CLAIMS

1. A method of operation of a robot, the method comprising:

receiving an objective to be completed by the robot;

identifying a set of candidate actions that may be performed by the robot in furtherance of the objective;

collecting, for each candidate action of the set of candidate actions, a respective set of ancillary data;

in response to determining the robot is unable to select a candidate action of the set of candidate actions to perform, transmitting a request for instructions to a tele-operation system communicatively coupled to the robot, the request for the instructions including each candidate action of the set of candidate actions and each respective set of ancillary data;

receiving the instructions from the tele-operation system;

executing the instructions; and

updating a control model of the robot based at least in part on each candidate action of the set of candidate actions, each respective set of ancillary data, and the instructions, to increase a level of autonomy of the robot.

2. The method of claim 1, wherein the transmitting the request for instructions to the tele-operation system in response to determining the robot is unable to select a candidate action of the set of candidate actions to perform includes transmitting the request for instructions to the tele-operation system in response to determining the robot is unable to select a candidate action of the set of candidate actions to perform in furtherance of the objective.

3. The method of claim 2, further comprising:

scoring each candidate action of the set of candidate actions, wherein the scoring each candidate action of the set of candidate actions includes assigning a respective probability to each candidate action, the respective probability being based at least in part

on a respective expectation of progress, achievable by each candidate action, towards the objective;

ranking each candidate action in an order of preference, the order of preference being based at least in part on the respective probability of each candidate action; and

using at least one of the respective probability of each candidate action and the order of preference to determine whether the robot is able to select a candidate action of the set of candidate actions to perform.

4. The method of claim 3, wherein the transmitting a request for instructions to a tele-operation system, the request for the instructions which includes each candidate action of the set of candidate actions and each respective set of ancillary data includes transmitting a request for instructions to a tele-operation system, the request for the instructions which includes each respective probability and the order of preference.

5. The method of claim 3, wherein the using at least one of the respective probability of each candidate action and the order of preference to determine whether the robot is able to select a candidate action of the set of candidate actions to perform includes determining whether a respective probability meets a predetermined probability criterion.

6. The method of claim 3, wherein the using at least one of the respective probability of each candidate action and the order of preference to determine whether the robot is able to select a candidate action of the set of candidate actions to perform includes determining whether a difference between a first respective probability and a second respective probability meets a predetermined difference criterion.

7. The method of claim 1, the robot being a semi-autonomous robot characterized by a level of autonomy, the level of autonomy being determined at least in part by the control model, the method further comprising comparing the level of autonomy of the robot to a threshold level of autonomy, the threshold level of autonomy above which the robot is operable to autonomously select a candidate action of the set of candidate actions to perform, wherein the transmitting a request for instructions to a tele-operation system

includes transmitting the request for instructions to the tele-operation system in response to determining the level of autonomy of the robot is lower than the threshold level of autonomy.

8. The method of claim 7, further comprising, in response to determining the level of autonomy of the robot meets or exceeds the threshold level of autonomy, performing one of the candidate actions of the set of candidate actions.

9. The method of claim 7, further comprising:

determining the threshold level of autonomy, wherein the determining the threshold level of autonomy includes assigning a respective probability to each candidate action, the respective probability being based at least in part on a respective expectation of progress, achievable by each candidate action, towards the objective; and

ranking each candidate action in an order of preference, the order of preference being based at least in part on the respective probability.

10. The method of claim 7, wherein the determining the level of autonomy of the robot is lower than the threshold level of autonomy includes determining the respective probability of each candidate action in the set of candidate actions fails to satisfy at least one predetermined criterion.

11. The method of claim 1, the robot comprising one or more sensors and a data repository, the collecting, for each candidate action of the set of candidate actions, a respective set of ancillary data includes at least one of collecting a first subset of the respective set of ancillary data by the one or more sensors or extracting a second subset of the respective set of ancillary data from the data repository.

12. The method of claim 11, wherein the collecting the first subset of the respective set of ancillary data by the one or more sensors includes collecting at least one of audio, imagery, video, or environmental data.

13. The method of claim 1, wherein the transmitting a request for instructions to a tele-operation system includes transmitting a request for the tele-operation system to determine which candidate action the robot should perform.

14. The method of claim 1, wherein the transmitting a request for instructions to a tele-operation system includes entering a standby mode.

15. The method of claim 1, wherein the updating a control model, based at least in part on each candidate action of the set of candidate actions, each respective set of ancillary data, and the instructions includes increasing a level of autonomy of the robot from a first level of autonomy to a second level of autonomy, the second level of autonomy being higher than the first level of autonomy.

