CLAIMS

1. A system, comprising:

a radiation source; and

a controller, configured to:

designate multiple target regions on an eye of a patient for irradiation with respective amounts of energy,

cause the radiation source to irradiate at least a first one of the target regions,

subsequently to causing the radiation source to irradiate at least the first one of the target regions, by processing an image of the eye, identify a change in the eye, and

in response to identifying the change, refrain from causing the radiation source to irradiate a second one of the target regions, which has not yet been irradiated, with the amount of energy designated for the second one of the target regions.

2. The system according to claim 1, wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions by:

designating a new target region, and

causing the radiation source to irradiate the new target region instead of the second one of the target regions.

3. The system according to claim 1, wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions with the amount of energy designated for the second one of the target regions by causing the radiation source to irradiate the second one of the target regions with another amount of energy that is less than the designated amount.

4. The system according to claim 1, wherein the change includes bleeding.

5. The system according to claim 1, wherein the change includes swelling.

6. The system according to claim 1, wherein the change includes a change in color.

7. The system according to claim 1, wherein the change includes a formation of one or more bubbles.

8. The system according to claim 1, wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions in response to a distance between the second one of the target regions and another region of the eye.

9. The system according to any one of claims 1-8,

wherein the controller is further configured to identify an anatomical feature at the second one of the target regions, and

wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions in response to identifying the anatomical feature.

10. The system according to claim 9,

wherein the controller is further configured to calculate a predicted measure of overlap between a radiation beam irradiating the second one of the target regions and the anatomical feature, and

wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions in response to the predicted measure of overlap.

11. The system according to claim 9,

wherein the anatomical feature is a second-target-region anatomical feature,

wherein the controller is further configured to identify a first-target-region anatomical feature at the first one of the target regions, and

wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions in response to identifying the first-target-region anatomical feature.

12. The system according to claim 11, wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions in response to the first-target-region anatomical feature and the second-target-region anatomical feature being of the same type.

13. The system according to claim 11,

wherein the controller is further configured to:

calculate an estimated measure of overlap between (a) a first radiation beam that irradiated the first one of the target regions and (b) the first-target-region anatomical feature, and

calculate a predicted measure of overlap between (a) a second radiation beam irradiating the second one of the target regions and (b) the first-target-region anatomical feature, and

wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions in response to the predicted measure of overlap and the estimated measure of overlap.

14. The system according to claim 13,

wherein the controller is further configured to:

calculate an estimated amount of energy delivered by a first radiation beam to the first-target-region anatomical feature, and

calculate a predicted amount of energy delivered by a second radiation beam to the second-target-region anatomical feature, and

wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions in response to the predicted amount of energy and the estimated amount of energy.

15. The system according to any one of claims 1-8,

wherein the controller is further configured to calculate a risk measure associated with irradiating the second one of the target regions, and

wherein the controller is configured to refrain from causing the radiation source to irradiate the second one of the target regions in response to the risk measure.

16. The system according to claim 15, wherein the controller is configured to calculate the risk measure based on a medical profile of the patient.

17. The system according to claim 15,

wherein the controller is further configured to identify an anatomical feature at the second one of the target regions, and

wherein the controller is configured to calculate the risk measure based on a type of the second anatomical feature.

~~18. A method, comprising:~~

~~designating multiple target regions on an eye of a patient for irradiation with respective amounts of energy;~~

~~causing a radiation source to irradiate at least a first one of the target regions;~~

~~subsequently to causing the radiation source to irradiate at least the first one of the target regions, by processing an image of the eye, identifying a change in the eye; and~~

~~in response to identifying the change, refraining from causing the radiation source to irradiate a second one of the target regions, which has not yet been irradiated, with the amount of energy designated for the second one of the target regions.~~

~~19. The method according to claim 18, wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises:~~

~~designating a new target region; and~~

~~causing the radiation source to irradiate the new target region instead of the second one of~~

~~the target regions.~~

~~20. The method according to claim 18, wherein refraining from causing the radiation source to irradiate the second one of the target regions with the amount of energy designated for the second one of the target regions comprises causing the radiation source to irradiate the second one of the target regions with another amount of energy that is less than the designated amount.~~

~~21. The method according to claim 18, wherein the change includes bleeding.~~

~~22. The method according to claim 18, wherein the change includes swelling.~~

~~23. The method according to claim 18, wherein the change includes a change in color.~~

