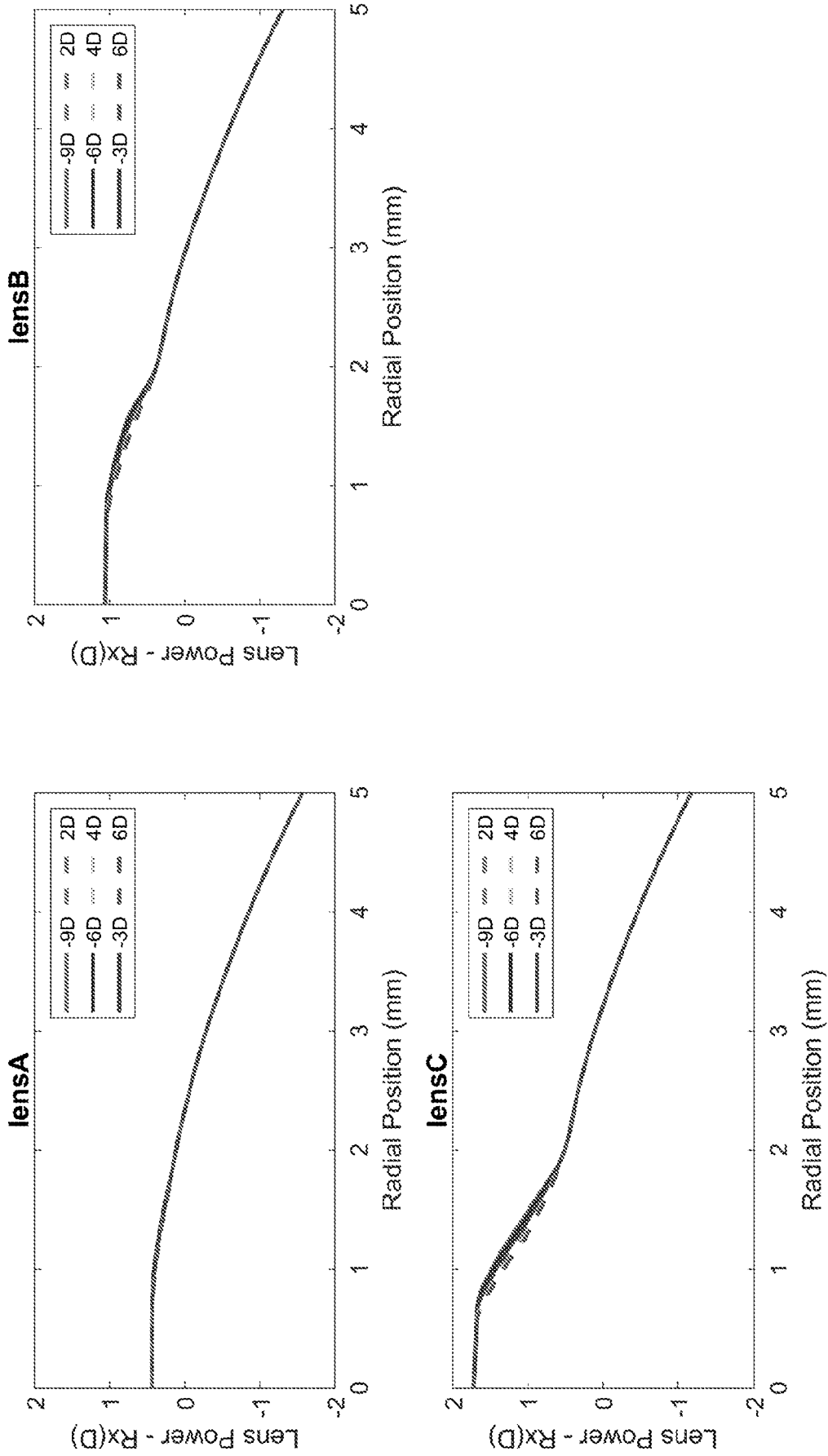


FIG. 1

Example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 0.75D

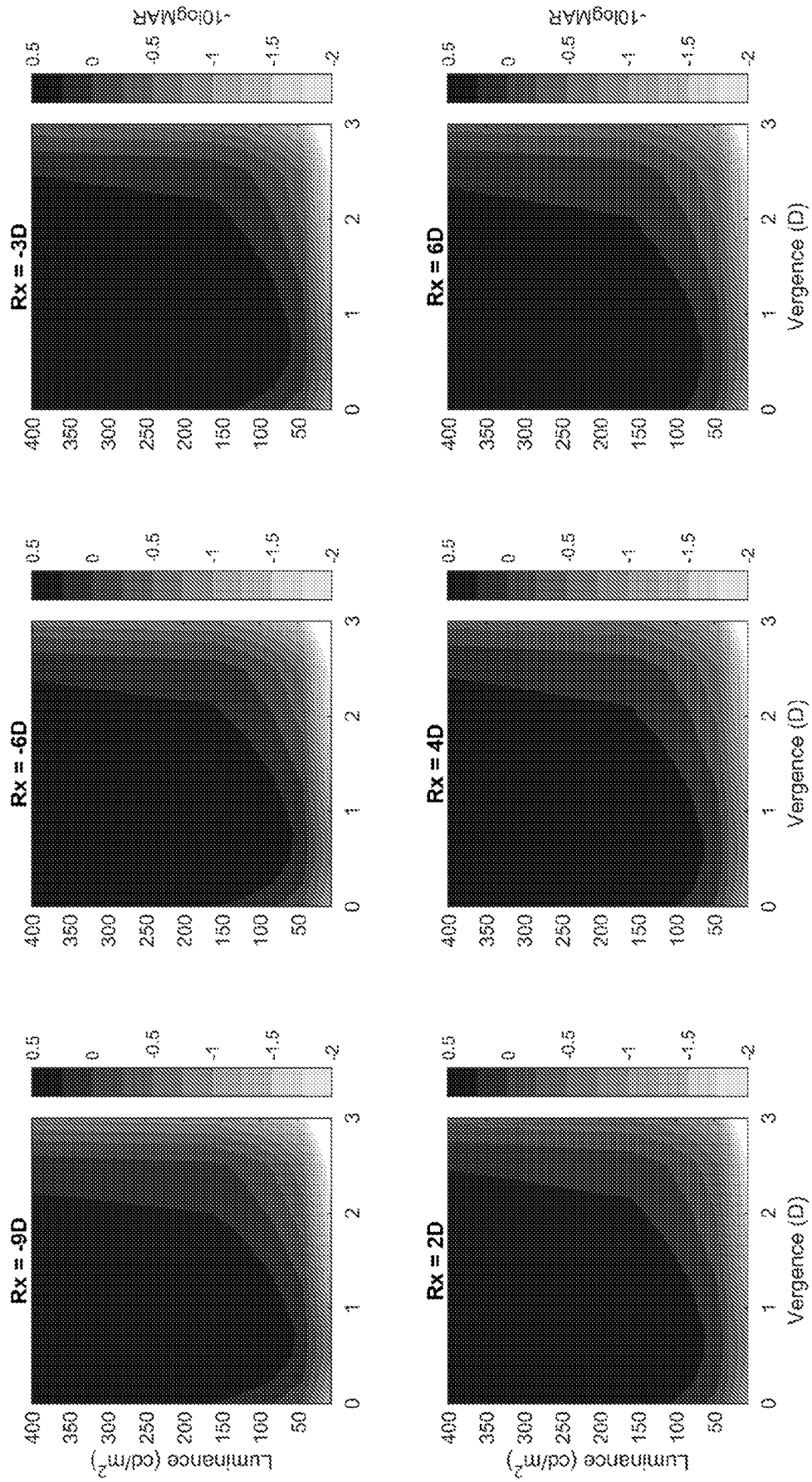


FIG. 2

Example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 1.00D

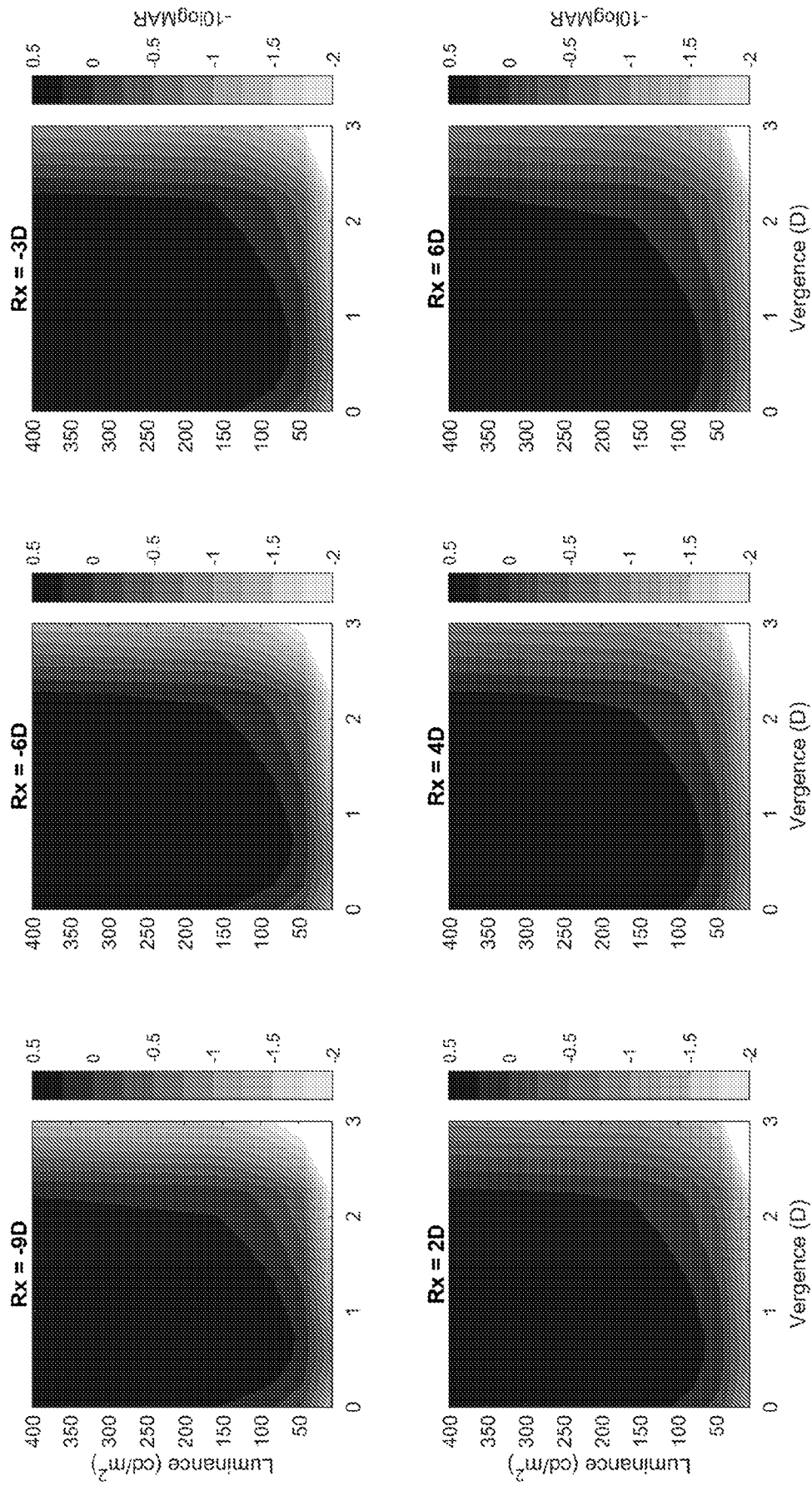


FIG. 3

Example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 1.25D

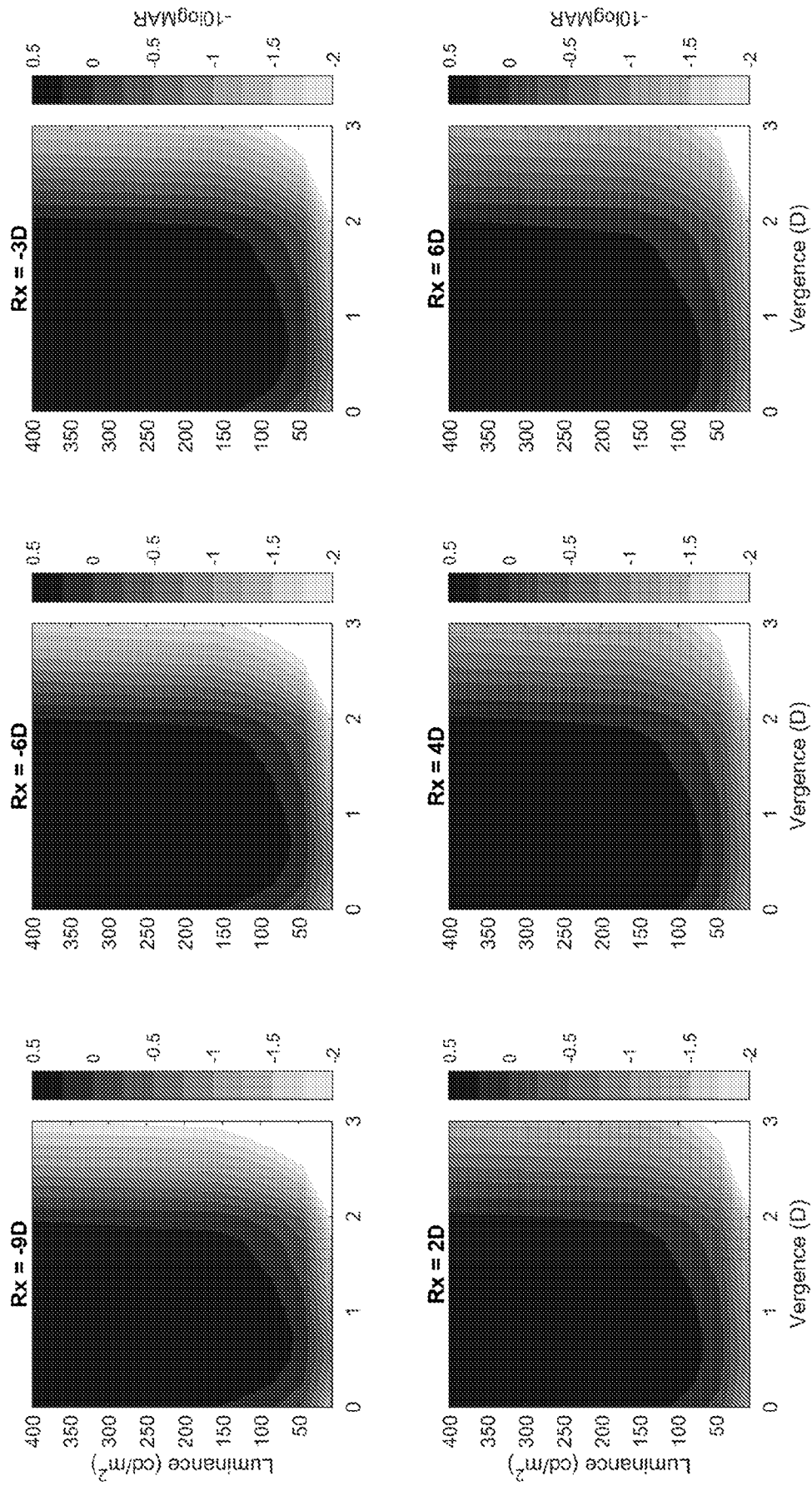


FIG. 4

Example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 1.50D

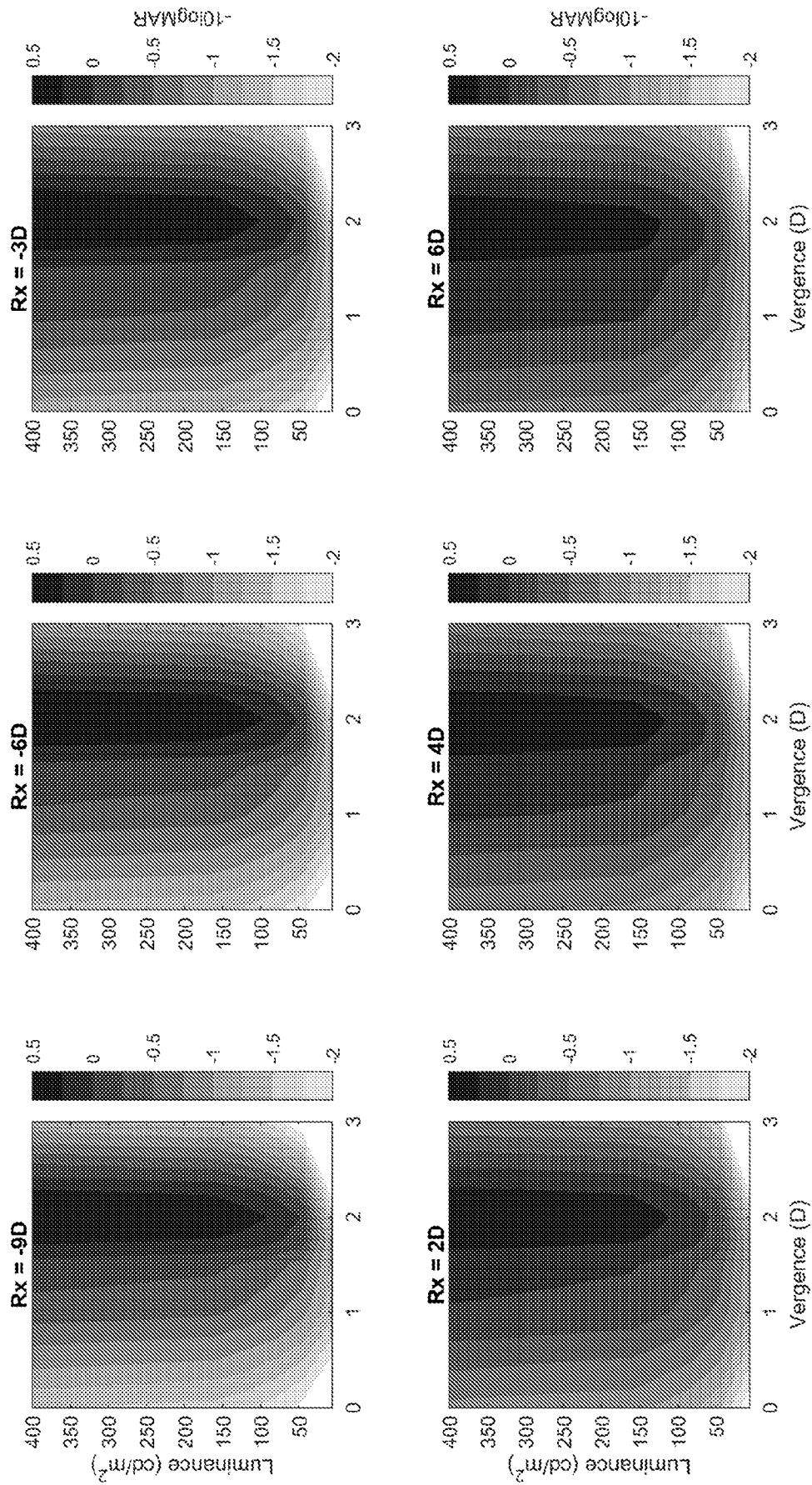


FIG. 5

Example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 1.75D

