the predetermined air pressure in the second reservoir by pumping air into the second reservoir using the peristaltic air pump.

[0004] The present disclosure further provides, in one aspect, a system that generates a flow of sheath fluid for a flow cytometer, comprising: a first peristaltic sheath fluid pump that pumps the sheath fluid; a first pressurized reservoir that receives the sheath fluid from the first peristaltic pump; a first fluid sensor that senses an amount of the sheath fluid in the first pressurized reservoir and generates a first sheath fluid quantity signal that is used to control the first peristaltic sheath fluid pump to maintain a predetermined amount of sheath fluid in the first pressurized reservoir; a second peristaltic sheath fluid pump that pumps the sheath fluid; a second pressurized reservoir that receives the sheath fluid from the second peristaltic pump; a second fluid sensor that senses an amount of the sheath fluid in the second pressurized reservoir this is used to control the second peristaltic sheath fluid pump to maintain a predetermined amount of sheath fluid in the second pressurized reservoir; a peristaltic air pump that pumps air between the first pressurized reservoir and the second pressurized reservoir.

[0005] In one aspect, the present disclosure provides methods of generating a low-pulsatility fluid flow, comprising: pumping a fluid into a first pressurized reservoir using a first peristaltic fluid pump; sensing an amount of the fluid in the first pressurized reservoir to create a first fluid quantity signal; in response to the first fluid quantity signal, maintaining a predetermined amount of the fluid in the first pressurized reservoir by pumping the fluid into the first pressurized reservoir and/or removing the fluid from the first pressurized reservoir using the first peristaltic fluid pump; pumping the fluid from the first pressurized reservoir to a second pressurized reservoir using a second peristaltic fluid pump; sensing an amount of the fluid in the second pressurized reservoir to create a second fluid quantity signal; in response to the second fluid quantity signal, maintaining a predetermined amount of the fluid in the second pressurized reservoir by pumping the fluid into the second pressurized reservoir using the second peristaltic pump and/or removing the fluid from the second pressurized reservoir in response to the second fluid quantity signal; supplying air to the first pressurized reservoir so as to pressurize the first pressurized reservoir; communicating air from the first pressurized reservoir to the second pressurized reservoir using a peristaltic air pump to pressurize air in the second reservoir to a predetermined air pressure; and maintaining the predetermined air pressure in the second pressurized reservoir by communicating air into the second pressurized reservoir using the peristaltic air pump.

[0006] Also provided are systems for generating a low-pulsatility fluid flow, comprising: a first peristaltic fluid pump; a first pressurized reservoir configured to receive a fluid from the first peristaltic pump; a first fluid sensor that generates a first fluid quantity signal in response to an amount of the fluid in the first pressurized reservoir and, the system being configured to modulate the operation of the first peristaltic fluid pump at least partially in response to the first fluid quantity signal so as to maintain a predetermined amount of fluid in the first pressurized reservoir; a second peristaltic fluid pump configured to pump the fluid from the first pressurized reservoir; a second pressurized reservoir that receives the fluid from the second peristaltic pump; a second fluid sensor that generates a second fluid quantity signal in response to an amount of the fluid in the second pressurized reservoir, the system being configured to modulate the operation of the second peristaltic fluid pump at least partially in response to the second fluid quantity signal so as to maintain a predetermined amount of fluid in the second pressurized reservoir; and a peristaltic air pump configured to pump air between the first pressurized reservoir and the second pressurized reservoir.

[0007] Additionally disclosed are methods, comprising operating a system according to the present disclosure, e.g., according to any one of Aspects 24-42.

[0008] Further provided are methods, comprising performing flow cytometry with a fluid delivered from a system according to the present disclosure, e.g., any one of Aspects 24-42.

[0009] Also disclosed are methods for generating a low-pulsatility fluid flow, the method comprising: with a fluidic circuit comprising (i) a first pressurized reservoir having at least some of a liquid disposed therein, (ii) a second pressurized reservoir having at least some of the liquid disposed therein, (iii) a peristaltic air pump configured to communicate air between the first pressurized reservoir and the second pressurized reservoir, and (iv) a peristaltic fluid pump configured to communicate the fluid between the first pressurized reservoir and the second pressurized reservoir, modulating the air communicated to and/or withdrawn from the first pressurized reservoir and the second pressurized reservoir and modulating the fluid communicated to and/or withdrawn from the first pressurized reservoir and the second pressurized reservoir; the modulating being performed so as to maintain the second pressurized reservoir at a pressure of within about 1% of a pressure of the first pressurized reservoir.