~~24. The method according to claim 18, wherein the change includes a formation of one or more bubbles.~~

~~25. The method according to claim 18, wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises refraining from causing the radiation source to irradiate the second one of the target regions in response to a distance between the second one of the target regions and another region of the eye.~~

~~26. The method according to any one of claims 18-25, further comprising identifying an anatomical feature at the second one of the target regions,~~

~~wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises refraining from causing the radiation source to irradiate the second one of the target regions in response to identifying the anatomical feature.~~

~~27. The method according to claim 26, further comprising calculating a predicted measure of overlap between a radiation beam irradiating the second one of the target regions and the anatomical feature, wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises refraining from causing the radiation source to irradiate the second one of the target regions in response to the predicted measure of overlap.~~

~~28. The method according to claim 26,~~

~~wherein the anatomical feature is a second-target-region anatomical feature,~~

~~wherein the method further comprises identifying a first-target-region anatomical feature at the first one of the target regions, and~~

~~wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises refraining from causing the radiation source to irradiate the second one of the target regions in response to identifying the first-target-region anatomical feature.~~

29. The method according to claim 28, wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises refraining from causing the radiation source to irradiate the second one of the target regions in response to the first-target-region anatomical feature and the second-target-region anatomical feature being of the same type.

30. The method according to claim 28, further comprising:

calculating an estimated measure of overlap between (a) a first radiation beam that irradiated the first one of the target regions and (b) the first-target-region anatomical feature; and

calculating a predicted measure of overlap between (a) a second radiation beam irradiating the second one of the target regions and (b) the first-target-region anatomical feature,

wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises refraining from causing the radiation source to irradiate the second one of the target regions in response to the predicted measure of overlap and the estimated measure of overlap.

31. The method according to claim 30, further comprising:

calculating an estimated amount of energy delivered by a first radiation beam to the first-target-region anatomical feature; and

calculating a predicted amount of energy delivered by a second radiation beam to the second-target-region anatomical feature,

wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises refraining from causing the radiation source to irradiate the second one of the target regions in response to the predicted amount of energy and the estimated amount of energy.

32. The method according to any one of claims 18-25, further comprising calculating a risk measure associated with irradiating the second one of the target regions, wherein refraining from causing the radiation source to irradiate the second one of the target regions comprises refraining from causing the radiation source to irradiate the second one of the target regions in response to the risk measure.

33. The method according to claim 32, wherein calculating the risk measure comprises calculating the risk measure based on a medical profile of the patient.

34. The method according to claim 32, further comprising identifying an anatomical feature at the second one of the target regions,

wherein calculating the risk measure comprises calculating the risk measure based on a type of the second anatomical feature.

35. A system, comprising:

a radiation source; and

a controller, configured to:

acquire an image of an eye,

identify, in the image, multiple edge points at different respective angles relative to a reference point located on the eye radially inward from the edge points, each of the edge points lying on an edge of a respective blood vessel,

define multiple target regions on the eye between the reference point and the edge points, and

cause the radiation source to irradiate the target regions.

36. The system according to claim 35, wherein the reference point is located at a center of an iris of the eye.

37. The system according to claim 35, wherein the reference point is located at a center of a limbus of the eye.

38. The system according to claim 35, wherein the reference point is located at a center of a pupil of the eye.

39. The system according to claim 35, wherein, for each angle, the edge of the respective blood vessel is closer to the reference point than is any other edge of any blood vessel at the angle.

40. The system according to any one of claims 35-39, wherein the controller is configured to define the target regions by:

defining at least one treatment path between the edge points and the reference point, and

defining the target regions such that each of the target regions lies on the treatment path.

41. The system according to claim 40, wherein the controller is configured to define the treatment path such that a shortest distance between any one of the edge points and the treatment path is at least 0.001 mm.

42. The system according to claim 40, wherein the controller is configured to define the treatment path by:

defining at least one curve passing through the edge points,

offsetting the curve toward the reference point, and

defining the treatment path responsively to the offset curve.

43. The system according to claim 42, wherein the controller is configured to define the treatment path responsively to the offset curve by defining the treatment path as a perimeter of a

predetermined shape inscribed within the offset curve.

44. The system according to claim 43, wherein the predetermined shape is an ellipse.

45. The system according to claim 42, wherein the controller is configured to define the treatment path responsively to the offset curve by defining the treatment path as a perimeter of a predetermined shape of maximal area inscribed within the offset curve.

