

WHAT IS CLAIMED IS:

1. A method comprising:

producing a light beam;

~~enabling control of~~ controlling a bandwidth of the produced light beam within a first target range of bandwidths including ~~enabling the activation and control of~~ activating and controlling a first bandwidth actuation system connected to a first optical feature optically coupled to the produced light beam; ~~and~~

~~enabling control of~~ controlling a bandwidth of the produced light beam within a second target range of bandwidths including ~~enabling the activation and control of~~ activating and controlling a second bandwidth actuation system connected to a second optical feature optically coupled to the produced light beam; ~~and~~

switching between activating and controlling the first bandwidth actuation system and activating and controlling the second bandwidth actuation system independently and separately of activating and controlling the first bandwidth actuation system based on a provided bandwidth measurement and a selected target bandwidth;

wherein:

the second target range of bandwidths is distinct from the first target range of bandwidths,

only the first bandwidth actuation system is used to control the bandwidth of the produced light beam within the first target range of bandwidths, and

only the second bandwidth actuation system is used to control the bandwidth of the produced light beam within the second target range of bandwidths.

2. The method of claim 1, further comprising receiving a request to change a bandwidth of the produced light beam from the first target range of bandwidths to the second target range of bandwidths.

3. The method of claim 1, further comprising switching between bandwidth control within the first target range and bandwidth control within the second target range in response to a command to switch.

4. The method of claim 1, further comprising switching between bandwidth control within the first target range to bandwidth control within the second target range, wherein the switching includes:

- selecting second target bandwidth information;
- setting the first bandwidth actuation system to a first fixed state;
- switching a bandwidth measurement system from a first configuration to a second configuration;
- receiving measured bandwidth information from the bandwidth measurement system;
- determining whether the measured bandwidth information matches the second target bandwidth information; and
- activating the second bandwidth actuation system to cause the second optical feature to modify the bandwidth of the produced light beam until it is determined that the measured bandwidth information matches the second target bandwidth information.

5. The method of claim 4, wherein receiving measured bandwidth information from the bandwidth measurement system includes receiving the measured bandwidth information while operating in the second configuration.

6. The method of claim 4, further comprising storing information about the state of one or more components of the first bandwidth actuation system before setting the first bandwidth actuation system to the first fixed state.

7. The method of claim 4, wherein the first fixed state is the state of the first bandwidth actuation system at the moment the request to change the bandwidth of the produced light beam from the first target bandwidth range to the second target bandwidth range is received.

8. The method of claim 4, wherein the first fixed state is determined from a function of the state of the first bandwidth actuation system at the moment that a request is received to change the bandwidth of the produced light beam from the first target bandwidth range to the second target bandwidth range.

9. The method of claim 4, further comprising controlling the second bandwidth actuation system to reduce an absolute error between the measured bandwidth information and the second target bandwidth information until a request is received to change the bandwidth of the produced light beam from the second target bandwidth range to the first target bandwidth range.

10. The method of claim 4, further comprising controlling the second bandwidth actuation system in a reset mode after switching the bandwidth measurement system from the first configuration to the second configuration.

11. The method of claim 4, further comprising switching between bandwidth control within the second target range to bandwidth control within the first target range upon receipt of the request to change bandwidth of the produced light beam from the second target bandwidth range to the first target bandwidth range, switching including:

- selecting first target bandwidth information;

- setting the second bandwidth actuation system to a second fixed state;

- switching the bandwidth measurement system from the second configuration to the first configuration;

- receiving measured bandwidth information from the bandwidth measurement system while operating in the first configuration;

- determining whether the measured bandwidth information matches the first target bandwidth information; and

- activating the first bandwidth actuation system to cause the first optical feature to modify the bandwidth of the produced light beam until it is determined that the measured bandwidth information matches the first target bandwidth information.

12. The method of claim 11, wherein the second fixed state is the state of the second bandwidth actuation system at the moment the request to change the bandwidth of the produced light beam from the second target bandwidth range to the first target bandwidth range is received.

13. The method of claim 11, wherein the second fixed state is a pre-determined state that is determined during calibration.

14. The method of claim 11, further comprising controlling the first bandwidth actuation system to reduce the absolute error between the measured bandwidth information and the first target bandwidth information until a request is received to change the bandwidth of the produced light beam from the first target bandwidth range to the second target bandwidth range.