What is Claimed:

1. A method of generating a low-pulsatility fluid flow, comprising:

pumping a fluid into a first pressurized reservoir using a first peristaltic fluid pump;

sensing an amount of the fluid in the first pressurized reservoir to create a first fluid quantity signal;

in response to the first fluid quantity signal, maintaining a predetermined amount of the fluid in the first pressurized reservoir by pumping the fluid into the first pressurized reservoir and/or removing the fluid from the first pressurized reservoir using the first peristaltic fluid pump;

pumping the fluid from the first pressurized reservoir to a second pressurized reservoir using a second peristaltic fluid pump;

sensing an amount of the fluid in the second pressurized reservoir to create a second fluid quantity signal;

in response to the second fluid quantity signal, maintaining a predetermined amount of the fluid in the second pressurized reservoir by pumping the fluid into the second pressurized reservoir using the second peristaltic pump and/or removing the fluid from the second pressurized reservoir in response to the second fluid quantity signal;

supplying air to the first pressurized reservoir so as to pressurize the first pressurized reservoir;

communicating air from the first pressurized reservoir to the second pressurized reservoir using a peristaltic air pump to pressurize air in the second reservoir to a predetermined air pressure; and

maintaining the predetermined air pressure in the second pressurized reservoir by communicating air into the second pressurized reservoir using the peristaltic air pump.

2. The method of claim 1, wherein maintaining the predetermined air pressure in the second pressurized reservoir further comprises maintaining the predetermined pressure in the second pressurized reservoir by removing air from the second pressurized reservoir using the peristaltic air pump.

3. The method of any one of claims 1-2, wherein supplying air to the first pressurized reservoir comprises supplying air to the first pressurized reservoir at an air pressure that is substantially the same as the predetermined pressure.

4. The method of any one of claims 1-3, wherein sensing an amount of the fluid in the first pressurized reservoir comprises weighing the first pressurized reservoir using a first weight sensor to give rise to the first fluid quantity signal.

5. The method of any one of claims 1-4, wherein maintaining a predetermined amount of the fluid in the first pressurized reservoir comprises, in response to the first fluid quantity signal, pumping the fluid into the first pressurized reservoir and removing the fluid from the first pressurized reservoir with the first peristaltic fluid pump.

6. The method of any one or claims 1-5, wherein sensing an amount of the fluid in the second pressurized reservoir comprises weighing the second pressurized reservoir using a second weight sensor to give rise to the second fluid quantity signal.

7. The method of any one of claims 1-6, wherein maintaining the predetermined amount of the fluid in the second pressurized reservoir comprises, in response to the second fluid quantity signal, pumping the fluid into the second pressurized reservoir and removing fluid from the second pressurized reservoir using the second peristaltic fluid pump.

8. The method of any one of claims 1-7, further comprising detecting an air pressure in the first pressurized reservoir using a first pressure transducer and generating a first air pressure transducer signal from the first pressure transducer.

9. The method of claim 8, further comprising modulating operation of the peristaltic air pump at least partially in response to the first air pressure transducer signal.

10. The method of any one of claims 8-9, further comprising modulating operation of a release valve in fluid communication with the first reservoir at least partially in response to the first air pressure transducer signal.

11. The method of any one of claims 1-10, further comprising detecting an air pressure in the second pressurized reservoir using a second pressure transducer and generating a second air pressure transducer signal from the second pressure transducer.

12. The method of claim 11, further comprising modulating operation of the peristaltic air pump at least partially in response to the second air pressure transducer signal.

13. The method of any one of claims 11-12, wherein maintaining the predetermined air pressure in the second pressurized reservoir comprises opening a release valve in fluid communication with the second reservoir at least partially in response to the second air pressure transducer signal.

14. The method of any one of claims 1-13, further comprising modulating operation of a third fluid pump at least partially in response to the second fluid quantity signal, the third fluid pump configured to remove fluid from the second pressurized reservoir.

15. The method of any one of claims 1-14, further comprising modulating operation of the first peristaltic fluid pump at least partially in response to the second fluid quantity signal.

16. The method of any one of claims 1-15, further comprising modulating operation of the second peristaltic fluid pump at least partially in response to the first fluid quantity signal.

17. The method of any one of claims 1-16, further comprising modulating operation of a valve so as to deliver input air to the first pressurized reservoir.

18. The method of claim 17, wherein the input air is pressurized by a boost pump.

19. The method of any one of claims 1-18, wherein air exiting the first pressurized reservoir is at a pressure of within about 1% of the pressure of air entering the second pressurized reservoir.

20. The method of claim 19, wherein air exiting the first pressurized reservoir is at a pressure of within about 0.5% of the pressure of air entering the second pressurized reservoir.

21. The method of any one of claims 1-20, wherein fluid exiting the first pressurized reservoir is at a pressure of within about 5% of the pressure of fluid entering the second pressurized reservoir.

22. The method of claim 21, wherein fluid exiting the first pressurized reservoir is at a pressure of within about 1% of the pressure of fluid entering the second pressurized reservoir.

23. The method of any one of claims 1-22, wherein the fluid is a sheath fluid and further comprising communicating the sheath fluid from the second pressurized reservoir to a flow cytometer.