46. The system according to claim 42, wherein the controller is configured to define the treatment path responsively to the offset curve by defining the treatment path as a perimeter of a predetermined shape of maximal area centered at the reference point and inscribed within the offset curve.

47. The system according to claim 42, wherein the controller is configured to define the treatment path responsively to the offset curve by defining the treatment path as a closed curve inscribed within the offset curve and having a shape of a limbus of the eye.

48. A method, comprising:

acquiring an image of an eye;

identifying, in the image, multiple edge points at different respective angles relative to a reference point located on the eye radially inward from the edge points, each of the edge points lying on an edge of a respective blood vessel;

defining multiple target regions on the eye between the reference point and the edge points; and

causing a radiation source to irradiate the target regions.

49. The method according to claim 48, wherein the reference point is located at a center of an iris of the eye.

50. The method according to claim 48, wherein the reference point is located at a center of a limbus of the eye.

51. The method according to claim 48, wherein the reference point is located at a center of a pupil of the eye.

52. The method according to claim 48, wherein, for each angle, the edge of the respective blood vessel is closer to the reference point than is any other edge of any blood vessel at the angle.

53. The method according to any one of claims 48-52, wherein defining the target regions comprises:

defining at least one treatment path between the edge points and the reference point; and

defining the target regions such that each of the target regions lies on the treatment path.

54. The method according to claim 53, wherein defining the treatment path comprises defining the treatment path such that a shortest distance between any one of the edge points and the treatment path is at least 0.001 mm.

55. The method according to claim 53, wherein defining the treatment path comprises:

defining at least one curve passing through the edge points;

offsetting the curve toward the reference point; and

defining the treatment path responsively to the offset curve.

56. The method according to claim 55, wherein defining the treatment path responsively to the offset curve comprises defining the treatment path as a perimeter of a predetermined shape inscribed within the offset curve.

57. The method according to claim 56, wherein the predetermined shape is an ellipse.

58. The method according to claim 55, wherein defining the treatment path responsively to the offset curve comprises defining the treatment path as a perimeter of a predetermined shape of maximal area inscribed within the offset curve.

59. The method according to claim 55, wherein defining the treatment path responsively to the offset curve comprises defining the treatment path as a perimeter of a predetermined shape of maximal area centered at the reference point and inscribed within the offset curve.

60. The method according to claim 55, wherein defining the treatment path responsively to the offset curve comprises defining the treatment path as a closed curve inscribed within the offset curve and having a shape of a limbus of the eye.

61. A system, comprising:

a radiation source; and

a controller, configured to:

acquire an image of an eye,

identify, in the image, multiple edge points at different respective angles relative to a reference point located on the eye radially inward from the edge points, each of the edge points lying on an edge of a respective blood vessel,

define at least one curve passing through the edge points,

offset the curve toward the reference point,

while displaying the offset curve to a user, receive, from the user, a definition of multiple target regions on the eye, and

cause the radiation source to irradiate the target regions.

62. A method, comprising:

acquiring an image of an eye;

identifying, in the image, multiple edge points at different respective angles relative to a reference point located on the eye radially inward from the edge points, each of the edge points lying on an edge of a respective blood vessel;

defining at least one curve passing through the edge points;

offsetting the curve toward the reference point;

while displaying the offset curve to a user, receiving, from the user, a definition of multiple target regions on the eye; and

causing a radiation source to irradiate the target regions.

63. A method, comprising:

administering an α2 agonist to an eye of a patient; and

less than 40 minutes following the administering of the α2 agonist, treating an eye of the patient with laser radiation.

64. The method according to claim 63, wherein treating the eye of the patient comprises treating the eye of the patient by irradiating a trabecular meshwork of the eye with the laser radiation.

65. The method according to any one of claims 63-64, wherein treating the eye of the patient comprises treating the eye of the patient less than 30 minutes following the administering of the α2 agonist.

66. The method according to any one of claims 63-64, wherein treating the eye of the patient comprises treating the eye of the patient in response to an indication, from a controller, that blood vessels of the eye were sufficiently constricted by the α2 agonist.

67. An α2 agonist for use in a method of vasoconstricting an eye of a patient, wherein the α2 agonist is administered to the patient less than 40 minutes prior to treating the eye with laser radiation.

68. The α2 agonist according to claim 67, wherein treating the eye includes treating the eye by irradiating a trabecular meshwork of the eye with the laser radiation.

69. The α2 agonist according to any one of claims 67-68, wherein the α2 agonist is administered to the patient less than 30 minutes prior to treating the eye with the laser radiation.

