CLAIMS

1. A system, comprising:

a radiation source;

one or more beam-directing elements; and

a controller, configured to:

~~display a live sequence of images of an eye of a patient,~~

~~while displaying the sequence of images,~~ cause the radiation source to ~~irradiate the eye with~~ emit one or more aiming beams at the beam-directing elements such that the aiming beams are directed, by the beam-directing elements, toward an eye of a patient~~, which are visible in the images~~,

verify that each of the aiming beams is properly directed by the beam-directing elements by processing a feedback signal from an encoder for the beam-directing elements,

subsequently to causing the radiation source to ~~irradiate the eye with~~ emit the aiming beams, receive a confirmation input from a user, and

in response to verifying that each of the aiming beams is properly directed by the beam-directing elements and to receiving the confirmation input, treat the eye by causing the radiation source to irradiate ~~respective~~ one or more target regions of the eye with ~~a plurality of~~ respective treatment beams.

2. The system according to claim 1, further comprising ~~:~~

a focusing lens~~; and~~

~~one or more beam-directing elements~~,

wherein the controller is configured to cause the radiation source to irradiate the target regions of the eye ~~with the treatment beams~~ by firing the treatment beams at the beam-directing elements through the focusing lens, such that the treatment beams are focused by the focusing lens prior to being directed, by the beam-directing elements, toward the respective target regions.

3. The system according to any one of claims 1-2, wherein a respective one of the aiming beams impinges on at least part of each of the target regions.

4. The system according to any one of claims 1-3, further comprising a camera configured to acquire a sequence of images while the aiming beams are emitted, wherein the aiming beams are visible in the images.

~~4. The system according to claim 3, wherein the controller is further configured to~~

~~superimpose, on each of the images, a marker passing through each of the target regions.~~

~~5. The system according to claim 4, wherein the marker is elliptical.~~

~~6. The system according to any one of claims 1-5, wherein at least part of each of the target regions is located within 1 mm of a limbus of the eye.~~

~~7~~5. The system according to ~~any one of~~ claim~~s~~ ~~4~~1-~~6~~, wherein the controller is further configured to ~~:~~

superimpose a marker on each of the images, and wherein the controller is configured to verify that each of the aiming beams is properly directed by the beam-directing elements

~~prior to treating the eye,~~ by processing the images~~,~~ so as to verify respective positions of the aiming beams with respect to the marker~~,~~

~~wherein the controller is configured to treat the eye in response to verifying the positions~~

~~of the aiming beams~~.

6~~8~~. The system according to claim 5~~7~~, wherein the controller is configured to verify the respective positions of the aiming beams by verifying that the aiming beams overlap the marker.

7~~9~~. The system according to claim 5~~7~~, wherein the controller is configured to verify the respective positions of the aiming beams by verifying that the aiming beams lie outside the marker.

8~~10~~. The system according to any one of claims 5~~7~~-7~~9~~, wherein the controller is configured to treat the eye such that respective edges of the treatment beams impinge on respective portions of the eye over which the marker is superimposed.

9~~11~~. The system according to any one of claims 5~~7~~-8~~10~~, wherein the marker is elliptical.

10~~12~~. The system according to any one of claims 5~~1~~-9~~11~~,

wherein the controller is further configured to:

prior to ~~displaying the live images~~causing the radiation source to emit the aiming beams, display a still image of the eye, and

identify an elliptical portion of the eye in the still image, based on input from the user, and

wherein the controller is configured to, in response to identifying the elliptical portion of the eye, superimpose ~~an elliptical~~ the marker over the elliptical portion of the eye in each of the images.

11~~13~~. The system according to claim 10~~12~~, wherein the controller is configured to superimpose the ~~elliptical~~ marker over the elliptical portion of the eye by:

subsequently to identifying the elliptical portion of the eye, identifying an offset from a center of a limbus of the eye to a center of the elliptical portion in the still image, and

for each image of the images:

identifying the center of the limbus in the image, and

superimposing the elliptical marker on the image such that the center of the elliptical marker is at the identified offset from the center of the limbus.