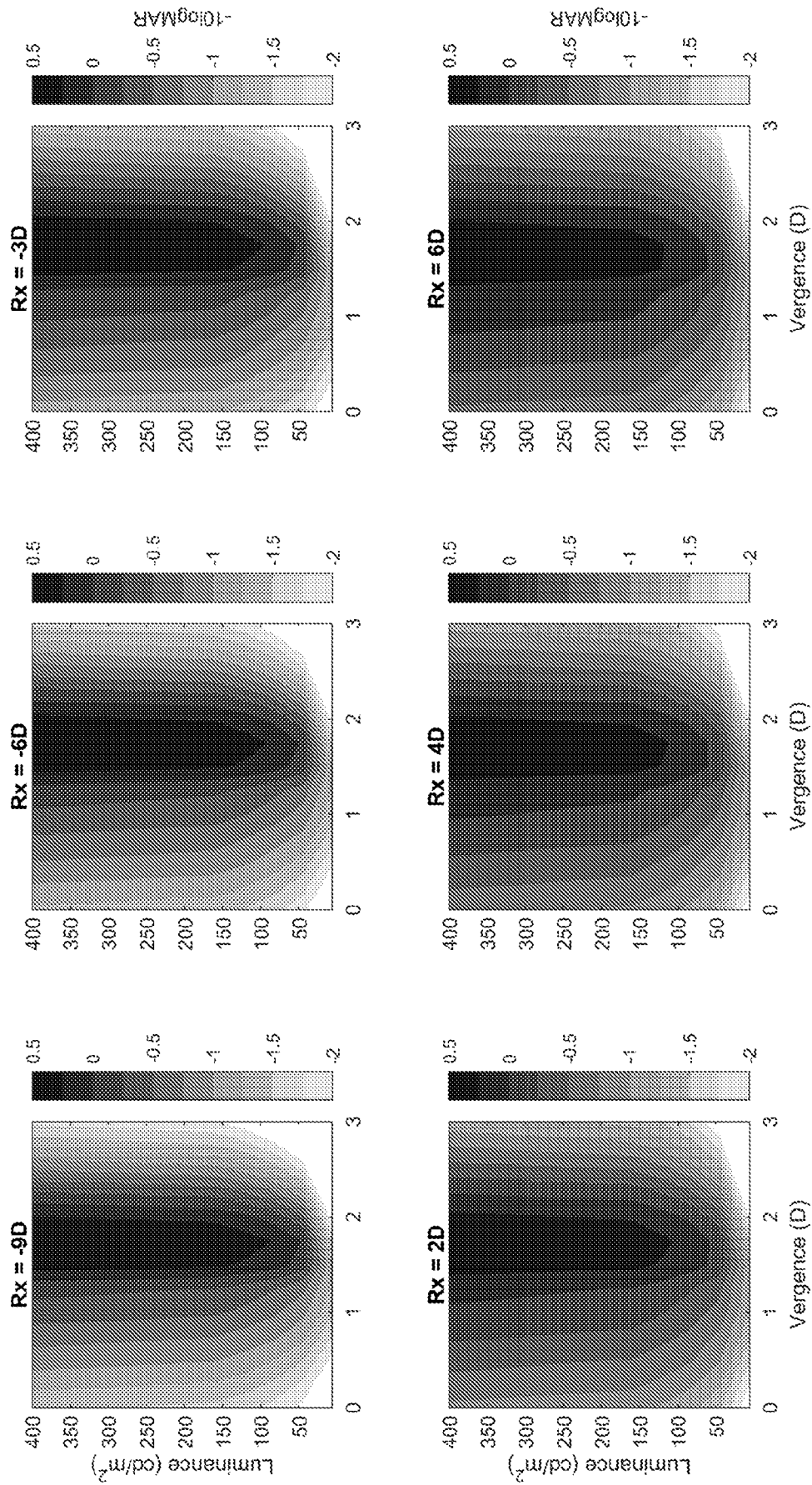


FIG. 6

Example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 2.00D

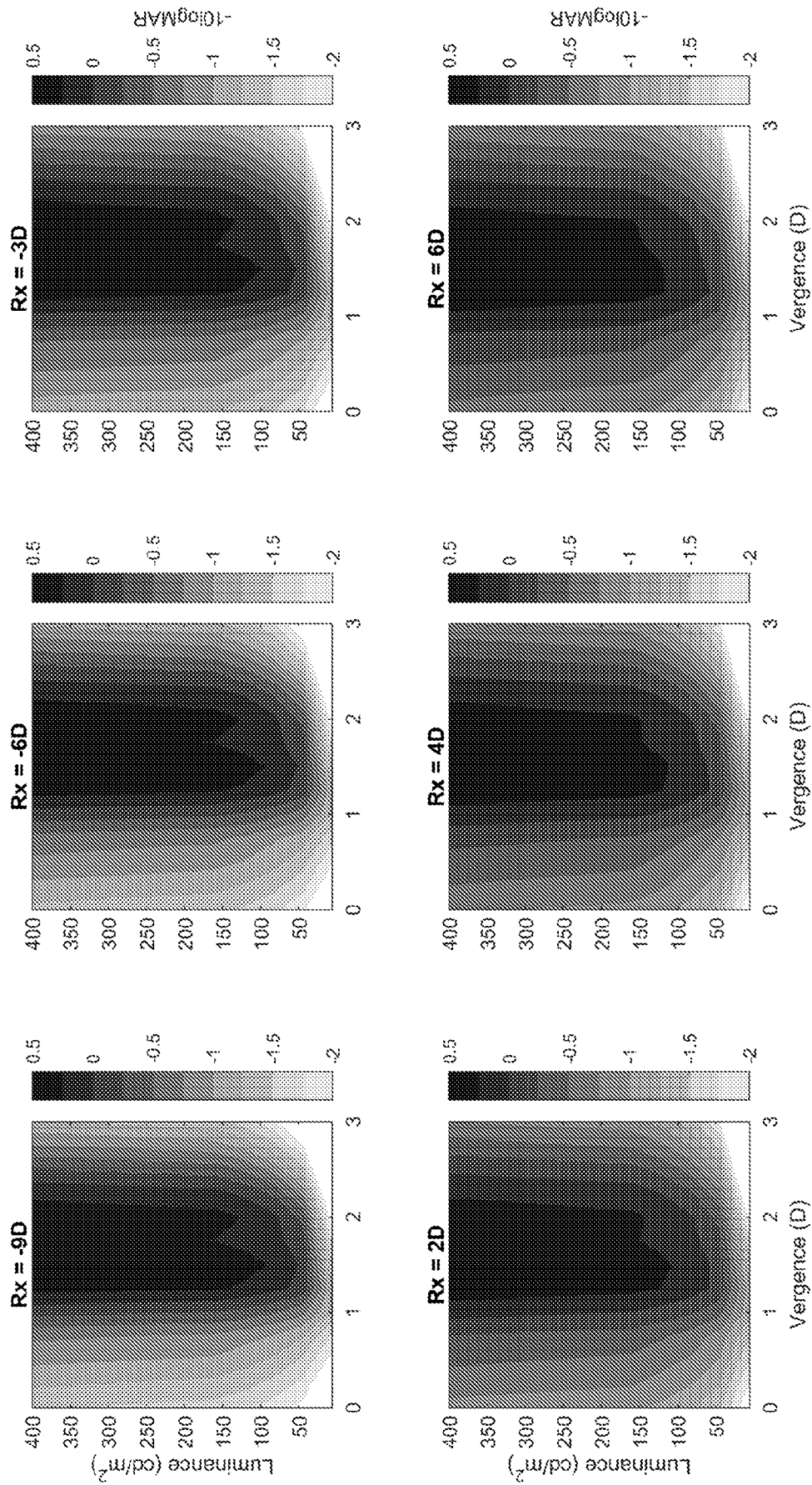


FIG. 7

Example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 2.25D

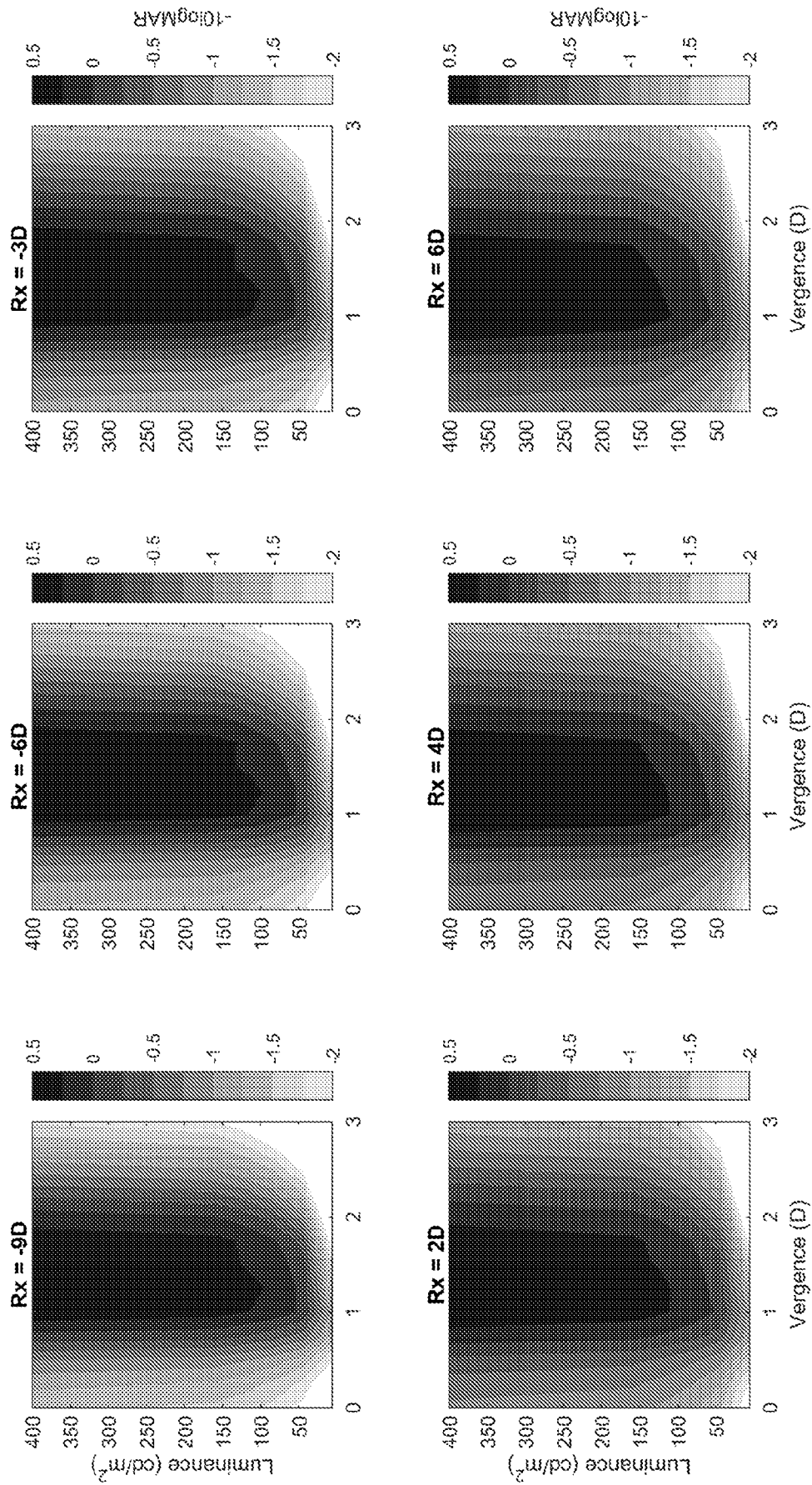


FIG. 8

Example graphs of visual performance of a comparative lens system for various prescriptions (Rx) and an Add of 2.50D

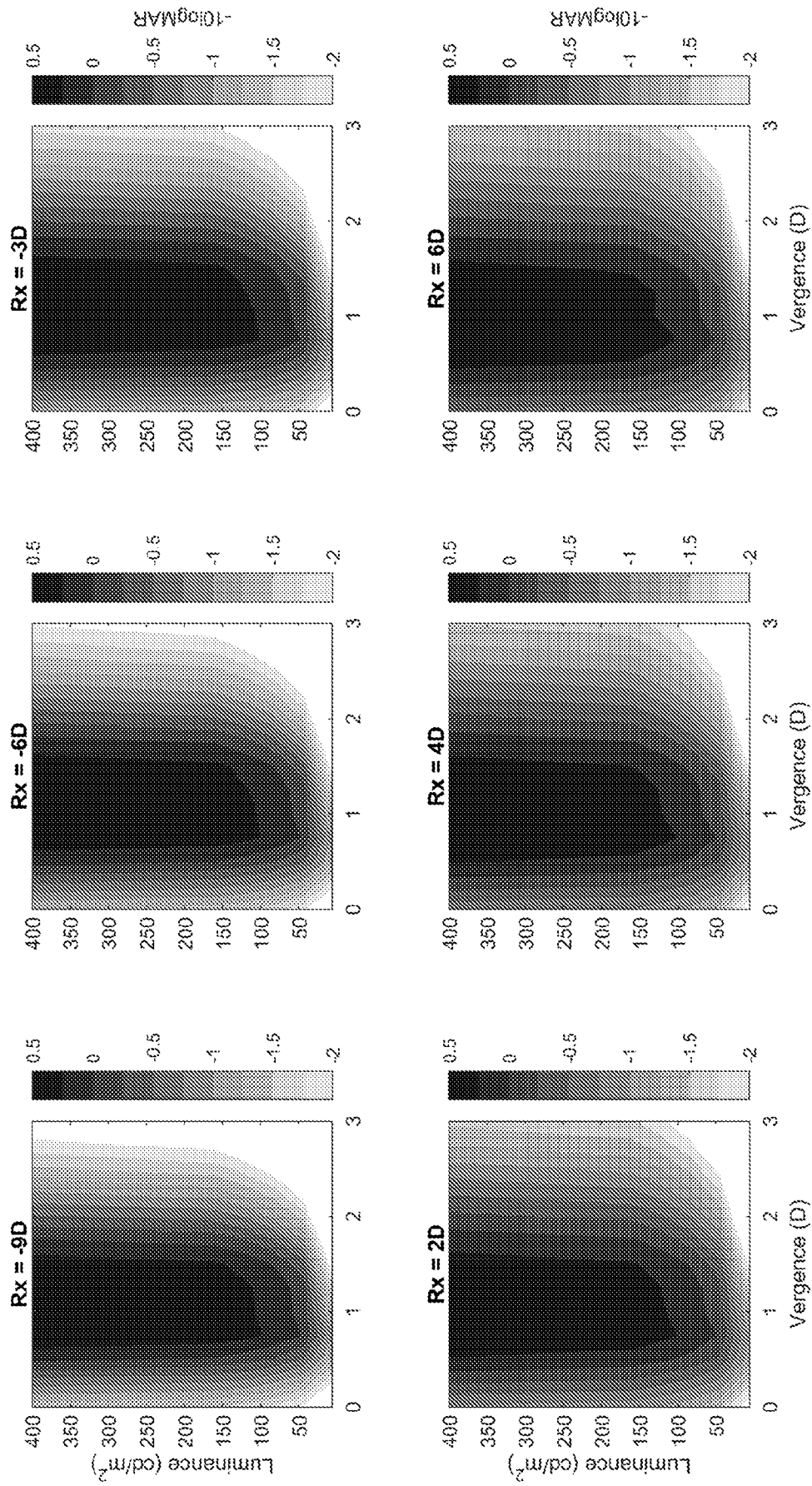


FIG. 9

Example power profiles and fit guides for a lens system in accordance with the present disclosure