15. The method of claim 11, further comprising sending a signal to the first bandwidth actuation system to return to the state that was stored prior to setting the first bandwidth actuation system to the first fixed state.

16. The method of claim 11, further comprising controlling the first bandwidth actuation system in a reset mode after switching the bandwidth measurement system from the second configuration to the first configuration.

17. The method of claim 1, further comprising switching between bandwidth control within the first target range to bandwidth control within the second target range, wherein switching between bandwidth control within the first target range to bandwidth control within the second target range comprises switching a bandwidth measurement system from a first configuration to a second configuration.

18. The method of claim 17, wherein switching the bandwidth measurement system from the first configuration to the second configuration includes switching from a first set of calibration variables to a second set of calibration variables.

19. The method of claim 18, wherein:

the first set of calibration variables is predetermined and configured to provide a metric that is tuned to estimate bandwidth over the first target range of bandwidths; and

the second set of calibration variables is predetermined and configured to provide a metric that is tuned to estimate bandwidth over the second target range of bandwidths.

20. The method of claim 1, wherein producing the light beam includes producing a laser beam.

~~21. An apparatus comprising:~~

~~a light source that produces a light beam;~~

~~a bandwidth measurement system configured to receive a portion of light beam output from the light source and configured to measure a bandwidth of the light beam portion and to provide the bandwidth measurement;~~

~~a plurality of bandwidth actuation systems, each bandwidth actuation system including one or more bandwidth actuators and each bandwidth actuation system being connected to an optical feature that is optically coupled to the produced light beam and operable to modify the connected optical feature to select a bandwidth within a bandwidth range of the produced light beam; and~~

~~a control system connected to the bandwidth measurement system and to the plurality of bandwidth actuation systems, the control system configured to switch between activating and operating a first bandwidth actuation system and activating and operating a second bandwidth actuation system independently and separately of activating and operating the first bandwidth actuation system based on a provided bandwidth measurement and a selected target bandwidth.~~

~~22. The apparatus of claim 21, further comprising a target bandwidth switch that is configured to be set at a target bandwidth that is within a target bandwidth range selected from a plurality of distinct target bandwidth ranges.~~

~~23. The apparatus of claim 21, wherein the light source includes a laser source and the light beam is a laser beam.~~

~~24. The apparatus of claim 21, further comprising a lithography apparatus that receives the produced light beam.~~

~~25. The apparatus of claim 21, wherein at least one of the optical features includes a dispersive element.~~

~~26. The apparatus of claim 21, wherein at least one of the optical features includes a beam expander.~~

~~2721. A method of controlling a bandwidth of a pulsed laser beam comprising:~~
~~producing the pulsed laser beam;~~
~~receiving measured bandwidth information of the produced laser beam from a bandwidth measurement system; and~~
~~based on the received measured bandwidth information, controlling a bandwidth of the produced laser beam to within a plurality of target ranges of bandwidths;~~
~~for each of the target ranges of bandwidths, including activating and controlling a plurality of bandwidth actuation systems each system connected to an optical feature optically coupled to the produced laser beam; and~~
~~switching between controlling one of the bandwidth actuation systems and controlling another of the bandwidth actuation systems independently and separately of controlling one of the bandwidth actuation systems based on the received measured bandwidth information and a selected target bandwidth;~~

~~wherein:~~

~~each target range of bandwidths in the plurality of target ranges is distinct from each of the other target ranges of bandwidths in the plurality of ranges, and~~

only one of the bandwidth actuation systems is activated and controlled to control the bandwidth to within a particular target range of bandwidths at any one particular moment.

22. The method of claim 21, further comprising receiving a request to change a bandwidth of the produced light beam from one of the target range of bandwidths to another of the target range of bandwidths.

23. The method of claim 21, further comprising switching between bandwidth control within a first target range of bandwidths by controlling a first bandwidth actuation system and bandwidth control within a second target range of bandwidths by controlling a second bandwidth actuation system in response to a command to switch.

24. The method of claim 23, wherein the switching includes:
selecting second target bandwidth information;
setting the first bandwidth actuation system to a first fixed state;
switching a bandwidth measurement system from a first configuration to a second configuration;

determining whether the measured bandwidth information matches the second target bandwidth information; and

activating the second bandwidth actuation system to cause the second optical feature to modify the bandwidth of the produced light beam until it is determined that the measured bandwidth information matches the second target bandwidth information.