12~~14~~. The system according to ~~any one of~~ claim~~s~~ 10~~12-13~~, wherein the controller is configured to identify the elliptical portion of the eye by:

displaying, over the still image, (i) the elliptical marker, and (ii) a rectangle circumscribing the elliptical marker, and

subsequently to displaying the elliptical marker and the rectangle, in response to the user

adjusting the rectangle, adjusting the elliptical marker such that the elliptical marker remains circumscribed by the rectangle, until the elliptical marker is superimposed over the portion of the eye.

13~~15~~. The system according to claim 12~~14~~, wherein the controller is further configured to identify

a limbus of the eye in the still image, and wherein the controller is configured to display the elliptical marker over the limbus.

14~~16~~. The system according to any one of claims 1-3 or any one of claims 7-~~15~~11, further comprising a camera configured to ~~:~~

~~acquire the images, and~~

acquire a still image of the eye~~,~~ prior to ~~acquiring~~ the ~~images~~emitting of the aiming beams,

wherein the controller is further configured to:

based on the still image of the eye, identify a static region in a field of view of the camera that includes a pupil of the eye, and

treat the eye such that each of the treatment beams impinges on the eye outside the static region.

15~~17~~. The system according to claim 14~~16~~, ~~further comprising one or more beam-directing elements,~~

wherein the controller is configured to treat the eye by aiming the beam-directing elements at the target regions in sequence and causing the radiation source to fir~~inge~~ the treatment beams at the beam-directing elements, and

wherein the controller is further configured to inhibit the beam-directing elements from being aimed at the static region even while none of the treatment beams is being fired.

16~~18~~. The system according to any one of claims 14~~16~~-15~~17~~, wherein the controller is configured to identify the static region by:

receiving, from the user, a limbus-locating input indicating a location of the limbus in the still image, and

identifying the static region based on the location of the limbus.

17~~19~~. The system according to ~~any one of~~ claim~~s~~ 1-~~18~~, further comprising a camera configured to acquire multiple images of the eye,

~~wherein the images are first images and the aiming beams are first aiming beams,~~

~~wherein the system further comprises a camera configured to acquire multiple second images of the eye while treating the eye, and~~

wherein the controller is configured to treat the eye by ~~iteratively~~performing an iterative process, each iteration of the process including:

using the camera, acquiring a different respective image of the images,

verifying a position of a different respective ~~second aiming beam~~ one of the target regions in the ~~second~~ image, and

in response to ~~the~~ verifying the position, firing a respective one of the treatment beams at the ~~eye~~ target region whose position was verified during the iteration.

18~~20. The system according to claim 19, wherein the controller is configured to verify the position by verifying that a distance between the second aiming beam and a respective one of the~~

~~target regions is less than a predefined threshold.~~

~~21. The system according to claim 20, wherein the controller is configured to fire the respective one of the treatment beams at the respective one of the target regions.~~

~~22~~. The system according to ~~any one of~~ claim~~s~~ 17~~19-21~~, further comprising an illumination source, wherein the controller is further configured to cause the illumination source to intermittently flash visible light at the eye such that the light illuminates the eye at least during respective acquisitions of the ~~second~~ images.

19~~23~~. The system according to claim 18~~22~~, wherein a peak average intensity of the light over a duration of each of the flashes is between 0.003 and 3 mW/cm^2.

20~~24~~. The system according to any one of claims 18~~22~~-19~~23~~, wherein the controller is configured to cause the illumination source to flash the light at a frequency of at least 60 Hz.

21~~25~~. The system according to claim 20~~24~~, wherein the frequency is at least 100 Hz.

22~~26~~. The system according to ~~any one of~~ claim~~s~~ 17~~19-21~~, further comprising an illumination source, wherein the controller is further configured to cause the illumination source to illuminate the eye with near-infrared light at least during respective acquisitions of the ~~second~~ images.

23~~27~~. The system according to claim 22~~26~~, wherein the controller is further configured to cause the illumination source to intermittently flash visible light at the eye while treating the eye.