70. A system, comprising:

a camera, configured to acquire an image of an eye of a patient prior to a treatment of the eye with laser radiation; and

a controller, configured to:

by processing the image, compute a constriction measure indicating an extent to which blood vessels of the eye were constricted by an α2 agonist, and

in response to the constriction measure passing a predefined threshold, output an indication that the blood vessels were sufficiently constricted by the α2 agonist.

71. A system, comprising:

a laser, comprising a pump source and a lasing medium; and

a controller, configured to:

designate multiple target regions on an eye of a patient for irradiation, in sequence, by the laser,

start the irradiation of the target regions, by driving the pump source to begin pumping the lasing medium with a train of lasing-causing pulses, each of which is configured to cause the lasing medium to lase, and

subsequently to starting the irradiation of the target regions, cause the pump source to substitute one or more heating pulses for one of the lasing-causing pulses, the heating pulses being configured to heat the lasing medium without causing the lasing medium to lase.

72. The system according to claim 71, wherein the controller is further configured to cause the pump source, prior to starting the irradiation of the target regions, to heat the lasing medium without causing the lasing medium to lase.

73. The system according to claim 71, wherein a total energy of the heating pulses is between 70% and 100% of a lasing-causing-pulse energy of each of the lasing-causing pulses.

74. The system according to any one of claims 71-73, wherein the one or more heating pulses consist of N > 1 heating pulses.

75. The system according to claim 74, wherein each of the heating pulses has a heating-pulse duration of D0/N, D0 being a lasing-causing-pulse duration of each of the lasing-causing pulses.

76. The system according to claim 75, wherein each of the heating pulses has a peak power equal to that of each of the lasing-causing pulses.

77. The system according to claim 74, wherein the train is periodic with a period T, and

wherein the controller is configured to cause the pump source to substitute the heating pulses at times {k*T/N}, k = 0…N-1 from a time at which the one of the lasing-causing pulses was to have been pumped.

78. The system according to any one of claims 71-73, wherein the controller is configured to cause the pump source to substitute the heating pulses in response to a signal indicating an error.

79. The system according to any one of claims 71-73, wherein the controller is further configured to process one or more images of the eye acquired by a camera, and wherein the controller is configured to cause the pump source to substitute the heating pulses in response to processing the images.

80. The system according to claim 79, wherein the controller is configured to identify an obstruction of the eye by processing the images, and wherein the controller is configured to cause the pump source to substitute the heating pulses in response to identifying the obstruction.

81. The system according to claim 79, wherein the controller is configured to identify a change in the eye by processing the images, and wherein the controller is configured to cause the pump source to substitute the heating pulses in response to identifying the change.

82. The system according to claim 81, wherein the change includes a formation of one or more bubbles.

83. The system according to claim 79,

wherein the controller is configured to identify a reference-point location of a reference point on the eye by processing the images,

wherein the controller is further configured to:

based on the reference-point location, calculate a target-region location of one of the target regions, and

ascertain that the laser is not aimed at the target-region location, and

wherein the controller is configured to cause the pump source to substitute the heating pulses in response to the ascertaining.

84. The system according to claim 83, further comprising one or more motors, wherein the controller is further configured to aim the laser using the motors, and wherein the controller is configured to ascertain that the laser is not aimed at the target-region location in response to respective signals from respective encoders of the motors.

85. The system according to claim 83,

wherein the laser is a treatment laser,

wherein the system further comprises an aiming laser,

wherein the controller is further configured to:

cause the aiming laser to emit an aiming beam at a location at which the treatment laser is aimed, and

identify an aiming-beam location of the aiming beam by processing the images, and

wherein the controller is configured to ascertain that the treatment laser is not aimed at the target-region location based on a displacement between the aiming-beam location and the target-region location.

86. The system according to claim 85, wherein a wavelength of the aiming beam is greater than 700 nm.

87. The system according to claim 85,

wherein the images include a first image, which is acquired while the aiming beam is emitted such that the aiming beam appears in the first image, and a second image, which is acquired before or after the aiming beam is emitted such that the aiming beam does not appear in the second image,

wherein the controller is configured to identify the aiming-beam location in the first image, and

wherein the controller is configured to identify the reference-point location in the second image.

88. The system according to claim 85,

wherein the images consist of a single image including a first frame, in which the aiming beam appears, and a second frame, in which the aiming beam does not appear,

wherein the controller is configured to identify the aiming-beam location in the first frame, and

wherein the controller is configured to identify the reference-point location in the second frame.