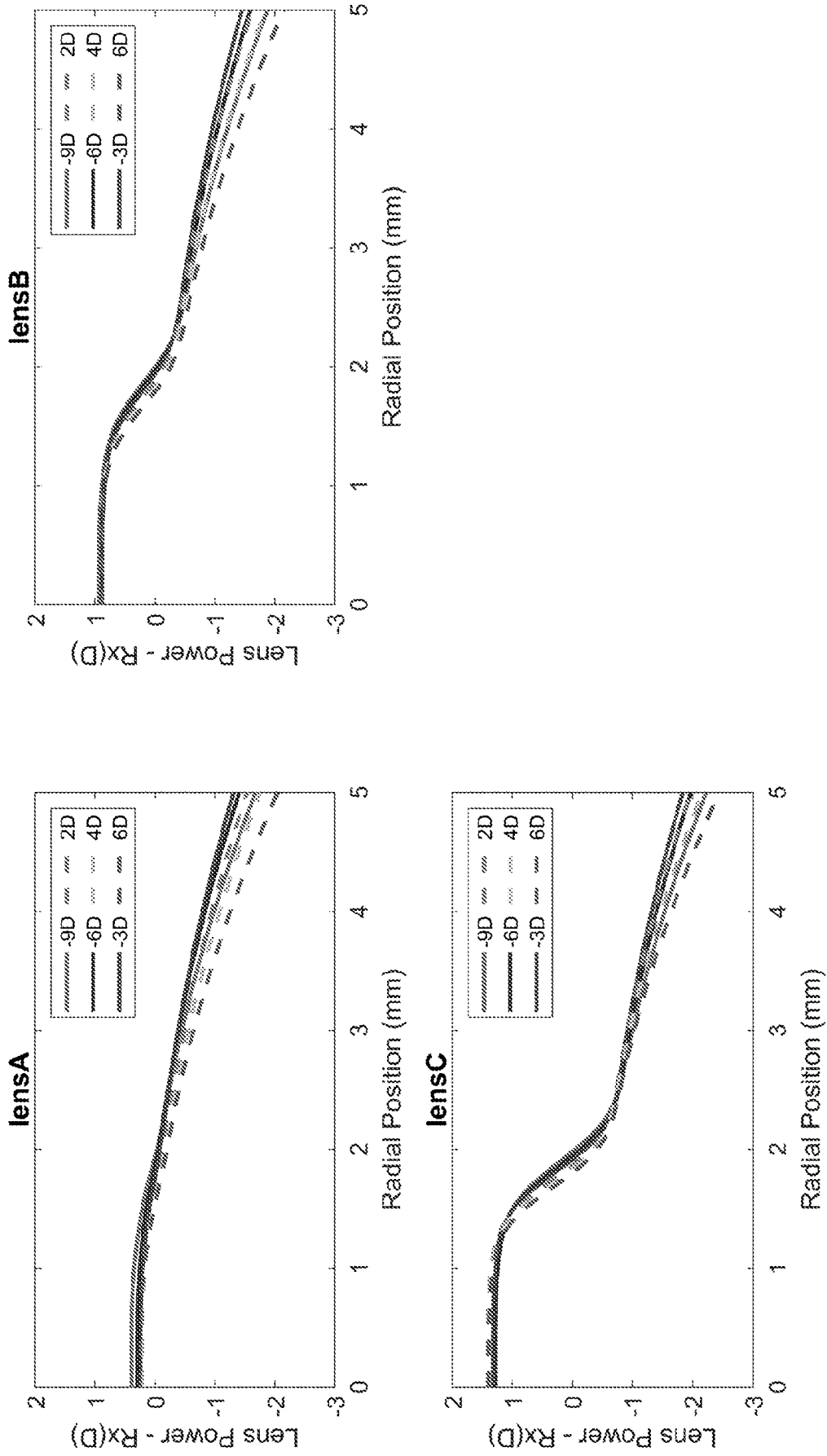


FIG. 10

Example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 0.75D

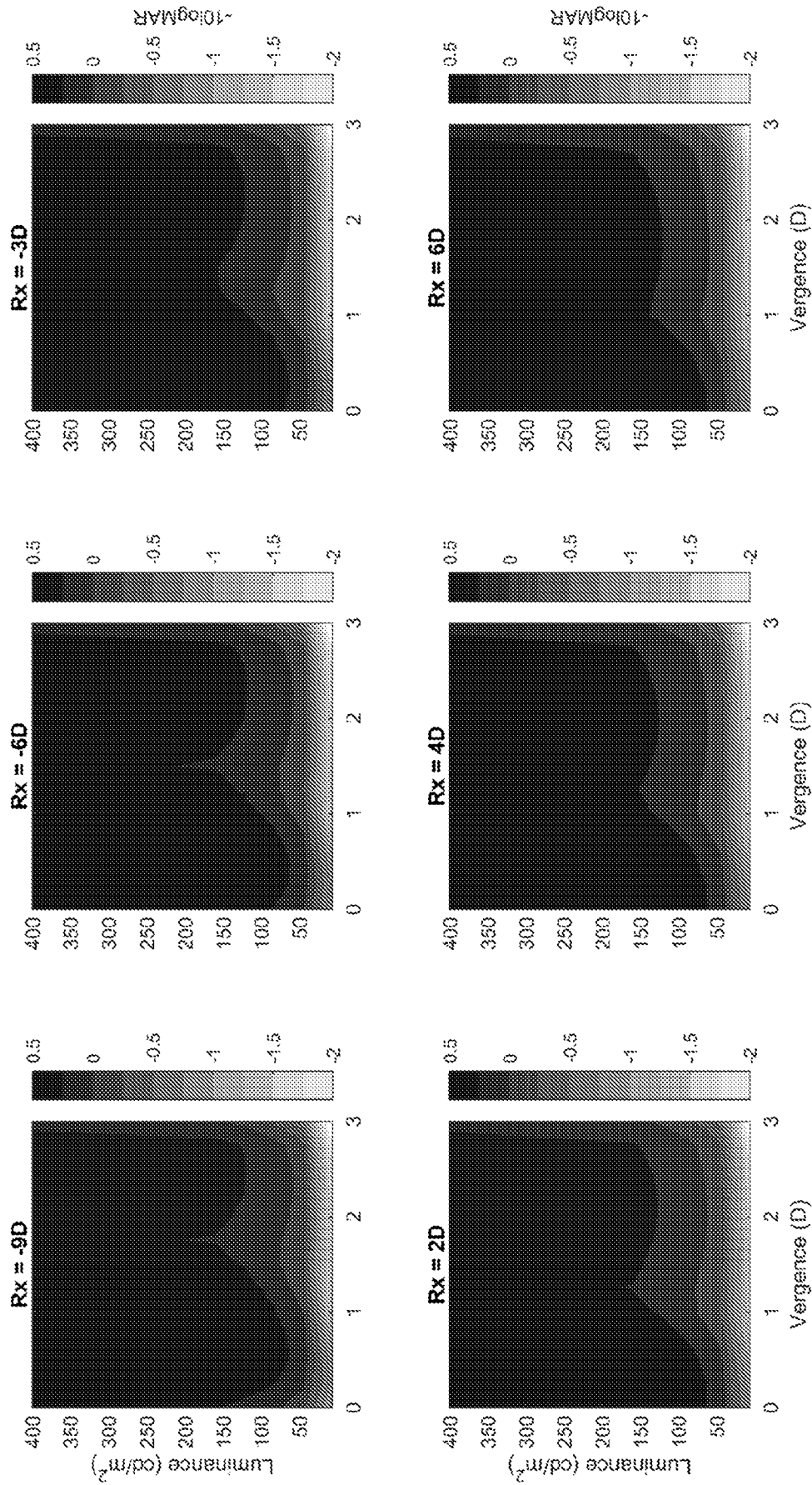


FIG. 11

Example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 1.00D

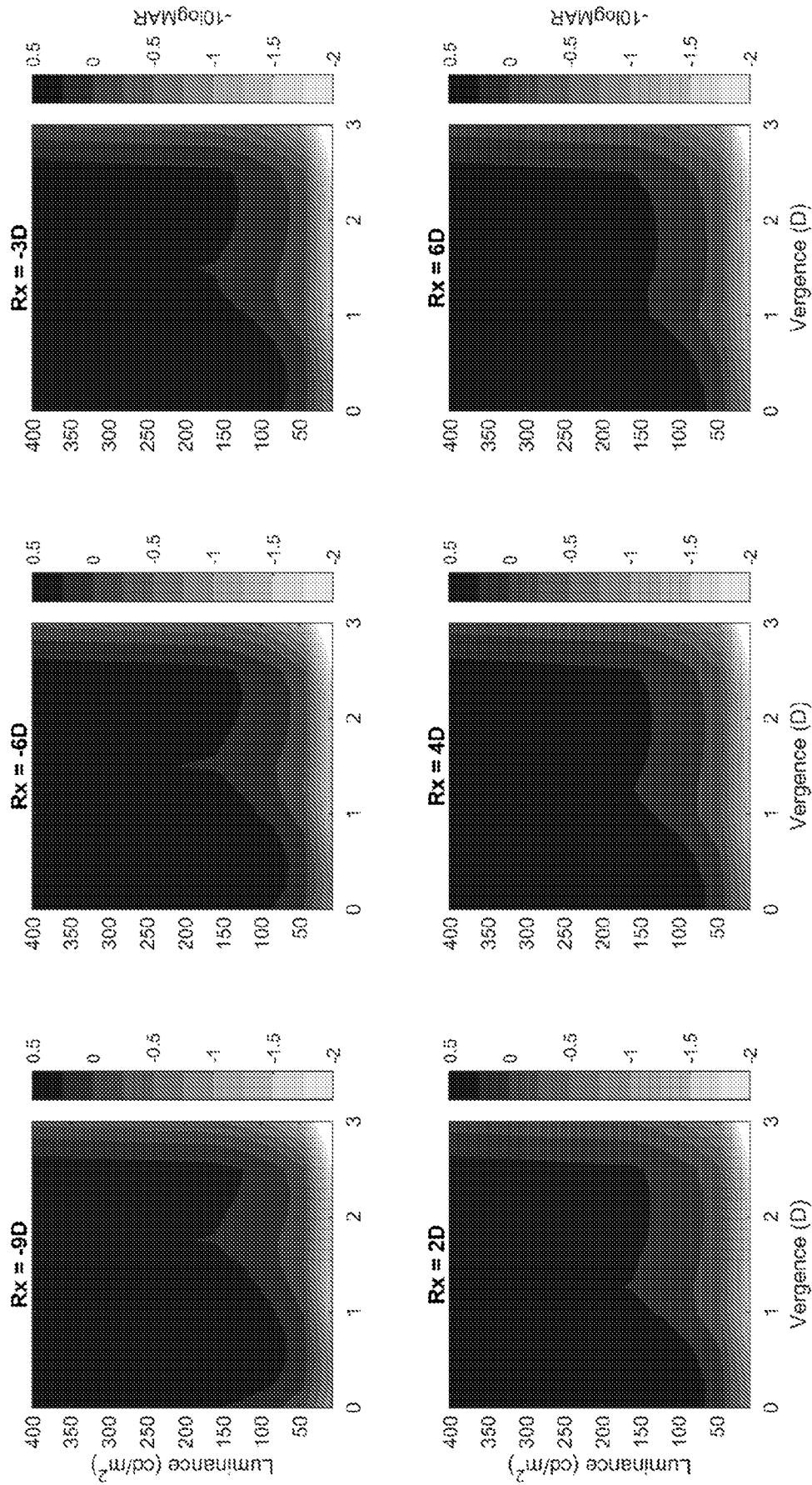


FIG. 12

Example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 1.25D

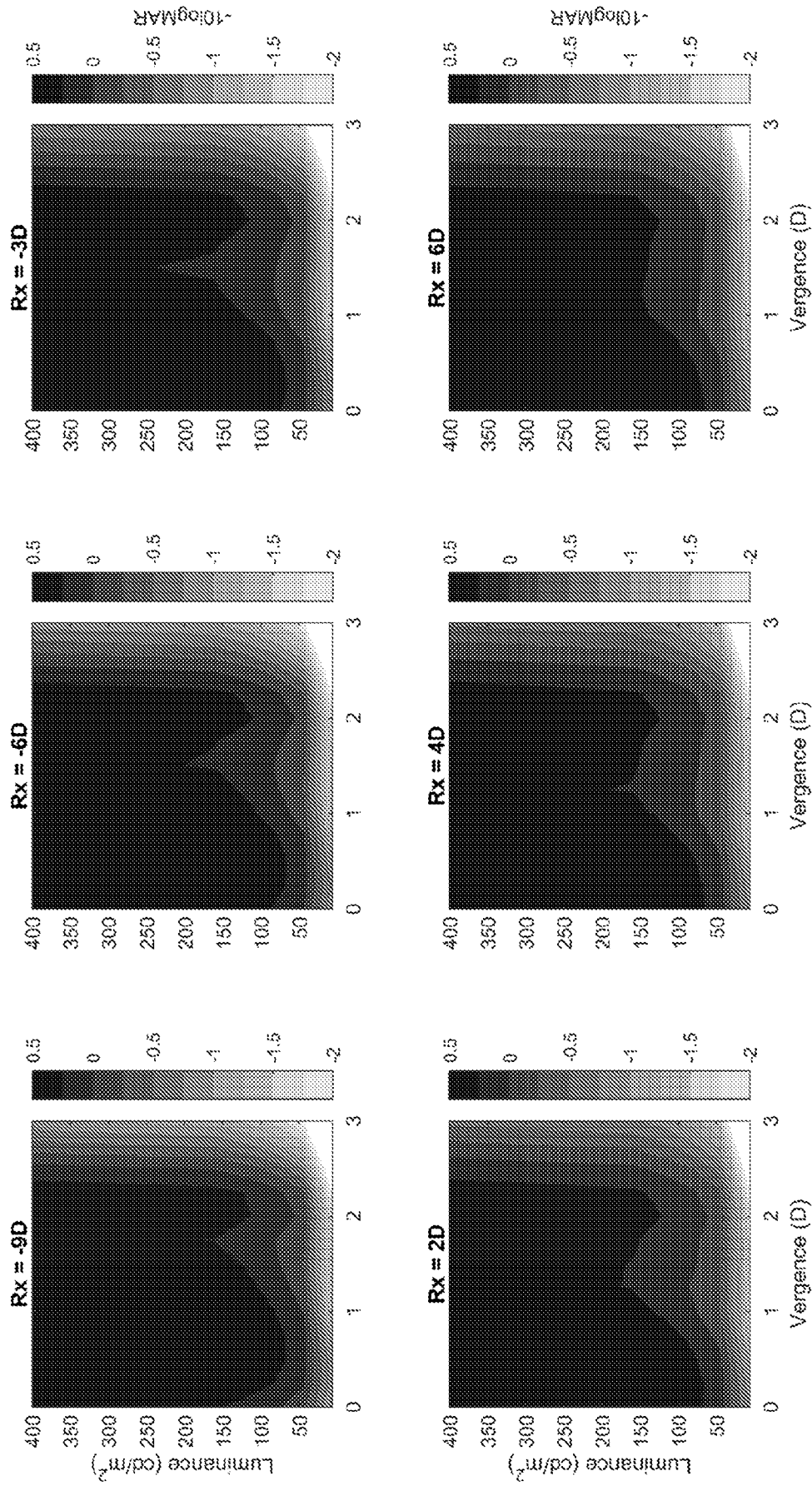


FIG. 13

Example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 1.50D

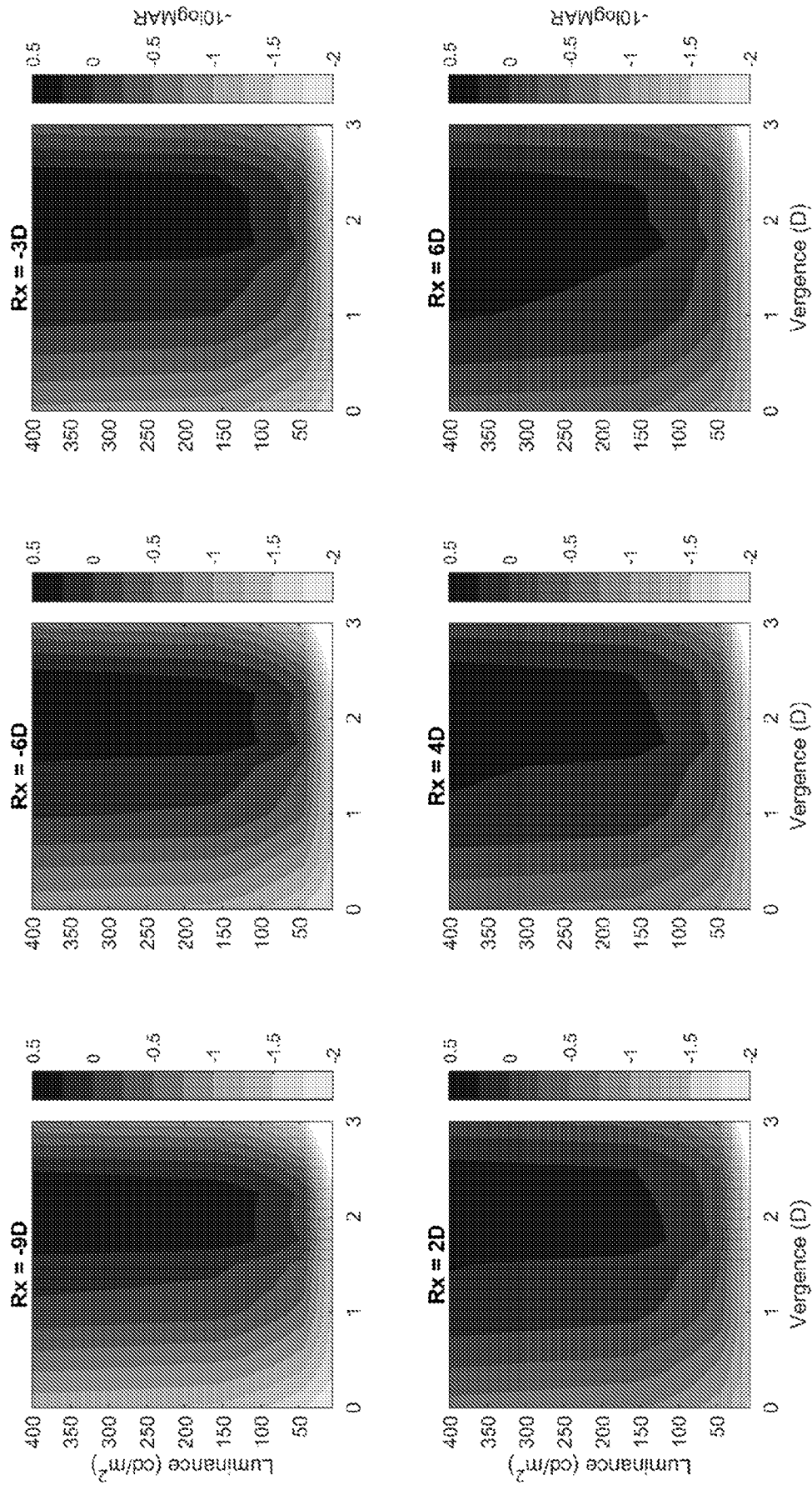


FIG. 14

Example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 1.75D

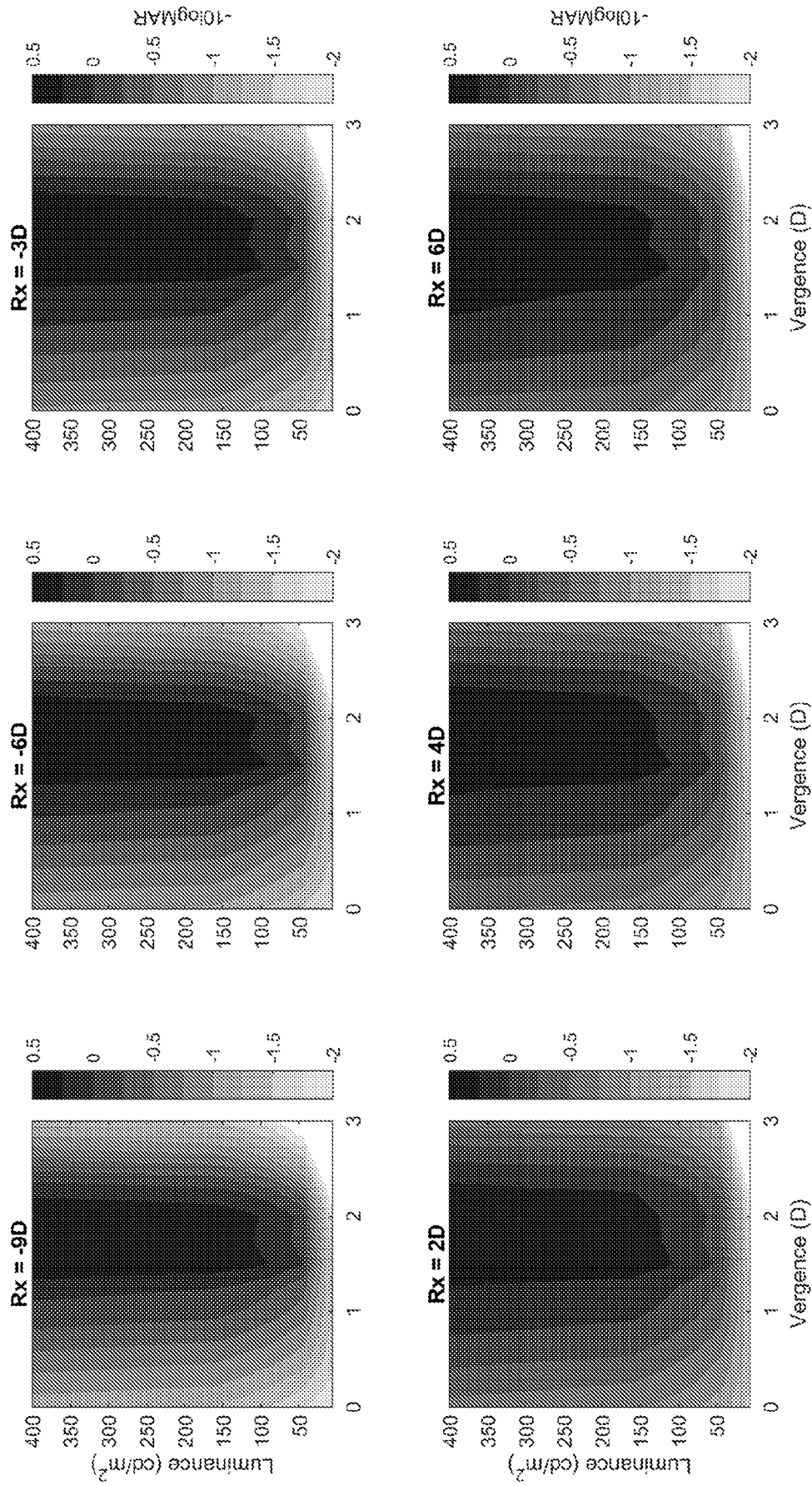


FIG. 15

Example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 2.00D

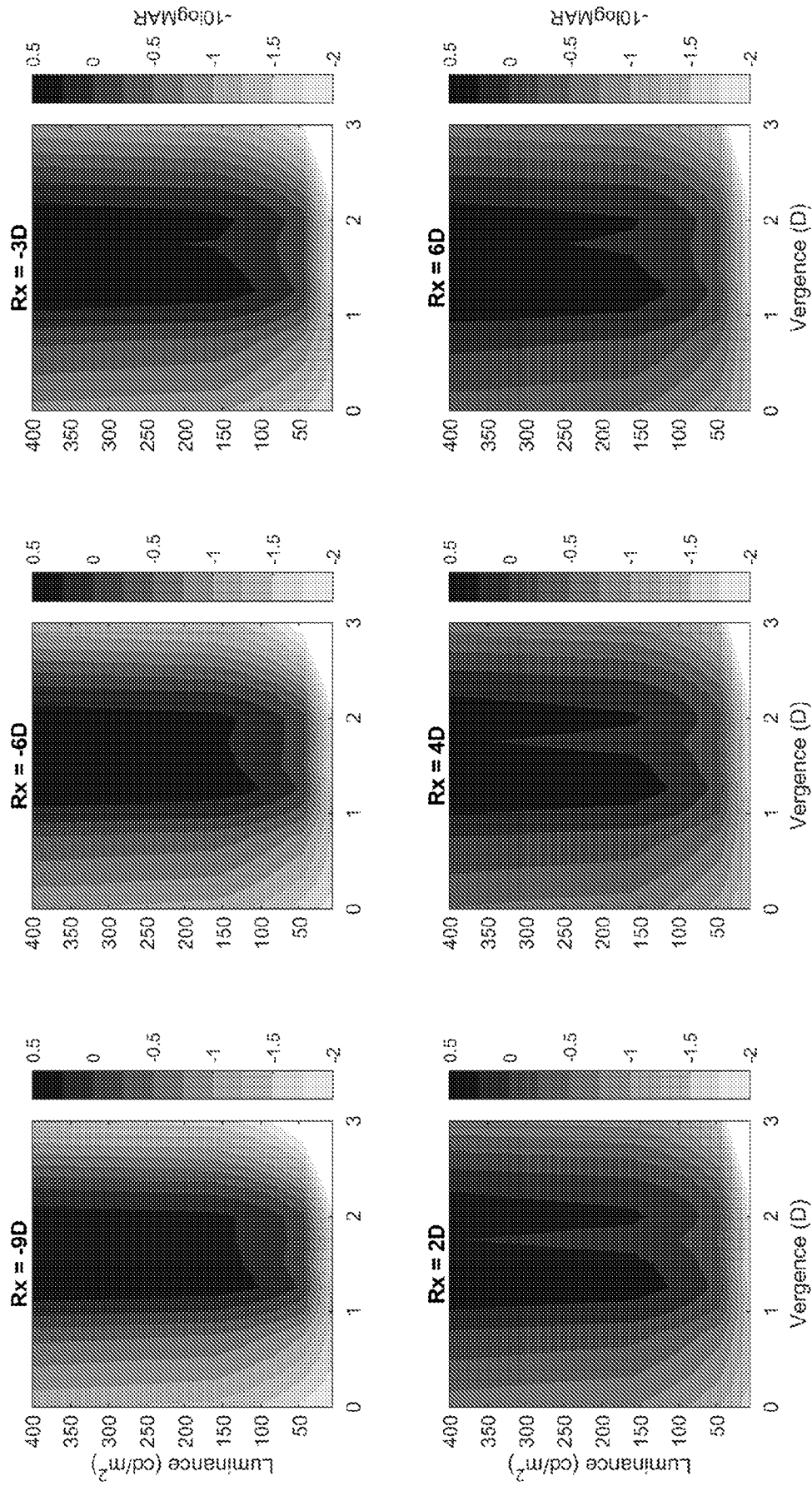