24~~28~~. The system according to any one of claims 1-23~~27~~, further comprising an optical unit comprising the radiation source and a plurality of beam emitters,

wherein the controller is further configured to, prior to causing the radiation source to ~~irradiate the eye with~~ emit the aiming beams, cause the beam emitters to shine a plurality of range-finding beams on the eye, the range-finding beams being shaped to define different respective portions of a predefined composite pattern such that the predefined composite pattern is formed on the eye only when the optical unit is at a predefined distance from the eye.

25~~29~~. The system according to claim 24~~28~~, wherein the range-finding beams are shaped to define two perpendicular shapes, and wherein the predefined composite pattern includes a cross.

26~~30~~. The system according to any one of claims 1-23~~29~~, further comprising an optical unit comprising the radiation source, wherein the controller is configured to cause the radiation source to irradiate the target regions while the optical unit is directed obliquely upward toward the eye and the eye gazes obliquely downward toward the optical unit.

2731. The system according to claim 2630, further comprising a wedge, wherein the optical unit is directed obliquely upward toward the eye by virtue of being mounted on the wedge.

28. The system according to any one of claims 1-27, wherein the beam-directing elements comprise one or more galvo mirrors, and wherein the encoder is for the galvo mirrors.

~~32. A system, comprising:~~

~~a wedge;~~

~~an optical unit mounted on the wedge such that the optical unit is directed obliquely upward, the optical unit comprising a radiation source; and~~

~~a controller, configured to treat an eye of a patient by causing the radiation source to irradiate respective target regions of the eye with a plurality of treatment beams while the eye gazes obliquely downward toward the optical unit.~~

~~33. A method, comprising:~~

~~displaying a live sequence of images of an eye of a patient;~~

~~while displaying the sequence of images, irradiating the eye with one or more aiming beams, which are visible in the images;~~

~~subsequently to irradiating the eye with the aiming beams, receiving a confirmation input from a user; and~~

~~in response to receiving the confirmation input, treating the eye by irradiating respective target regions of the eye with a plurality of treatment beams.~~

~~34. The method according to claim 33, wherein irradiating the eye with the treatment beams comprises irradiating the eye by firing the treatment beams at one or more beam-directing elements through a focusing lens, such that the beams are focused by the focusing lens prior to being directed, by the beam-directing elements, toward the respective target regions.~~

~~35. The method according to any one of claims 33-34, wherein the aiming beams impinge on at least part of each of the target regions.~~

~~36. The method according to claim 35, further comprising superimposing, on each of the images, a marker passing through each of the target regions.~~

~~37. The method according to claim 36, wherein the marker is elliptical.~~

~~38. The method according to any one of claims 33-37, wherein at least part of each of the target regions is located within 1 mm of a limbus of the eye.~~

~~39. The method according to any one of claims 33-38, further comprising:~~

~~superimposing a marker on each of the images; and~~

~~prior to treating the eye, by processing the images, verifying respective positions of the aiming beams with respect to the marker,~~

wherein treating the eye comprises treating the eye in response to verifying the positions of the aiming beams.

40. The method according to claim 39, wherein verifying the positions of the aiming beams comprises verifying that the aiming beams overlap the marker.

41. The method according to claim 39, wherein verifying the positions of the aiming beams comprises verifying that the aiming beams lie outside the marker.

42. The method according to any one of claims 39-41, wherein treating the eye comprises treating the eye such that respective edges of the treatment beams impinge on respective portions of the eye over which the marker is superimposed.

43. The method according to any one of claims 39-42, wherein the marker is elliptical.

44. The method according to any one of claims 33-43, further comprising, prior to displaying the live images:

displaying a still image of the eye;

identifying an elliptical portion of the eye in the still image, based on input from the user; and

in response to identifying the elliptical portion of the eye, superimposing an elliptical marker over the elliptical portion of the eye in each of the images.