24. A system for generating a low-pulsatility fluid flow, comprising:

a first peristaltic fluid pump;

a first pressurized reservoir configured to receive a fluid from the first peristaltic pump;

a first fluid sensor that generates a first fluid quantity signal in response to an amount of the fluid in the first pressurized reservoir and,

the system being configured to modulate the operation of the first peristaltic fluid pump at least partially in response to the first fluid quantity signal so as to maintain a predetermined amount of fluid in the first pressurized reservoir;

a second peristaltic fluid pump configured to pump the fluid from the first pressurized reservoir;

a second pressurized reservoir that receives the fluid from the second peristaltic pump;

a second fluid sensor that generates a second fluid quantity signal in response to an amount of the fluid in the second pressurized reservoir,

the system being configured to modulate the operation of the second peristaltic fluid pump at least partially in response to the second fluid quantity signal so as to maintain a predetermined amount of fluid in the second pressurized reservoir; and

a peristaltic air pump configured to pump air between the first pressurized reservoir and the second pressurized reservoir.

25. The system of claim 24, wherein the system is configured such that the peristaltic air pump operates to maintain the first pressurized reservoir and the second pressurized reservoir at substantially the same pressure.

26. The system of any one of claims 24-25, wherein the first fluid sensor is configured to weigh the first pressurized reservoir.

27. The system of any one of claims 24-26, wherein the first fluid sensor is configured to determine a level of fluid in the first pressurized reservoir.

28. The system of any one of claims 24-27, wherein the second fluid sensor is configured to weigh the second pressurized reservoir.

29. The system of any one of claims 24-28, wherein the second fluid sensor is configured to determine a level of fluid in the second pressurized reservoir.

30. The system of any one of claims 24-29, further comprising a first pressure transducer that generates a first air pressure signal in response to a pressure within the first pressurized reservoir.

31. The system of any one of claims 24-30, further comprising a second pressure transducer that generates a second air pressure signal in response to a pressure within the second pressurized reservoir.

32. The system of any one of claims 24-31, further comprising a first valve in fluid communication with the first pressurized reservoir.

33. The system of claim 32, wherein the valve reduces air pressure in the first pressurized reservoir if the air pressure in the first pressurized reservoir exceeds a threshold pressure.

34. The system of any one of claims 24-33, further comprising a second valve in fluid communication with the second pressurized reservoir.

35. The system of claim 34, wherein the valve reduces air pressure in the second pressurized reservoir if the air pressure in the second pressurized reservoir exceeds a threshold pressure.

36. The system of any one of claims 24-35, further comprising a boost pump configured to deliver air to the first pressurized reservoir.

37. The system of claim 36, wherein the boost pump is operable to maintain a predetermined pressure in the first pressurized reservoir.

38. The system of any one of claims 24-37, further comprising:

a control signal generator,

the control signal generator configured to generate a first peristaltic pump control signal in response to the first fluid quantity signal, which first peristaltic pump signal is used to modulate operation of the first peristaltic fluid pump to achieve a first predetermined amount of fluid in the first pressurized reservoir by pumping the fluid in a forward direction into the first pressurized reservoir and/or in a reverse direction out of the first pressurized reservoir,

the control signal generator configured to generate a second peristaltic pump control signal in response to the second fluid quantity signal, which second peristaltic pump signal is used to modulate operation of the second peristaltic fluid pump to achieve a second predetermined amount of fluid in the second pressurized reservoir by pumping the fluid in a forward direction into the second pressurized reservoir and/or in a reverse direction out of the second pressurized reservoir,

the control signal generator generating a peristaltic air pump control signal in response to a signal related to a pressure in at least one of the first pressurized reservoir and the second pressurized reservoir, which peristaltic air pump control signal is used to modulate operation of the peristaltic air pump to achieve a predetermined pressure in the second reservoir.

39. The system of any one of claims 24-38, wherein the system is configured such that fluid entering the second peristaltic fluid pump defines a pressure P_{entry}, fluid exiting the second peristaltic pump defines a pressure P_{exit}, and P_{exit} is within about 1% of the value of P_{entry}.

40. The system of claim 39, wherein P_{exit} is within about 0.5% of the value of P_{entry}.

41. The system of any one of claims 24-40, further comprising a flow cytometer, the flow cytometer being in fluid communication with the second pressurized reservoir.

42. The system of any one of claims 24-41, wherein the system is configured so as to maintain the second pressurized reservoir at a pressure of within about 1% of a pressure of the first pressurized reservoir.

43. A method, comprising operating a system according to any one of claims 24-42.

44. A method, comprising performing flow cytometery with a fluid delivered from a system according to any one of claims 24-42.

45. A method for generating a low-pulsatility fluid flow, the method comprising:

with a fluidic circuit comprising (i) a first pressurized reservoir having at least some of a liquid disposed therein, (ii) a second pressurized reservoir having at least some of the liquid disposed therein, (iii) a peristaltic air pump configured to communicate air between the first pressurized reservoir and the second pressurized reservoir, and (iv) a peristaltic fluid pump configured to communicate the fluid between the first pressurized reservoir and the second pressurized reservoir,

modulating the air communicated to and/or withdrawn from the first pressurized reservoir and the second pressurized reservoir and modulating the fluid communicated to and/or withdrawn from the first pressurized reservoir and the second pressurized reservoir;

the modulating being performed so as to maintain the second pressurized reservoir at a pressure of within about 1% of a pressure of the first pressurized reservoir.

46. The method of claim 45, further comprising communicating at least some of the fluid from the second reservoir to a flow cytometer.