

## CLAIMS

1. A system for dynamically optimizing an instrument system workflow, the system comprising:

- one or more instrument resources and at least one instrument resource sensor configured to acquire data from one or more of the instrument resource(s);

- a holder for a sample chamber and at least one sample chamber sensor;

- one or more receptacles, each receptacle configured to hold a reagent; and

- a computing device communicatively connected to each of the one or more instrument resources and/or their sensor(s) and each of the one or more sample chambers and/or their sensor(s), the computing device comprising:

- a workflow builder configured to accept user input and create a workflow program to be performed by the instrument system, wherein the workflow program comprises a series of operations;

- an operations framework configured to direct the performance of the workflow program by the instrument system by calling each operation in the series of operations, wherein timing of the calling of operations is adjusted based on data received from the at least one instrument resource sensor, the at least one sample chamber sensor, at least one operation, and/or additional user input to thereby optimize time to completion of the workflow program;

- a set of operations, each operation configured to instruct one or more instrument resources to perform a predetermined task; and

- a workflow modeling component configured to receive data from the operations framework and maintain a model of the status of the workflow program based upon the received data.

2. The system of claim 1 further comprising:

- a machine learning engine configured to work with the operations framework to improve the timing of the calling of operations and thereby further optimize the time to completion of the workflow program.

3. The system of claim 1, wherein the operations framework adjusts the calling of operations in real time.

4. The system of claim 1, wherein each of the one or more instrument resources comprises a pump, an input/output needle, an incubator, a holder for a sample chamber, a stage, or an optical train.
5. The system of claim 4, wherein the system comprises an incubator, and wherein the incubator is configured to hold a well plate.
6. The system of claim 4, wherein the system comprises a plurality of instrument resources, and wherein each of the plurality of instrument resources has an instrument resource sensor configured to acquire data from the instrument resource.
7. The system of claim 1, wherein the sample chamber holder is a nest and the sample chamber is a microfluidic device, and wherein the nest comprises electrical and fluidic connections for interfacing with the microfluidic device.
8. The system of claim 7, wherein the system comprises a plurality of sample chamber holders.
9. The system of any one of claims 1 to 8, wherein the at least one sample chamber sensor comprises an optical train, and wherein the optical train comprises a camera configured to image the sample chamber.
10. The system of claim 9, wherein the optical train further comprises a projector and/or a laser.
11. The system of any one of claims 1 to 8, wherein the system further comprises one or more holders for sample containers used to hold pre- or post-processed sample, and wherein the sample container holders are configured to hold a tube or a well plate.
12. The system of any one of claims 1 to 8, wherein data received by the operations framework from the at least one instrument resource sensor is received directly from the instrument resource sensor.

13. The system of any one of claims 1 to 8, wherein data received by the operations framework from the at least one instrument resource sensor is received indirectly from an operation that instructed the corresponding instrument resource.
14. The system of any one of claims 1 to 8, wherein the additional user input received by the operations framework is received indirectly from the workflow modeling component.
15. The system of any one of claims 1 to 8, wherein the set of operations comprises operations for loading a sample into the sample chamber, detecting micro-objects located within the sample chamber, relocating micro-objects detected in the sample chamber, supplying one or more reagents to the sample chamber, assaying micro-objects detected in the sample chamber, and exporting micro-objects from the sample chamber.
16. The system of any one of claims 1 to 8, wherein the workflow modeling component maintains a real time model of the status of the workflow program based upon the received data.
17. The system of claim 16, wherein the model of the status of the workflow program maintained by the workflow modeling component is displayed on a graphical user interface, wherein the workflow modeling component is further configured to instruct the user to perform specific tasks during the performance of the workflow program.
18. The system of any one of claims 1 to 8, wherein the data received by the operations framework comprises an alarm indicating that a one or more operations in the series of operations cannot be completed, a warning of low material detected in the one or more receptacles, a result from an analysis of an image of the sample chamber, or completion of an operation in the series of operations.
19. The system of any one of claims 1 to 8, wherein the one or more instrument resources, the sample chamber holder, and the one or more receptacles are housed within a housing.
20. A method for dynamically optimizing a workflow program, comprising:

creating a workflow program comprising a series of operations, each operation of the series comprising operating instructions for one or more instrument resources housed in an instrument system;

acquiring data from sensors monitoring the one or more instrument resources and a sample chamber comprising a sample;

generating an optimized workflow program in response to detecting a variance condition in the acquired data;

utilizing the optimized workflow program to update a model of the status of the workflow program; and

providing operating instructions to the one or more instrument resources based on the optimized instrument workflow program.

21. The method of claim 20, wherein the instrument system is the system of any one of claims 1 to 8.

22. The method of claim 20, wherein updating the model of the status of the workflow program is performed periodically, optionally at a preset interval.

23. The method of claim 20, wherein the variance condition comprises an alarm indicating that one or more operations in the series of operations cannot be completed, a warning of low material detected in an instrument system receptacle, a result from an analysis of an image of the sample chamber, or completion of an operation in the series of operations.

24. A non-transitory machine-readable storage medium comprising machine-readable instructions for causing a processor to execute a method for dynamically optimizing an workflow program, comprising:

creating a workflow program comprising a series of operations, each operation comprising operating instructions for one or more instrument resources housed in an instrument system; acquiring data from sensors monitoring the one or more instrument resources and a sample chamber comprising a sample;

generating an optimized workflow program in response to detecting a variance condition in the acquired data;

utilizing the optimized workflow program to update a model of the status of the workflow program; and

providing operating instructions to the one or more instrument resources based on the optimized instrument workflow program.

25. The non-transitory machine-readable storage medium of claim 24, wherein the instrument system is the system of any one of claims 1 to 8.