FIG. 16

Example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 2.25D

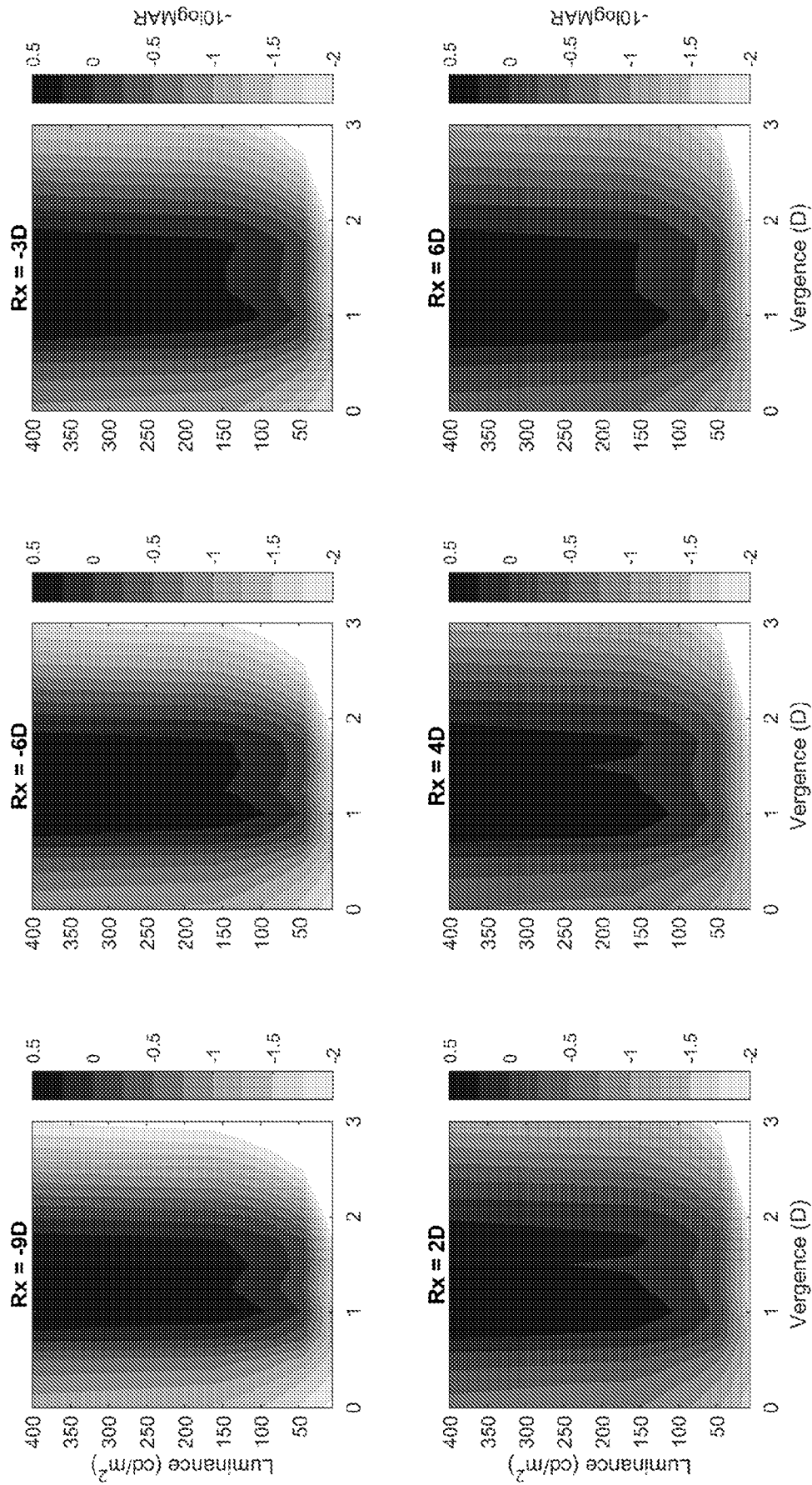


FIG. 17

Example graphs of visual performance of a lens system in accordance with the present disclosure for various prescriptions (Rx) and an Add of 2.50D

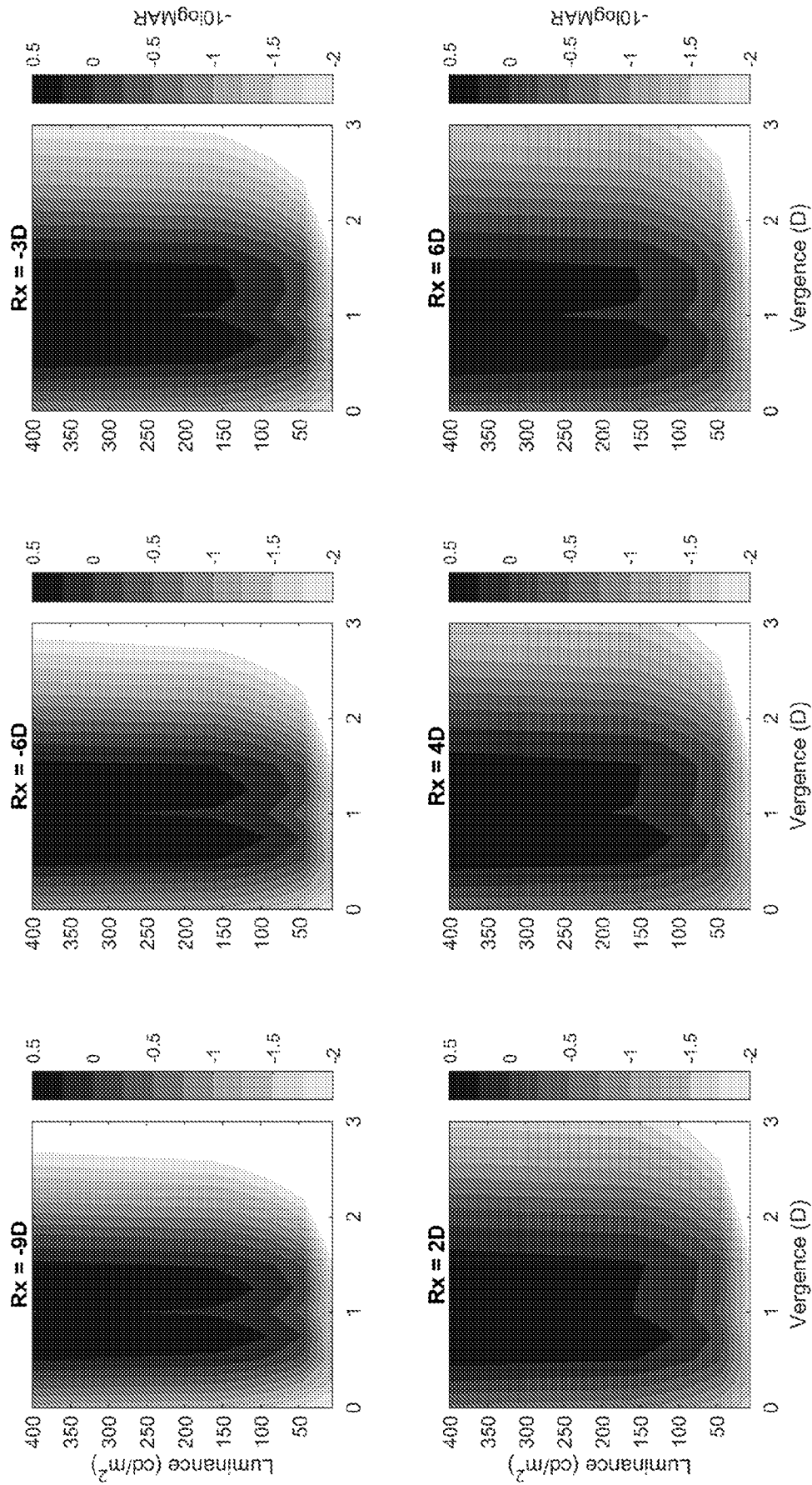


FIG. 18

Through focus visual performance

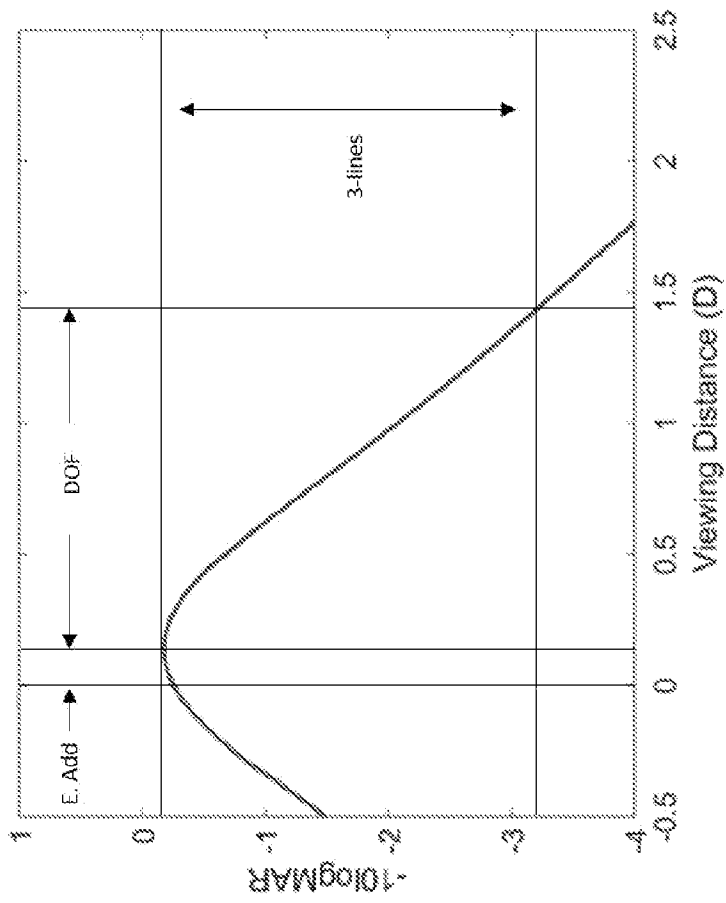


FIG. 19

Example graphs of vergence of peak visual performance of a comparative lens system in the dominant eye for various prescriptions (Rx)

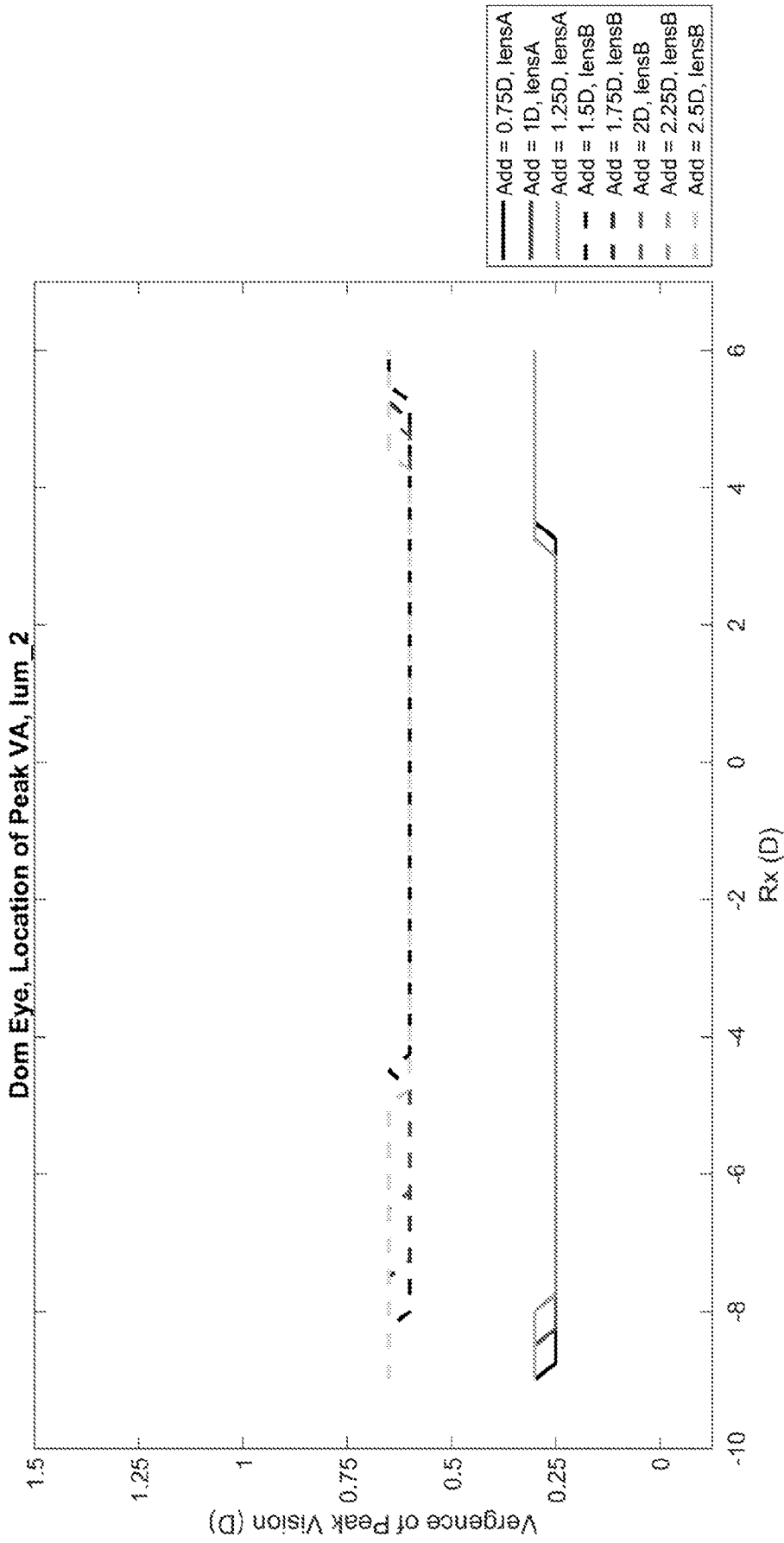


FIG. 20

Example graphs of vergence of peak visual performance of a comparative lens system in the non-dominant eye for various prescriptions (Rx)