16. A robot comprising:

a body;

a controller comprising at least one processor;

at least one physically actuatable component mechanically coupled to the body and communicatively coupled to the controller;

at least one sensor communicatively coupled to the controller, the at least one sensor operable to collect data; and

at least one non-transitory processor-readable storage medium communicatively coupled to the at least one processor, the at least one non-transitory processor-readable storage medium storing processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to:

identify a set of candidate actions that may be performed by the robot;

collect, for each candidate action of the set of candidate actions, a respective set of ancillary data;

transmit a request for instructions to a tele-operation system, the tele-operation system communicatively coupled to the robot, the request for the instructions which includes each candidate action of the set of candidate actions and each respective set of ancillary data;

receive the instructions from the tele-operation system; execute the instructions; and

update a control model of the robot, based at least in part on each candidate action of the set of candidate actions, each respective set of ancillary data, and the instructions, to increase a level of autonomy of the robot.

17. The robot of claim 16, wherein the robot is a humanoid robot, and the body has a form of a human body.

18. The robot of claim 16, wherein the at least one non-transitory processor-readable storage medium further stores processor-executable instructions and/or data that, when executed by at least one processor, cause the robot to detect, by the at least one sensor, at least one of an event or a condition, and wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to identify a set of candidate actions that may be performed by the robot, further cause the robot to identify a set of candidate actions that may be performed by the robot in response to detecting the at least one of an event or a condition.

19. The robot of claim 16, wherein:

the at least one non-transitory processor-readable storage medium further stores processor-executable instructions and/or data that, when executed by at least one processor, cause the robot to receive an objective to be completed by the robot, the objective received from the tele-operation system; and

the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to identify a set of candidate actions that may be performed by the robot, further cause the robot to identify a set of candidate actions that may be performed by the robot in furtherance of the objective.

20. The robot of claim 19, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to transmit a request for instructions to a tele-operation system further cause the robot to transmit the request

for instructions to the tele-operation system in response to determining the robot is unable to select a candidate action of the set of candidate actions to perform.

21. The robot of claim 20, wherein the at least one non-transitory processor-readable storage medium further stores processor-executable instructions and/or data that, when executed by at least one processor, cause the robot to:

score each candidate action of the set of candidate actions by assigning a respective probability to each candidate action, the respective probability being based at least in part on a respective expectation of progress, achievable by each candidate action, towards an objective;

rank each candidate action in an order of preference, the order of preference being based at least in part on the respective probability of each candidate action; and

use at least one of the respective probability of each candidate action and the order of preference to determine whether the robot is able to select a candidate action of the set of candidate actions to perform.

22. The robot of claim 21, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to use at least one of the respective probability of each candidate action and the order of preference to determine whether the robot is able to select a candidate action of the set of candidate actions to perform, further cause the robot to determine whether a respective probability meets a predetermined probability criterion.

23. The robot of claim 21, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to use at least one of the respective probability of each candidate action and the order of preference to determine whether the robot is able to select a candidate action of the set of candidate actions to perform, further cause the robot to determine whether a difference between a first respective probability and a second respective probability meets a predetermined difference criterion.

24. The robot of claim 16, the robot being a semi-autonomous robot characterized by a level of autonomy, the level of autonomy being determined at least in part by the control model, wherein:

the at least one non-transitory processor-readable storage medium further stores processor-executable instructions and/or data that, when executed by at least one processor, cause the robot to compare the level of autonomy of the robot to a threshold level of autonomy, the threshold level of autonomy above which the robot is operable to autonomously select a candidate action of the set of candidate actions to perform; and

the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to transmit a request for instructions to a tele-operation system further cause the robot to transmit the request for instructions to the tele-operation system in response to determining the level of autonomy of the robot is lower than the threshold level of autonomy.

25. The robot of claim 24, wherein the at least one non-transitory processor-readable storage medium further stores processor-executable instructions and/or data that, when executed by at least one processor, cause the robot, in response to determining the level of autonomy of the robot meets or exceeds the threshold level of autonomy, to perform one of the candidate actions of the set of candidate actions.

26. The robot of claim 24, wherein the at least one non-transitory processor-readable storage medium further stores processor-executable instructions and/or data that, when executed by at least one processor, cause the robot to:

determine the threshold level of autonomy;

assign a respective probability to each candidate action, the respective probability being based at least in part on a respective expectation of progress, achievable by each candidate action, towards the objective; and

rank each candidate action in an order of preference, the order of preference being based at least in part on the respective probability.

27. The robot of claim 24, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to:

determine the threshold level of autonomy;

assign a respective probability to each candidate action, the respective probability being based at least in part on a respective expectation of progress, achievable by each candidate action, towards the objective; and

determine the level of autonomy of the robot is lower than the threshold level of autonomy, further cause the robot to determine the respective probability of each candidate action in the set of candidate actions fails to satisfy at least one criterion.

28. The robot of claim 16, the robot further comprising a data repository, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to collect, for each candidate action of the set of candidate actions, a respective set of ancillary data, further cause the robot to collect a first subset of the respective set of ancillary data by the one or more sensors, and/or extract a second subset of the respective set of ancillary data from the data repository.

