What is claimed is:

1. An apparatus, comprising:

a sequencing stage configured to receive a flow cell comprising a plurality of reaction sites, each reaction site being configured to contain a biological sample; and

an illumination assembly configured to project light toward the sequencing stage to thereby illuminate the reaction sites, the illumination assembly including:

a light source,

a first lenslet array interposed between the light source and the sequencing stage,

a second lenslet array interposed between the light source and the sequencing stage, and

a diffuser interposed between the light source and the sequencing stage.

2. The apparatus of claim 1, the diffuser comprising a one-dimensional diffuser.

3. The apparatus of any of claims 1 through 2, the first lenslet array comprising a cylindrical mircolens array.

4. The apparatus of any of claims 1 through 3, the diffuser being interposed between the light source and the first lenslet array.

5. The apparatus of any of claims 1 through 3, the diffuser being interposed between the first lenslet array and the second lenslet array.

6. The apparatus of any of claims 1 through 3, the second lenslet array being interposed between the first lenslet array and the diffuser.

7. The apparatus of any of claims 1 through 6, further comprising a collimator interposed between the light source and one or both of the first lenslet array or the diffuser.

8. The apparatus of claim 7, the collimator comprising an anamorphic collimator.

9. The apparatus of any of claims 1 through 8, the first lenslet array comprising a plurality of lenslets, each lenslet having a focal length, the first lenslet array and the second lenslet array being spaced apart from each other by a distance approximately equal to the focal length.

10. The apparatus of any of claims 1 through 9, the light source comprising an optical fiber.

11. The apparatus of claim 10, the optical fiber having a core with a square cross-sectional shape.

12. The apparatus of claim 10, the optical fiber having a core with a circular cross-sectional shape.

13. The apparatus of claim 10, the optical fiber having a core with a rectangular cross-sectional shape defined by a length and a width, the width being greater than the length.

14. The apparatus of claim 13, the length and width providing an aspect ratio of at least 2:1.

17. The apparatus of any of claims 10 through 16, the light source comprising a laser diode.

18. The apparatus of any of claims 10 through 17, the laser diode comprising a multimode diode, the optical fiber being configured to transmit multiple channels of light.

19. The apparatus of any of claims 1 through 18, further comprising a camera system, the camera system being operable to capture images of the reaction sites.

20. The apparatus of claim 19, the camera system including a time delay integration camera.

22. A method comprising:

communicating light through an illumination assembly toward a sequencing stage,

the illumination assembly including:

a light source,

a first lenslet array interposed between the light source and the sequencing stage,

a second lenslet array interposed between the light source and the sequencing stage, and

a diffuser interposed between the light source and the sequencing stage;

the communicated light being further communicated toward a plurality of reaction sites at the sequencing stage, each reaction site containing a biological sample.

23. The method of claim 22, further comprising capturing images of the reaction sites with a camera system, the camera system including a time delay integration camera, the reaction sites including fluorophores, the fluorophores emitting light in response to the communicated light reaching the reaction sites, the capturing images of the reaction sites with the camera system including capturing the light emitted by the fluorophores at the reaction sites, the captured images including an original image having rows and columns, the method further comprising:

summing the rows of each column of the original image to form a one-dimensional flat-fielding array having a plurality of elements; summing the rows of each column of the original image to form a one-dimensional flat-fielding array having a plurality of elements;

dividing each column of the original image by the flat-fielding array to yield a demodulated image; and

identifying at least one nucleotide at a reaction site of the plurality of reaction sites, based on the captured light emitted by at least one fluorophore at the reaction site.

24. The method of either of claim 22 or 23, the reaction sites being located in a flow cell, the method further comprising performing sequencing by synthesis on the flow cell.

25. An apparatus, comprising:

a sequencing stage configured to receive a flow cell comprising a plurality of reaction sites, each reaction site being configured to contain a biological sample; and

an illumination assembly configured to project light toward the sequencing stage to thereby illuminate the reaction sites, the illumination assembly including:

a light source,

a collimator interposed between the light source and the sequencing stage,

an anamorphic lens assembly interposed between the collimator and the sequencing stage.

26. The apparatus of claim 25, the collimator comprising a rotationally symmetric lens.

27. The apparatus of either of claims 25 or 26, the anamorphic lens assembly being configured to convert an illumination footprint from the light source to a rectangular shape or an elliptical shape.

28. The apparatus of claim 27, the anamorphic lens assembly being configured to provide the illumination footprint at the reaction sites.

29. An apparatus, comprising:

a sequencing stage configured to receive a flow cell comprising a plurality of reaction sites, each reaction site being configured to contain a biological sample; and

an illumination assembly configured to project light toward the sequencing stage to thereby illuminate the reaction sites, the illumination assembly including:

a light source, and

an anamorphic collimator interposed between the light source and the sequencing stage.

30. A method comprising:

communicating light through an illumination assembly toward a plurality of reaction sites at a sequencing stage, each reaction site containing a biological sample;

capturing images of the reaction sites with a camera system, the camera system including a time delay integration camera, the captured images including an original image having rows and columns;

summing the rows of the original image to form a one-dimensional flat-fielding array having a plurality of elements; and

dividing each column of the original image by the flat-fielding array to yield a demodulated image.

31. The method of claim 30, the demodulated image having spatial patterns with specific periods, the method further comprising applying one or more frequency domain filters to reduce the spatial patterns.

32. A method comprising:

communicating light through an illumination assembly toward a plurality of reaction sites at a sequencing stage, each reaction site containing a biological sample;

capturing images of the reaction sites with a camera system, the camera system including a time delay integration camera, the captured images including an original image having spatial patterns with specific periods; and

applying one or more frequency domain filters to reduce the spatial patterns and thereby yield a demodulated image.

33. An apparatus, comprising:

a sequencing stage configured to receive a flow cell comprising a plurality of reaction sites, each reaction site being configured to contain a biological sample; and

an illumination assembly configured to project light toward the sequencing stage to thereby illuminate the reaction sites, the illumination assembly including:

a light source,

a first lenslet array interposed between the light source and the sequencing stage, and

a second lenslet array interposed between the light source and the sequencing stage.

34. The apparatus of claim 33, further comprising a diffuser interposed between the light source and the sequencing stage.

35. The apparatus of either claim 33 or 34, the illumination assembly further including a refractive substrate, the refractive substrate having a first surface and a second surface, the first lenslet array being disposed on the first surface of the refractive substrate, the second lenslet array being disposed on the second surface of the refractive substrate, refractive substrate being configured such that the first and second surfaces of the refractive substrate are respectively positioned to substantially focus a collimated beam that is incident on the first array onto the second array.