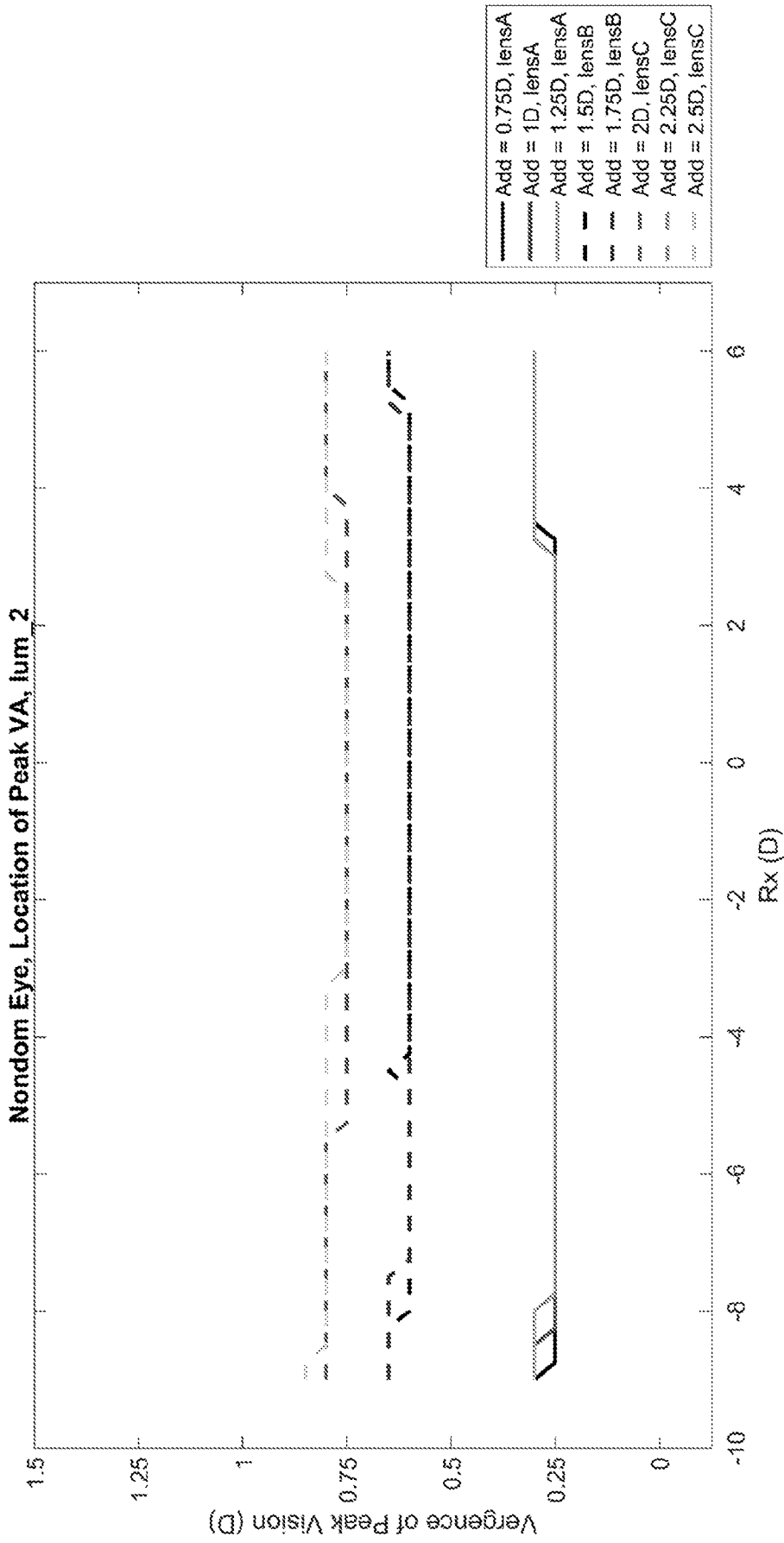


FIG. 21

Example graphs of depth of focus of a comparative lens system
in the dominant eye for various prescriptions (Rx)

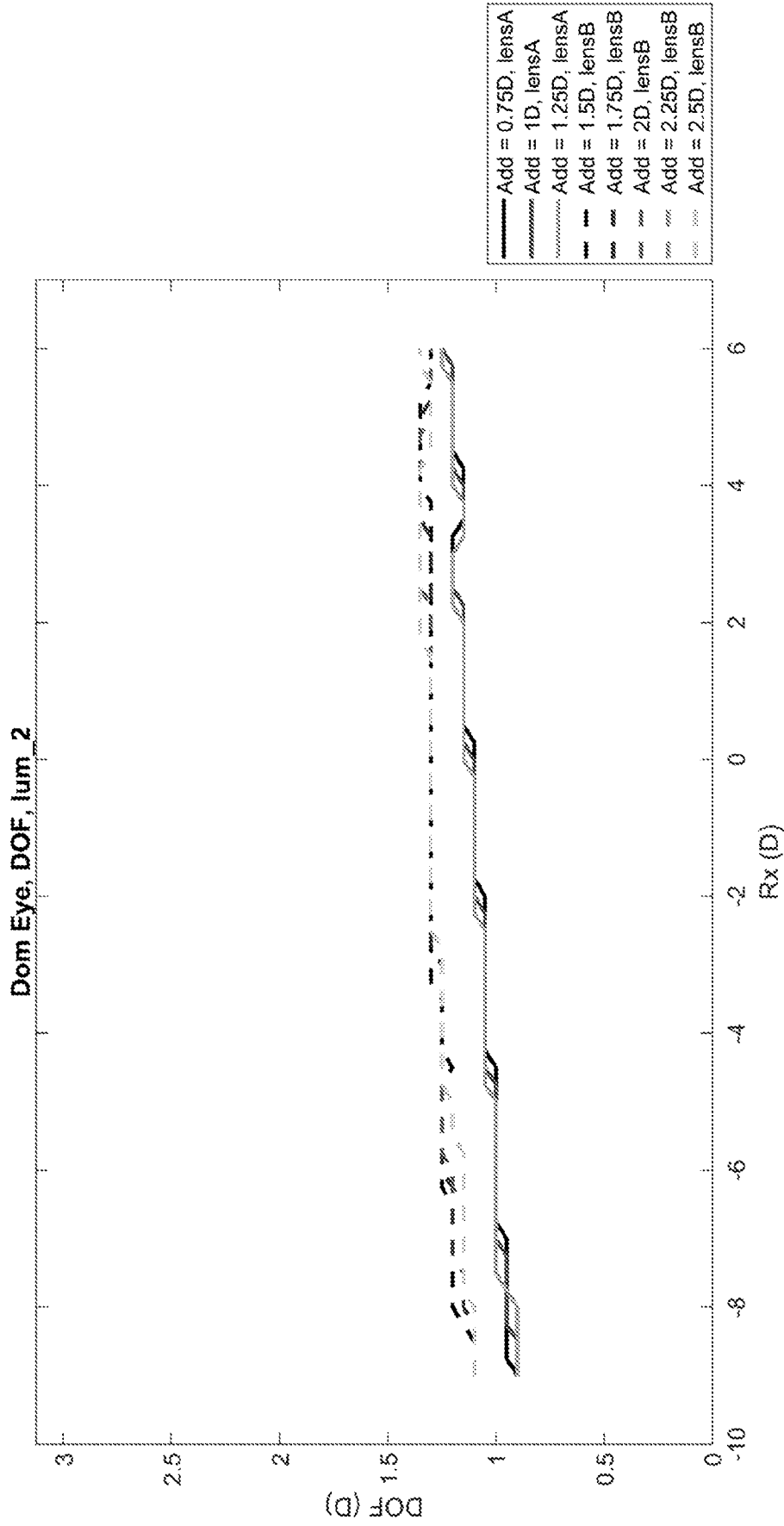


FIG. 22

Example graphs of depth of focus of a comparative lens system in the non-dominant eye for various prescriptions (Rx)

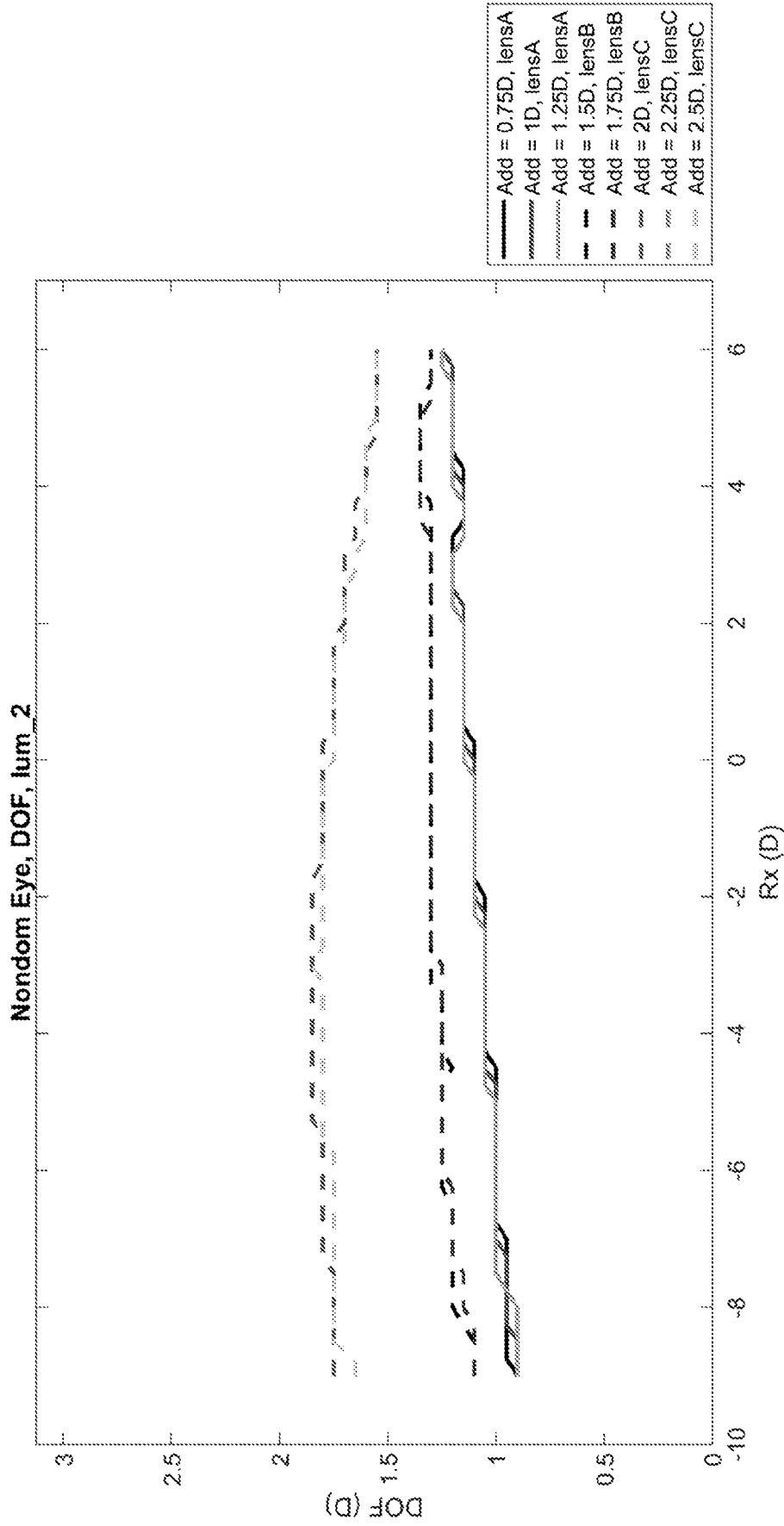


FIG. 23

Example graphs of vergence of peak visual performance of a lens system in accordance with the present disclosure in the dominant eye for various prescriptions (Rx)

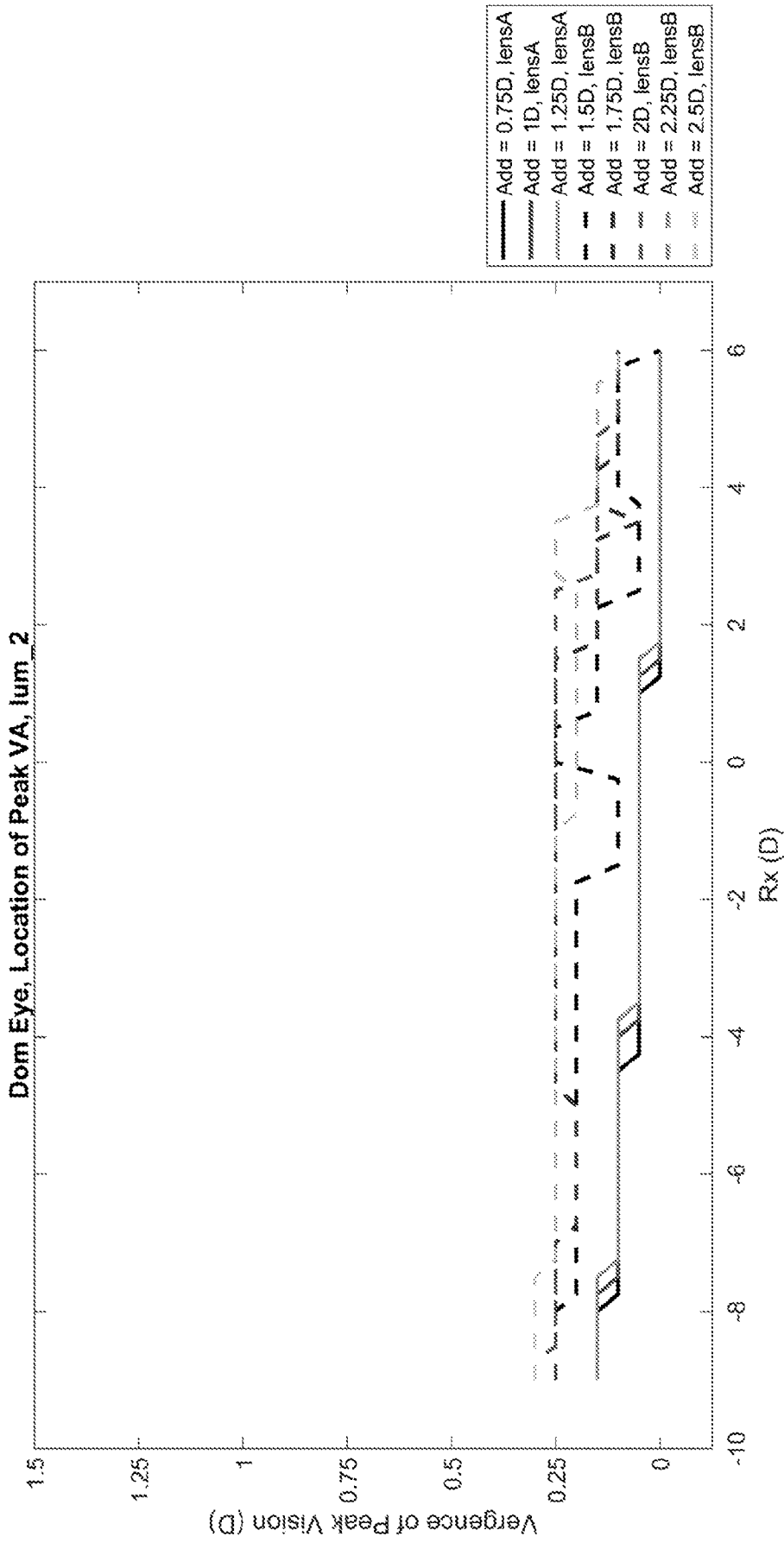


FIG. 24

Example graphs of vergence of peak visual performance of a lens system in accordance with the present disclosure in the non-dominant eye for various prescriptions (Rx)

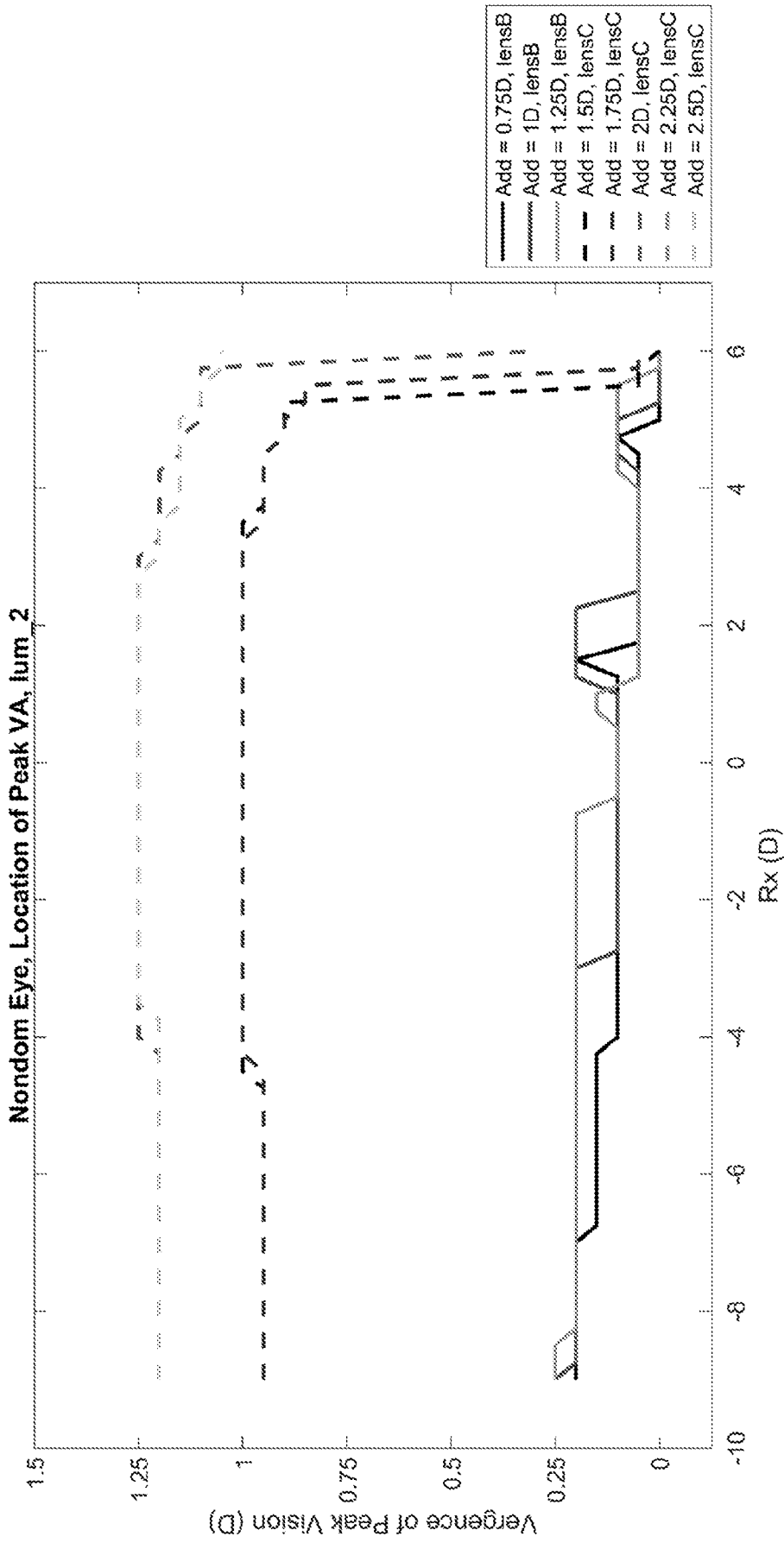


FIG. 25

Example graphs of depth of focus of a lens system in accordance with the present disclosure in the dominant eye for various prescriptions (Rx)