89. A method, comprising:

designating multiple target regions on an eye of a patient for irradiation, in sequence, by a laser;

starting the irradiation of the target regions, by driving a pump source to begin pumping a lasing medium of the laser with a train of lasing-causing pulses, each of which is configured to cause the lasing medium to lase; and

subsequently to starting the irradiation of the target regions, causing the pump source to substitute one or more heating pulses for one of the lasing-causing pulses, the heating pulses being configured to heat the lasing medium without causing the lasing medium to lase.

90. The method according to claim 89, further comprising, prior to starting the irradiation of the target regions, causing the pump source to heat the lasing medium without causing the lasing medium to lase.

91. The method according to claim 89, wherein a total energy of the heating pulses is between 70% and 100% of a lasing-causing-pulse energy of each of the lasing-causing pulses.

92. The method according to any one of claims 89-91, wherein the one or more heating pulses consist of N > 1 heating pulses.

93. The method according to claim 92, wherein each of the heating pulses has a heating-pulse duration of D0/N, D0 being a lasing-causing-pulse duration of each of the lasing-causing pulses.

94. The method according to claim 93, wherein each of the heating pulses has a peak power equal to that of each of the lasing-causing pulses.

95. The method according to claim 92, wherein the train is periodic with a period T, and wherein causing the pump source to substitute the heating pulses comprises causing the pump source to substitute the heating pulses at times {k*T/N}, k = 0…N-1 from a time at which the one of the lasing-causing pulses was to have been pumped.

96. The method according to any one of claims 89-91, wherein causing the pump source to substitute the heating pulses comprises causing the pump source to substitute the heating pulses in response to a signal indicating an error.

97. The method according to any one of claims 89-91, further comprising processing one or more images of the eye acquired by a camera, wherein causing the pump source to substitute the heating pulses comprises causing the pump source to substitute the heating pulses in response to processing the images.

98. The method according to claim 97, wherein processing the images comprises identifying an obstruction of the eye, and wherein causing the pump source to substitute the heating pulses comprises causing the pump source to substitute the heating pulses in response to identifying the obstruction.

99. The method according to claim 97, wherein processing the images comprises identifying a change in the eye, and wherein causing the pump source to substitute the heating pulses

comprises causing the pump source to substitute the heating pulses in response to identifying the change.

100. The method according to claim 99, wherein the change includes a formation of one or more bubbles.

101. The method according to claim 97,

wherein processing the images comprises identifying a reference-point location of a reference point on the eye,

wherein the method further comprises:

based on the reference-point location, calculating a target-region location of one of the target regions; and

ascertaining that the laser is not aimed at the target-region location, and

wherein causing the pump source to substitute the heating pulses comprises causing the pump source to substitute the heating pulses in response to the ascertaining.

102. The method according to claim 101, wherein the laser is aimed using one or more motors, and wherein ascertaining that the laser is not aimed at the target-region location comprises ascertaining that the laser is not aimed at the target-region location in response to respective signals from respective encoders of the motors.

103. The method according to claim 101,

wherein the laser is a treatment laser,

wherein the method further comprises causing an aiming laser to emit an aiming beam at a location at which the treatment laser is aimed,

wherein processing the images further comprises identifying an aiming-beam location of the aiming beam, and

wherein ascertaining that the treatment laser is not aimed at the target-region location comprises ascertaining that the treatment laser is not aimed at the target-region location based on a displacement between the aiming-beam location and the target-region location.

104. The method according to claim 103, wherein a wavelength of the aiming beam is greater than 700 nm.

105. The method according to claim 103,

wherein the images include a first image, which is acquired while the aiming beam is emitted such that the aiming beam appears in the first image, and a second image, which is acquired before or after the aiming beam is emitted such that the aiming beam does not appear in the second image,

~~wherein identifying the aiming-beam location comprises identifying the aiming-beam location in the first image, and~~

~~wherein identifying the reference-point location comprises identifying the reference-point location in the second image.~~

~~106. The method according to claim 103,~~

~~wherein the images consist of a single image including a first frame, in which the aiming beam appears, and a second frame, in which the aiming beam does not appear,~~

~~wherein identifying the aiming-beam location comprises identifying the aiming-beam location in the first frame, and~~

~~wherein identifying the reference-point location comprises identifying the reference-point location in the second frame.~~