29. The robot of claim 16, the robot further comprising a communications subsystem, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to transmit a request for instructions to a tele-operation system, further cause the robot to transmit, by the communications subsystem, a request for the instructions, and receive, by the communication subsystem, the instructions.

30. The robot of claim 16, wherein the tele-operation system is a piloted tele-operation system.

31. The robot of claim 16, wherein the tele-operation system is at a remote location relative to the robot.

32. The robot of claim 16, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to transmit a request

for instructions to a tele-operation system, further cause the robot to enter a standby mode.

33. The robot of claim 16, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to execute the instructions, further cause the robot to invoke at least one of the candidate actions of the set of candidate actions.

34. The robot of claim 33, the at least one physically actuatable component including a motion actuator, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to invoke at least one of the candidate actions, further cause the robot to execute, by the motion actuator, a movement.

35. The robot of claim 16, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to execute the instructions, further cause the robot to identify one or more auxiliary actions that can be performed by the robot.

36. The robot of claim 16, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to update the control model, further cause the robot to increase a level of autonomy of the robot from a first level of autonomy to a second level of autonomy, the second level of autonomy being higher than the first level of autonomy.

37. The robot of claim 16, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to update the control model, based at least in part on each candidate action of the set of candidate actions, each respective set of ancillary data, and the instructions, further cause the robot to update at least one of control instructions, control data, or control parameters.

38. The robot of claim 16, wherein the processor-executable instructions and/or data that, when executed by the at least one processor, cause the robot to update the control model, based at least in part on each candidate action of the set of candidate actions, each respective set of ancillary data, and the instructions, further cause the robot to update at least one of configuration settings, control methods, policies, procedures, classifiers, or rules.

39. A method of tele-operating a robot, the method performed by a tele-operation system, the tele-operation system communicatively coupled to the robot, the method comprising:

initializing the robot by transmitting an objective to the robot;

receiving, from the robot, a request for instructions, the request for instructions comprising a set of candidate actions that may be performed by the robot, and, for each candidate action of the set of candidate actions, a respective set of ancillary data;

analyzing each candidate action of the set of candidate actions and each respective set of ancillary data to determine a respective relative likelihood that each candidate action, if performed by the robot, will lead to furtherance of the objective; and

transmitting instructions to the robot, based at least part on each respective relative likelihood, to increase a level of autonomy of the robot.

40. The method of claim 39, wherein the receiving, from the robot, a request for instructions includes receiving, from the robot, a set of candidate actions that may be performed by the robot in furtherance of the objective.

41. The method of claim 39, wherein the receiving, from the robot, a request for instructions includes receiving, from the robot, a request for instructions in response to the robot determining the robot is unable to select a candidate action of the set of candidate actions to perform.

42. The method claim 41, wherein the receiving, from the robot, a request for instructions includes receiving a respective score for each candidate action of the set of

candidate actions, the respective score which includes a respective probability for each candidate action, the respective probability being based at least in part on an expectation of progress, achievable by each candidate action, towards an objective.

43. The method of claim 42, wherein the receiving, from the robot, a request for instructions further includes receiving an order of preference, the order of preference being based at least in part on the respective probability of each candidate action.

44. The method of claim 42, wherein analyzing each candidate action of the set of candidate actions and each respective set of ancillary data includes analyzing the respective score of each candidate action to determine a respective relative likelihood that each candidate action, if performed by the robot, will lead to furtherance of the objective.

45. The method of claim 44, further comprising updating at least one of a machine-learning model or a machine-learning process of the tele-operation system based at least in part on the respective score of each candidate action.

46. The method of claim 39, the robot being a semi-autonomous robot characterized by a level of autonomy, the level of autonomy being determined at least in part by the control model, wherein receiving, from the robot, a request for instructions includes receiving a request for instructions in response to the robot determining the level of autonomy of the robot is lower than a threshold level of autonomy, the threshold level of autonomy above which the robot is operable to autonomously select a candidate action of the set of candidate actions to perform.

47. The method of claim 39, wherein analyzing each candidate action of the set of candidate actions and each respective set of ancillary data to determine a respective relative likelihood that each candidate action, if performed by the robot, will lead to furtherance of the objective includes analyzing by a pilot each of at least a subset of the set of candidate actions and each respective set of ancillary data to determine a respective relative likelihood that each candidate action, if performed by the robot, will lead to furtherance of the objective.

48. The method of claim 39, wherein transmitting instructions to the robot, based at least part on each respective relative likelihood, to increase a level of autonomy of the robot includes transmitting instructions to the robot to cause the robot to update a control model.

49. The method of claim 48, wherein transmitting instructions to the robot to cause the robot to update a control model includes transmitting instructions to the robot to cause the robot to update at least one of control instructions, control data, or control parameters.