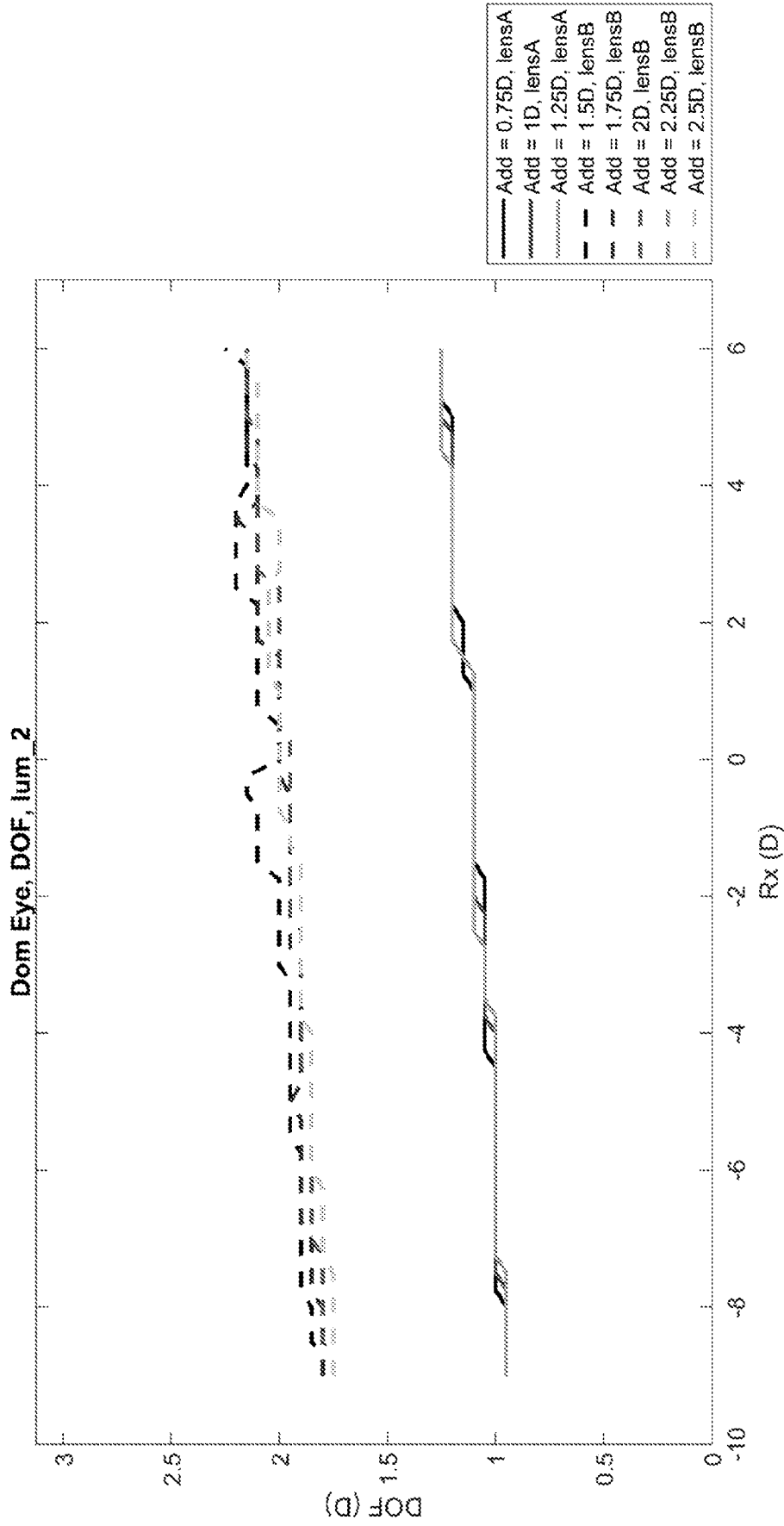


FIG. 26

Example graphs of depth of focus of a lens system in accordance with the present disclosure in the non-dominant eye for various prescriptions (Rx)

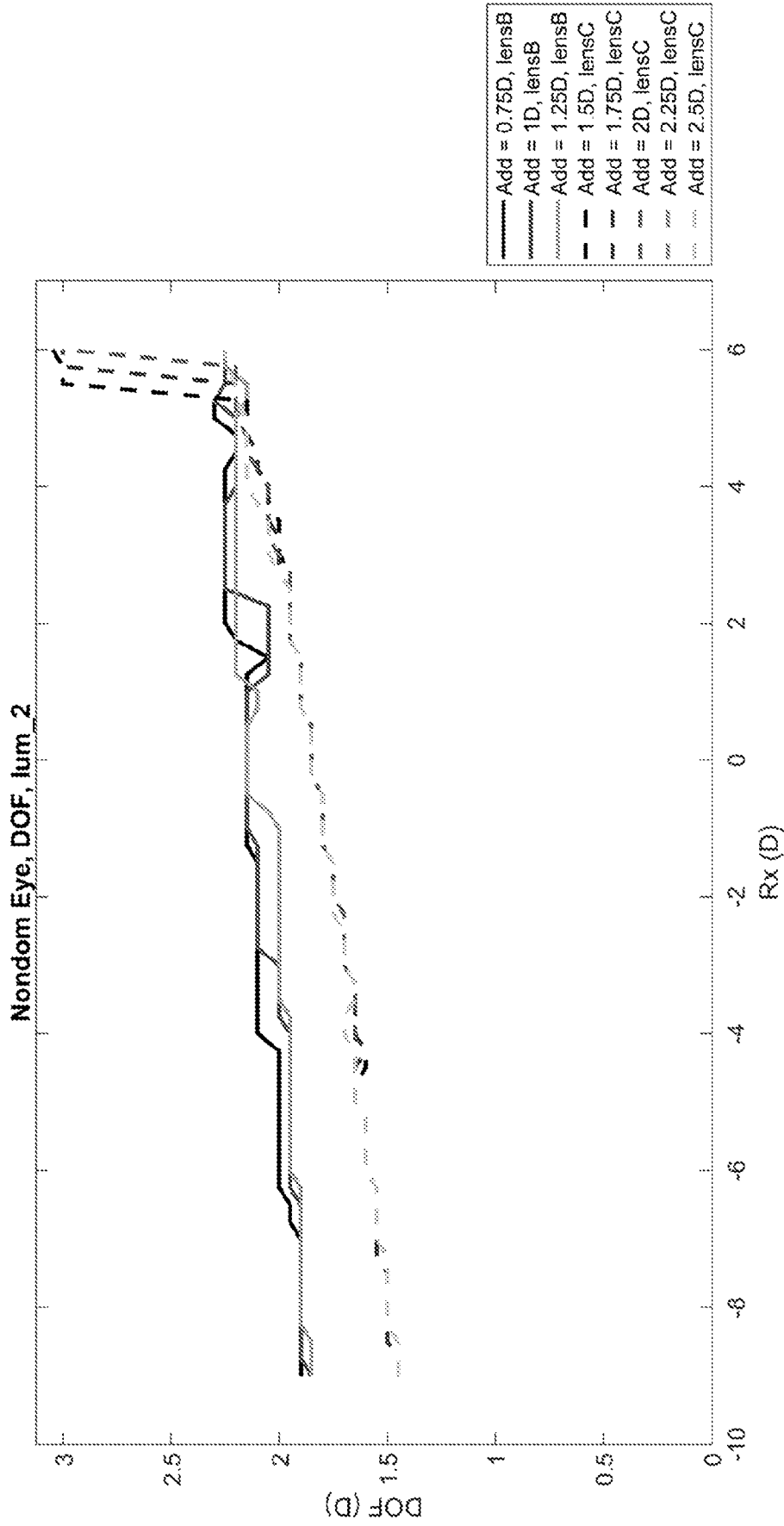


FIG. 27

Difference in location of peak visual acuity between the present disclosure and the comparative lens system, dominant eye in low luminance (luminance = 2cd/m²).

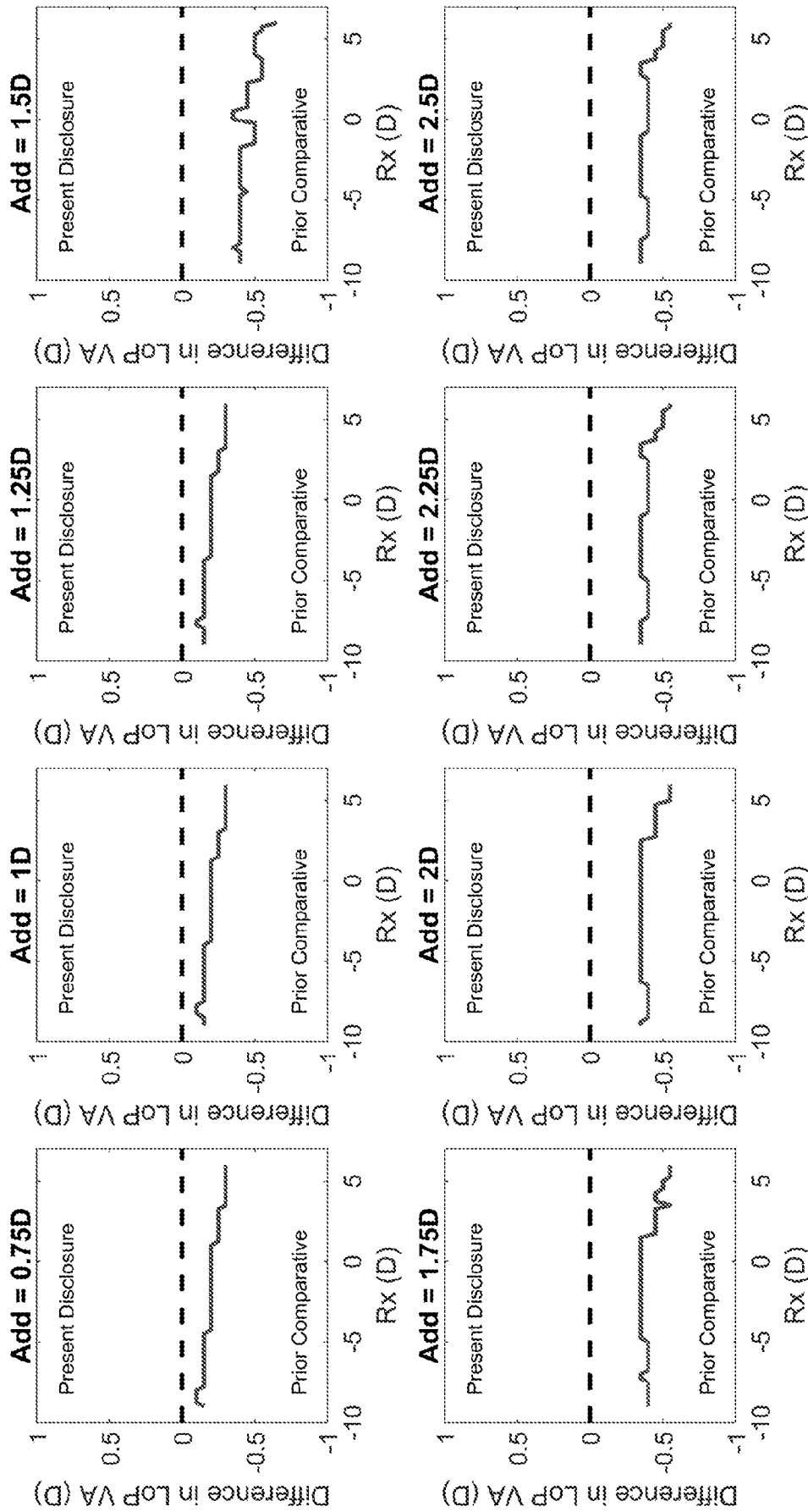


FIG. 28

Difference in location of peak visual acuity between the present disclosure and the comparative lens system, non-dominant eye in low luminance (luminance = 2cd/m²).

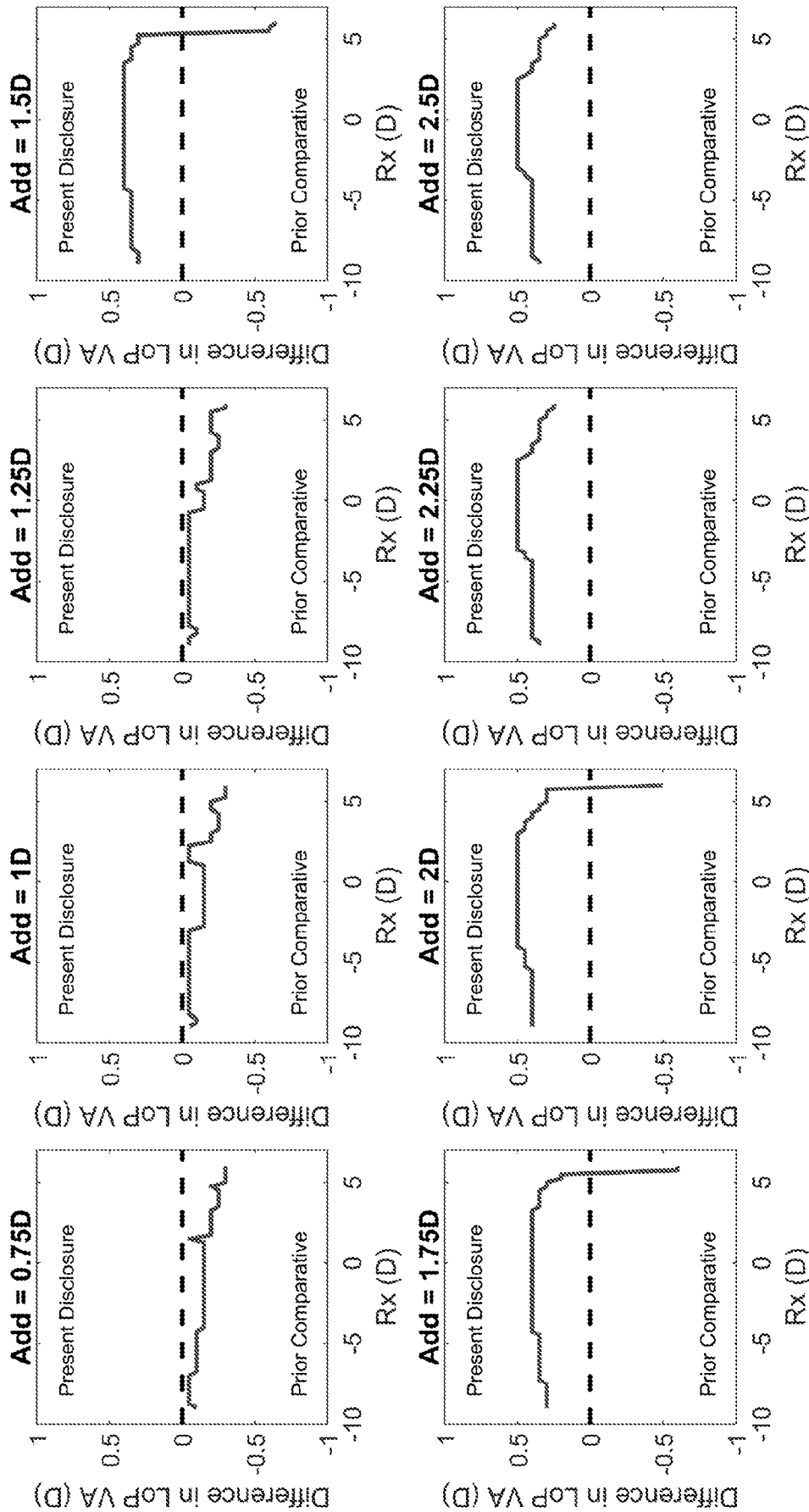


FIG. 29

Difference in depth of focus between the present disclosure and the comparative lens system, dominant eye in low luminance (luminance = 2cd/m²).

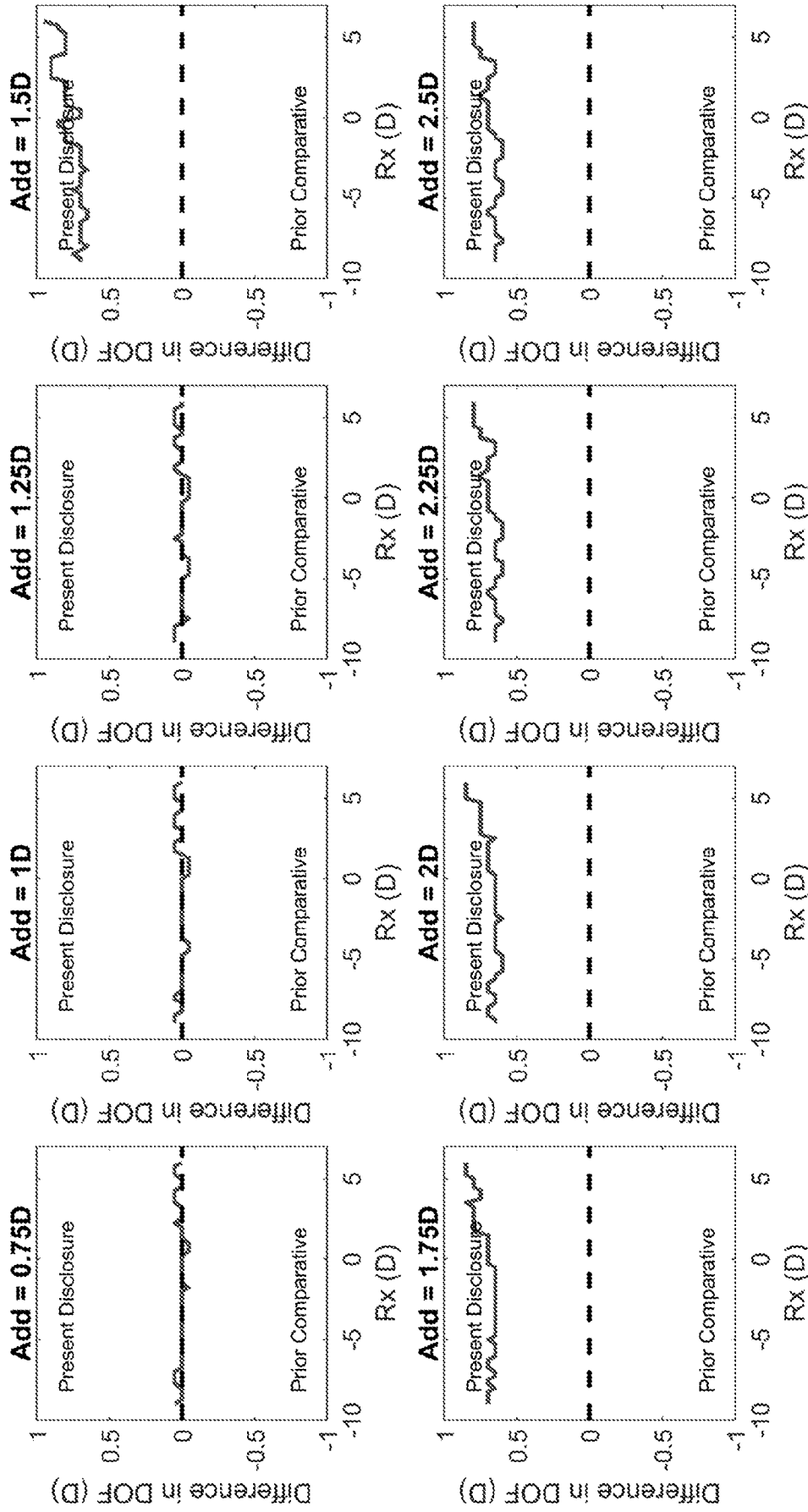


FIG. 30

Difference in depth of focus between the present disclosure and the comparative lens system, non-dominant eye in low luminance (luminance = 2cd/m²).