45. The method according to claim 44, wherein superimposing the elliptical marker over the elliptical portion of the eye comprises:

subsequently to identifying the elliptical portion of the eye, identifying an offset from a center of a limbus of the eye to a center of the elliptical portion in the still image; and

for each image of the images:

identifying the center of the limbus in the image; and

~~superimposing the elliptical marker on the image such that the center of the elliptical marker is at the identified offset from the center of the limbus.~~

~~46. The method according to any one of claims 44-45, wherein identifying the elliptical portion of the eye comprises:~~

~~displaying, over the still image, (i) the elliptical marker, and (ii) a rectangle circumscribing the elliptical marker; and~~

~~subsequently to displaying the elliptical marker and the rectangle, in response to the user adjusting the rectangle, adjusting the elliptical marker such that the elliptical marker remains circumscribed by the rectangle, until the elliptical marker is superimposed over the portion of the~~

eye.

47. The method according to claim 46, further comprising identifying a limbus of the eye in the still image, wherein displaying the elliptical marker comprises displaying the elliptical marker over the limbus.

48. The method according to any one of claims 33-47,

wherein the images are acquired by a camera,

wherein the method further comprises:

based on a still image of the eye, which was acquired by the camera, identifying a static region in a field of view of the camera that includes a pupil of the eye, and

wherein treating the eye comprises treating the eye such that each of the treatment beams impinges on the eye outside the static region.

49. The method according to claim 48, wherein treating the eye comprises treating the eye by firing the treatment beams at one or more beam-directing elements aimed at the target regions in sequence, and wherein the method further comprises inhibiting the beam-directing elements from being aimed at the static region even while none of the treatment beams is being fired.

50. The method according to any one of claims 48-49, wherein identifying the static region comprises:

receiving, from the user, a limbus-locating input indicating a location of the limbus in the still image; and

identifying the static region based on the location of the limbus.

51. The method according to any one of claims 33-50,

wherein the images are first images and the aiming beams are first aiming beams,

wherein the method further comprising acquiring multiple second images of the eye while treating the eye, and

wherein treating the eye comprises iteratively:

~~verifying a position of a respective second aiming beam in the second image; and~~

~~in response to the verifying, firing a respective one of the treatment beams at the eye.~~

~~52. The method according to claim 51, wherein verifying the position comprises verifying that a distance between the second aiming beam and a respective one of the target regions is less than a predefined threshold.~~

~~53. The method according to claim 52, wherein firing the respective one of the treatment beams~~

~~comprises firing the respective one of the treatment beams at the respective one of the target regions.~~

~~54. The method according to any one of claims 51-53, further comprising intermittently flashing visible light at the eye such that the light illuminates the eye at least during respective acquisitions of the second images.~~

~~55. The method according to claim 54, wherein flashing the light comprises flashing the light such that a peak-average intensity of the light over a duration of each of the flashes is between 0.003 and 3 mW/cm^2.~~

~~56. The method according to any one of claims 54-55, wherein flashing the light comprises flashing the light at a frequency of at least 60 Hz.~~

~~57. The method according to claim 56, wherein the frequency is at least 100 Hz.~~

~~58. The method according to any one of claims 51-53, further comprising illuminating the eye with near-infrared light at least during respective acquisitions of the second images.~~

~~59. The method according to claim 58, further comprising intermittently flashing visible light at the eye while treating the eye.~~

~~60. The method according to any one of claims 33-59, wherein treating the eye comprises treating the eye using an optical unit, and wherein the method further comprises, prior to irradiating the eye with the aiming beams, shining a plurality of range-finding beams on the eye,~~

~~the range-finding beams being shaped to define different respective portions of a predefined composite pattern such that the predefined composite pattern is formed on the eye only when the optical unit is at a predefined distance from the eye.~~

~~61. The method according to claim 60, wherein the range-finding beams are shaped to define two perpendicular shapes, and wherein the predefined composite pattern includes a cross.~~

~~62. The method according to any one of claims 33-61, wherein irradiating the target regions comprises irradiating the target regions by firing the treatment beams from an optical unit directed obliquely upward toward the eye while the eye gazes obliquely downward toward the optical unit.~~

~~63. The method according to claim 62, wherein the optical unit is directed obliquely upward toward the eye by virtue of being mounted on a wedge.~~