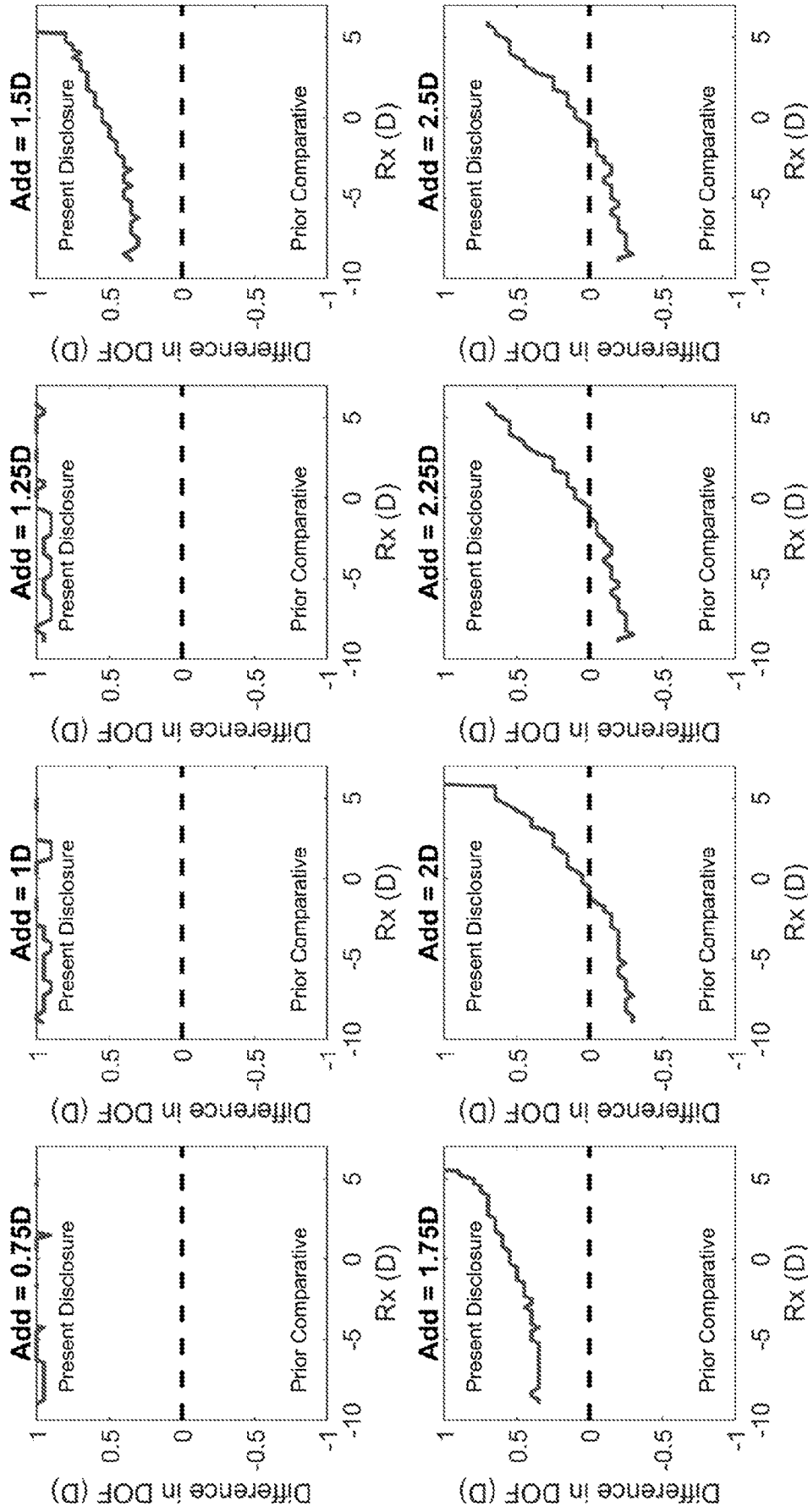


FIG. 31

Difference in location of peak visual acuity between the present disclosure and the comparative lens system, dominant eye in low luminance (luminance = 20cd/m²).

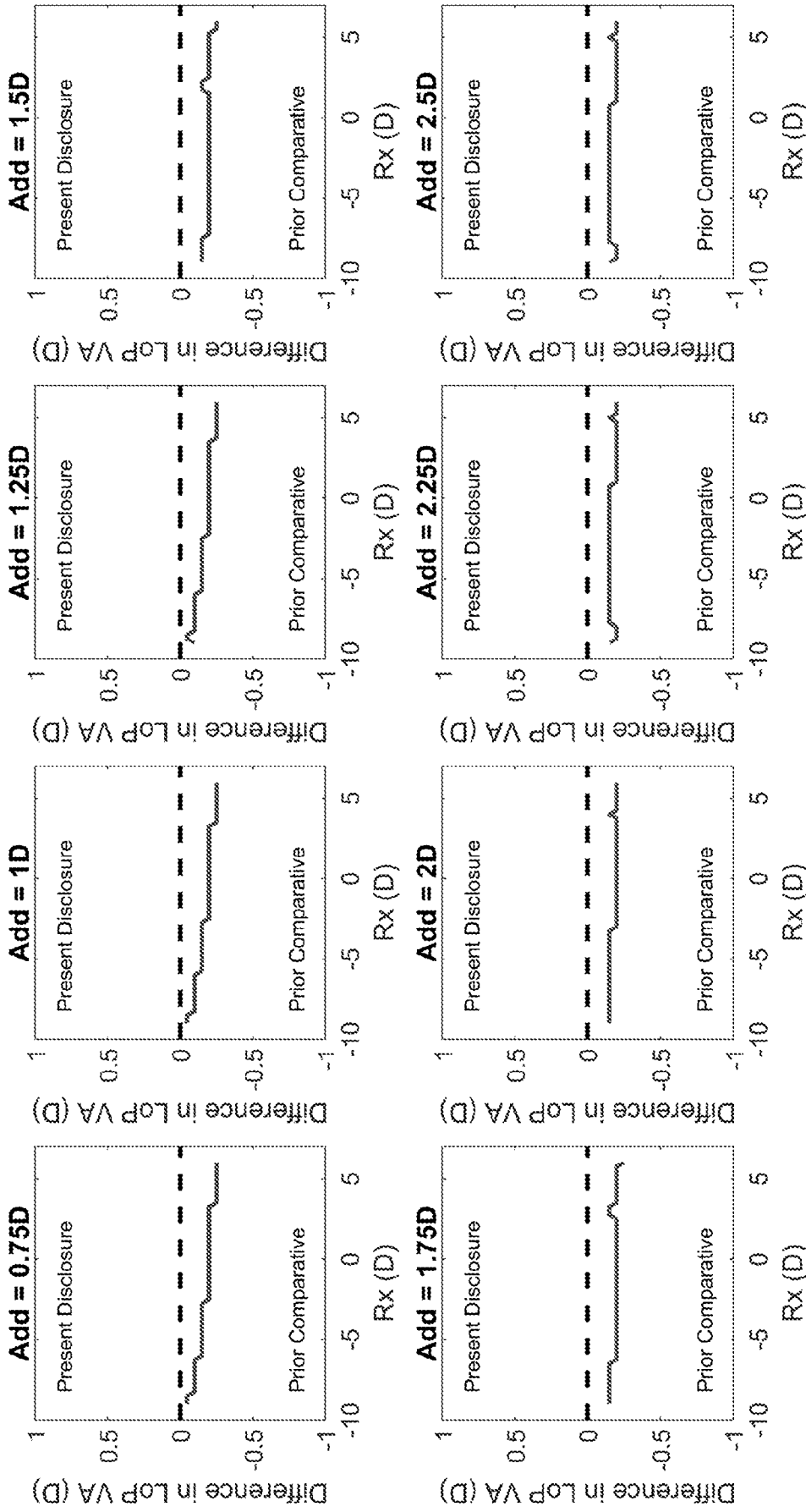


FIG. 32

Difference in location of peak visual acuity between the present disclosure and the comparative lens system, non-dominant eye in low luminance (luminance = 20cd/m²).

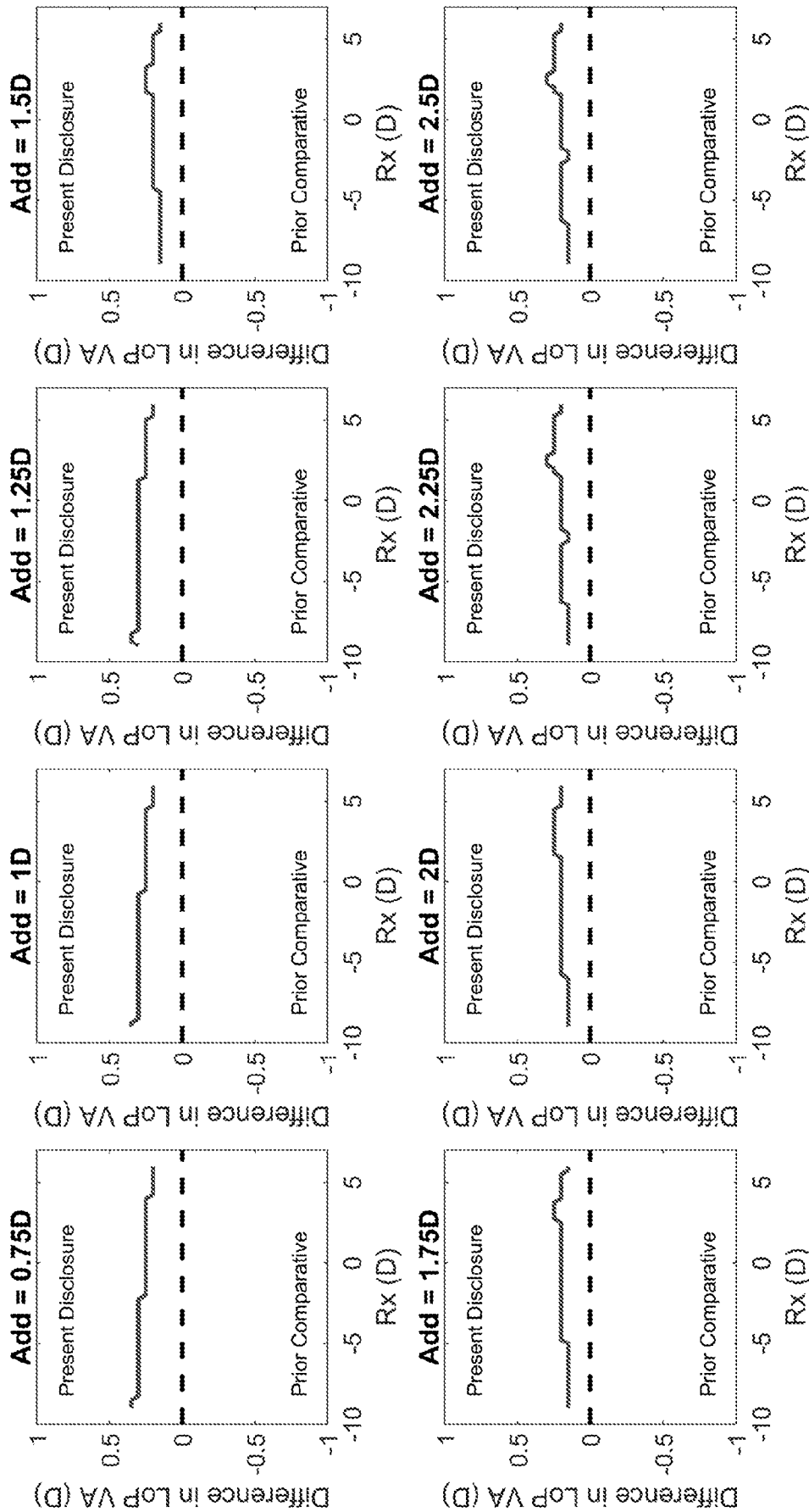


FIG. 33

Difference in depth of focus between the present disclosure and the comparative lens system, dominant eye in low luminance (luminance = 20cd/m²).

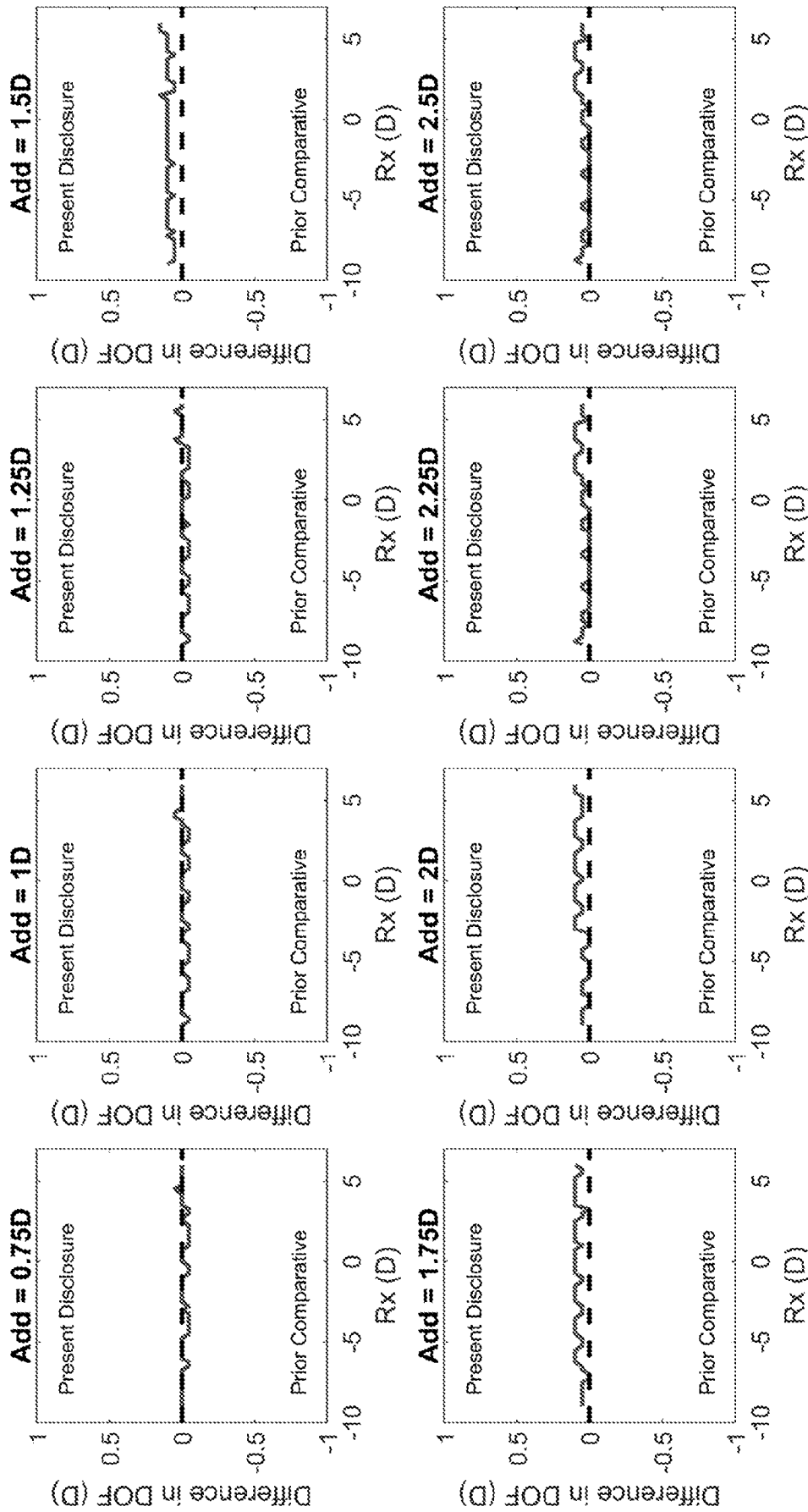


FIG. 34

Difference in depth of focus between the present disclosure and the comparative lens system, non-dominant eye in low luminance (luminance = 20cd/m²).

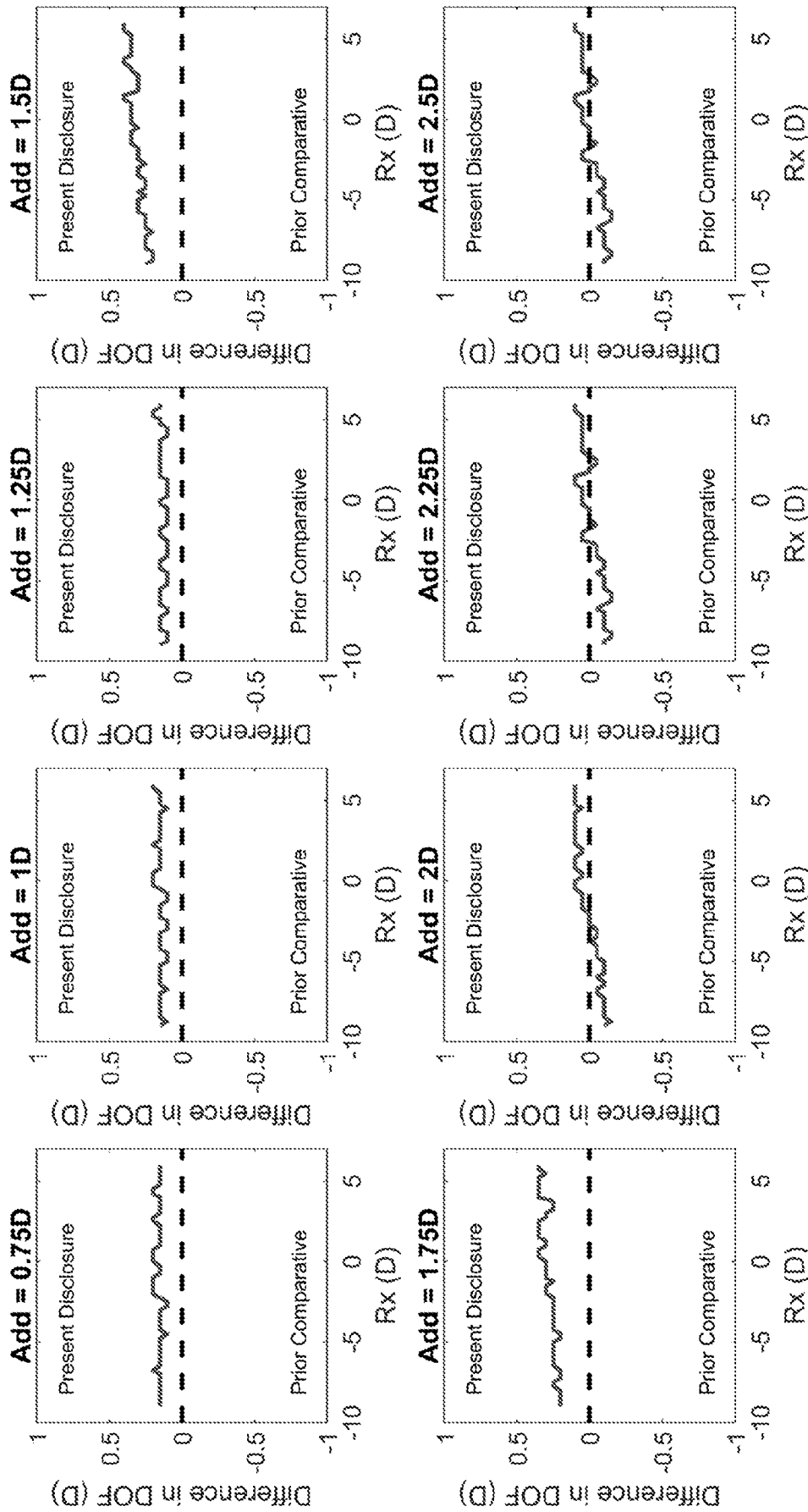


FIG. 35

Difference in location of peak visual acuity between the present disclosure and the comparative lens system, dominant eye in low luminance (luminance = 400cd/m²).

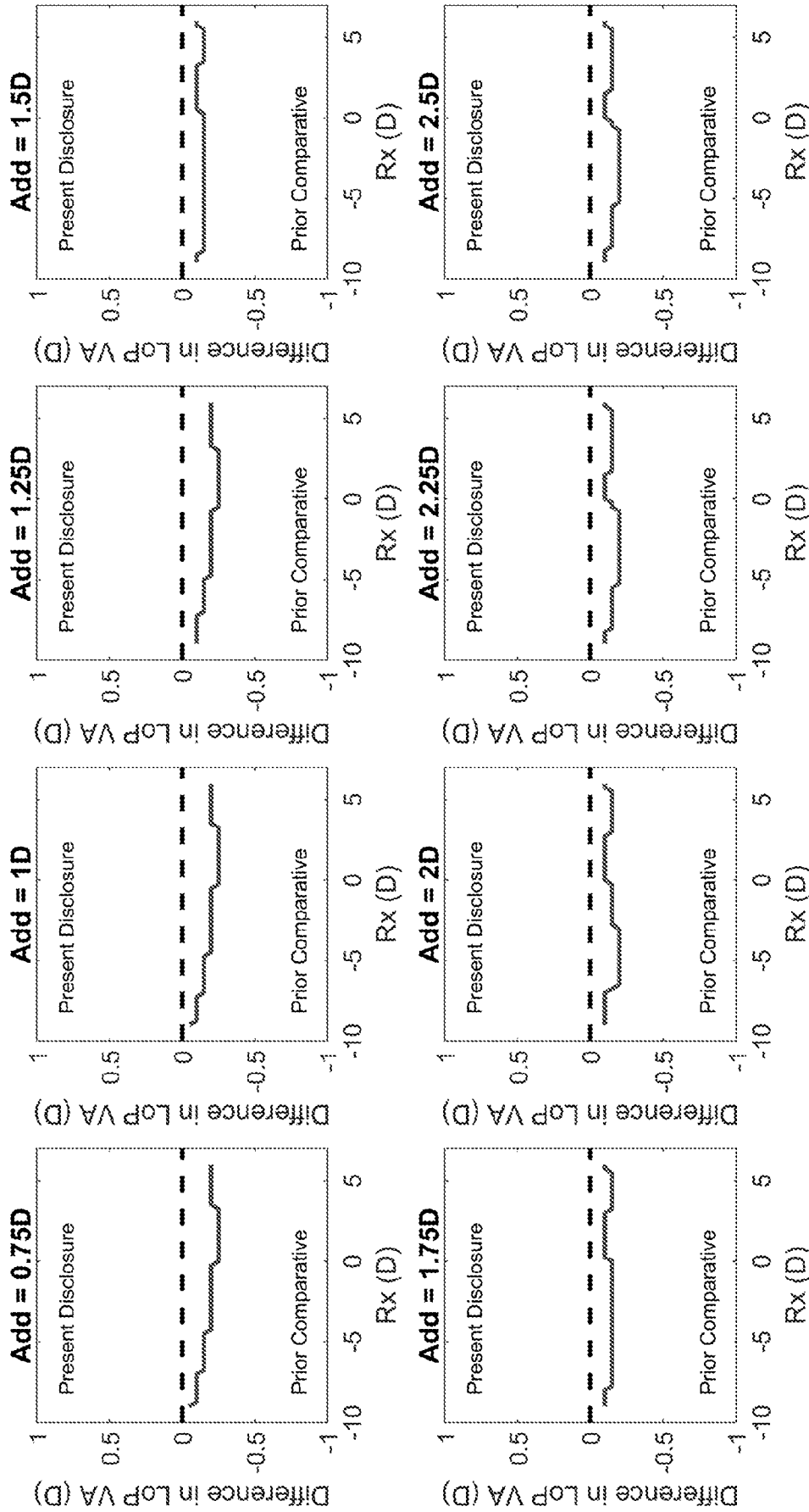


FIG. 36

Difference in location of peak visual acuity between the present disclosure and the comparative lens system, non-dominant eye in low luminance (luminance = 400cd/m²).

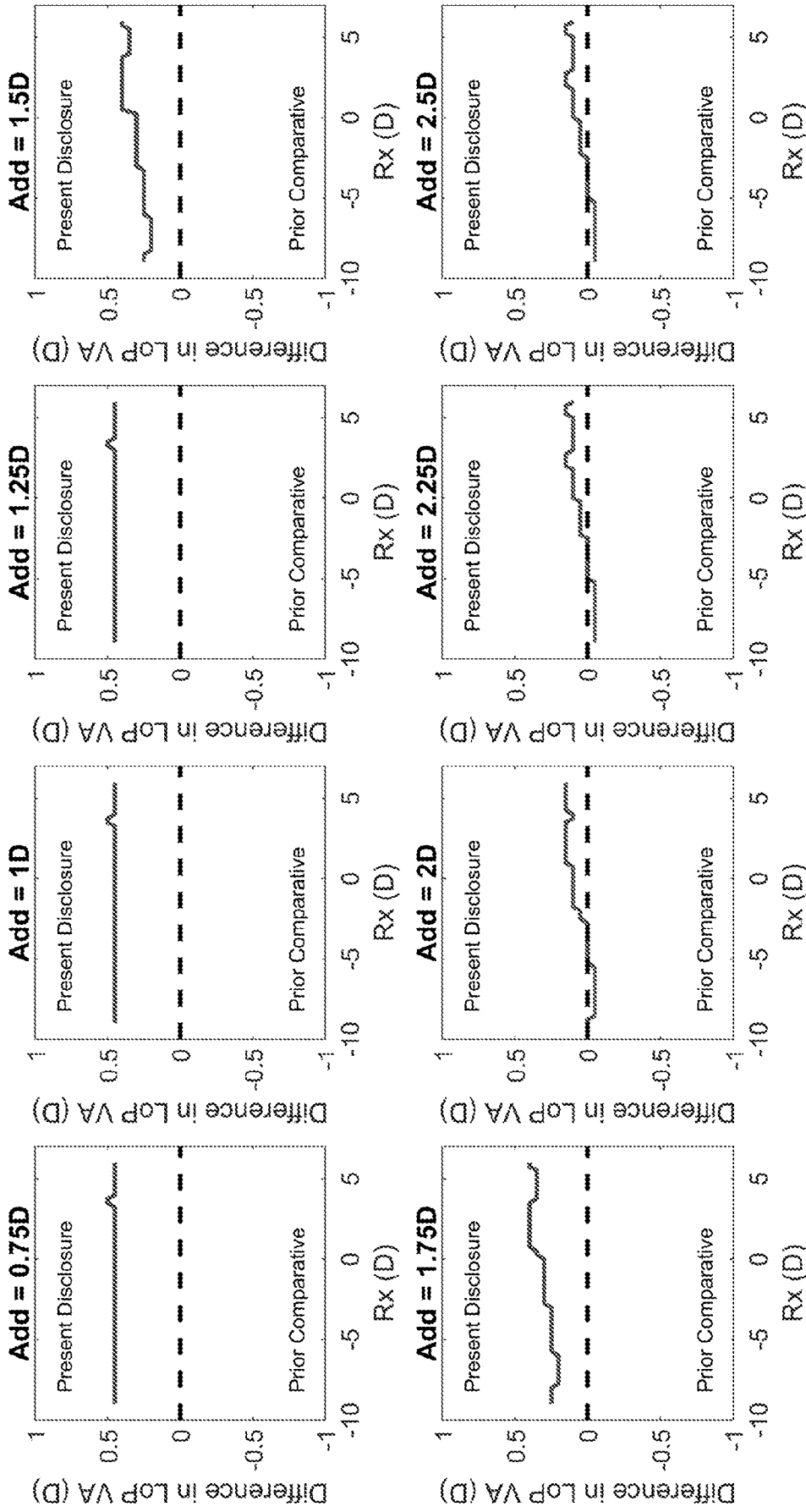


FIG. 37

Difference in depth of focus between the present disclosure and the comparative lens system, dominant eye in low luminance (luminance = 400cd/m²).

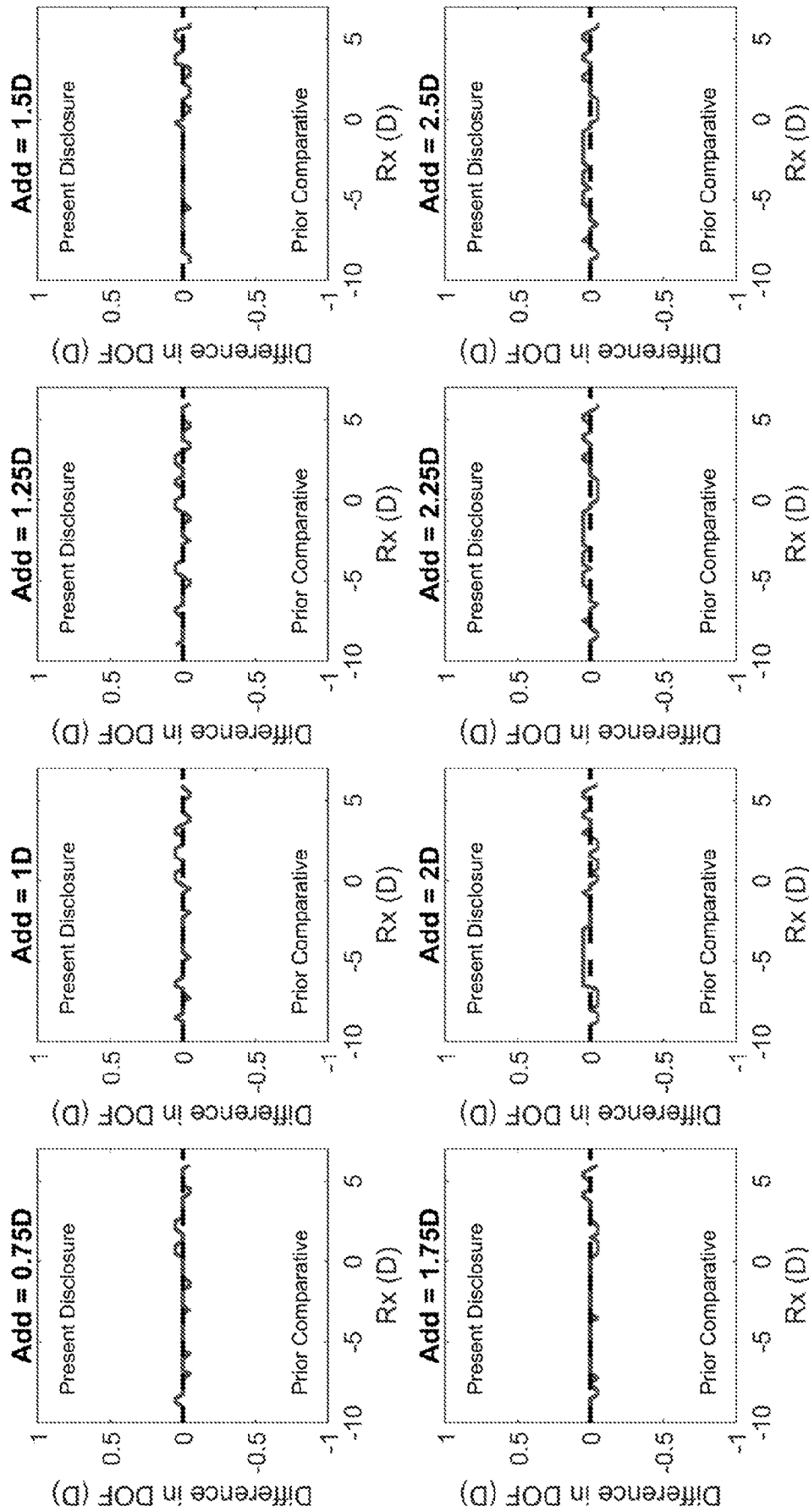


FIG. 38

Difference in depth of focus between the present disclosure and the comparative lens system, non-dominant eye in low luminance (luminance = 400cd/m²).

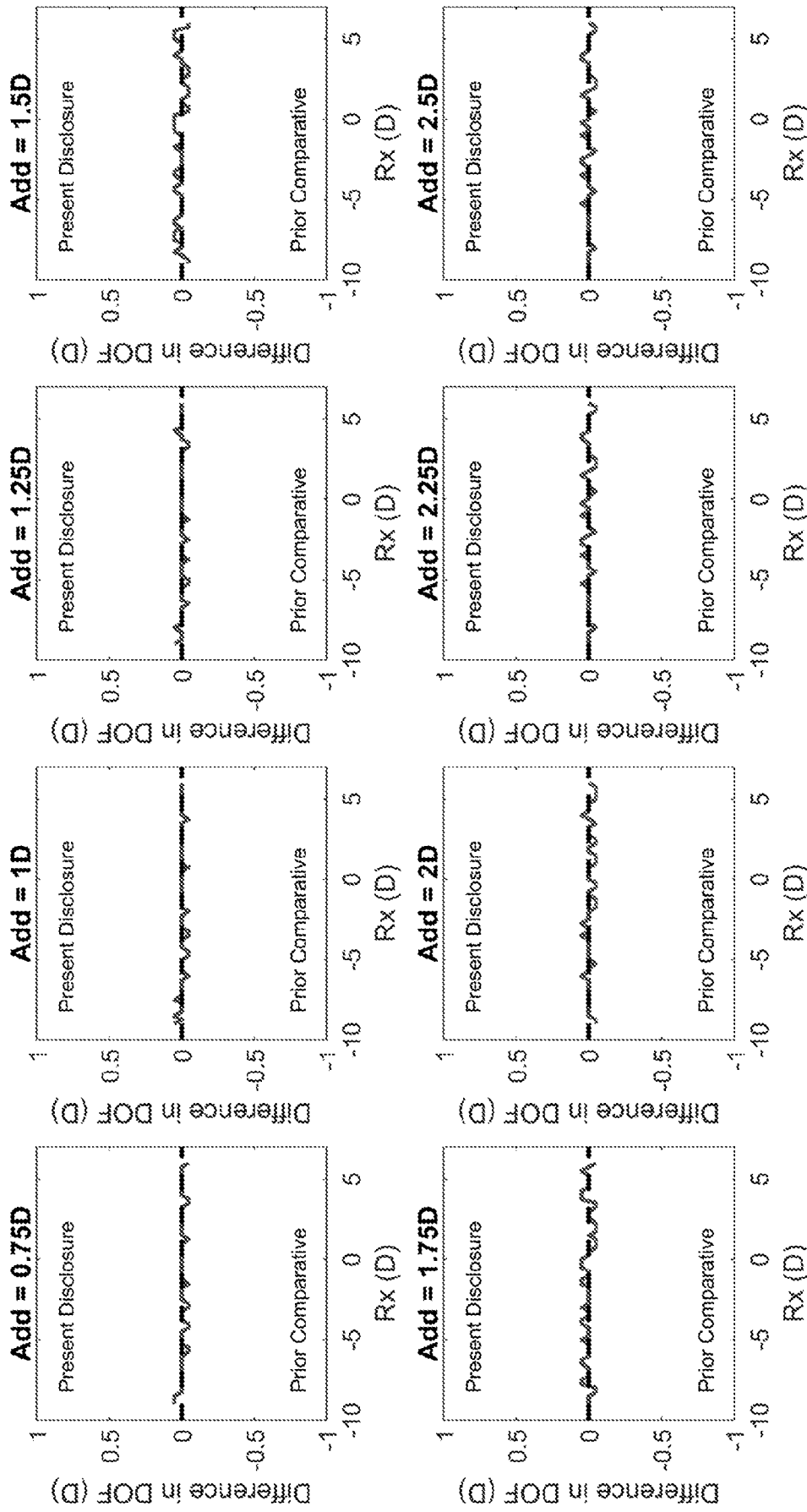


FIG. 39

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB21/51962

A. CLASSIFICATION OF SUBJECT MATTER

IPC - G02C 7/02; G02C 7/04; G02C 7/06 (2021.01)

CPC - G02C 7/024; G02C 7/027; G02C 7/028; G02C 7/041; G02C 7/047; G02C 7/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 2016/0062140 A1 (JOHNSON & JOHNSON VISION CARE, INC.) 03 March 2016; figure 6; paragraphs [0011]-[0012], [0038]-[0039], [0070]-[0073], [0077]	17-23 — 1-16, 24-31
Y	US 2014/0268034 A1 (JOHNSON & JOHNSON VISION CARE, INC.) 18 September 2014; figures 6, 17, 18; paragraphs [0060], [0067]	1-16, 24-31
A	US 2010/0026958 A1 (WOOLEY, CB et. al) 04 February 2010; see entire document	1-31
A	US 9,952,449 B2 (MENICON CO., LTD.) 24 April 2018; see entire document	1-31
A	US 2013/0201443 A1 (BACK, A et. al) 08 August 2013; see entire document	1-31

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

14 May 2021 (14.05.2021)

Date of mailing of the international search report

JUN 03 2021

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-8300

Authorized officer

Shane Thomas

Telephone No. PCT Helpdesk: 571-272-4300