CLAIMS

1. A mobility platform configured to execute one or more tasks in a worksite comprising a first passive landmark disposed at a first known landmark position and a second passive landmark disposed at a second known landmark position, the mobility platform comprising:

a chassis;

a drive system supporting the chassis, wherein the drive system comprises at least two wheels, wherein the drive system is configured to move the mobility platform within the worksite;

a first laser rangefinder disposed on the chassis at a first location;

a second laser rangefinder disposed on the chassis at a second location different than the first location; and

at least one processor configured to:

acquire the first passive landmark with the first laser rangefinder,

acquire the second passive landmark with the second laser rangefinder,

determine a first position of the chassis based on:

a first distance measured by the first laser rangefinder between the first location and the first known landmark position, and

a second distance measured by the second laser rangefinder between the second location and the second known landmark position, and

determine a first orientation of the mobility platform based on first yaw angle information from at least one of the first laser rangefinder and the second laser rangefinder.

2. The mobility platform of claim 1, wherein the drive system is a holonomic drive system.

3. The mobility platform of claim 2, wherein the drive system comprises a plurality of wheel assemblies, wherein each of the plurality of wheel assemblies comprises:

a wheel configured to rotate about a wheel axis,

a first actuator configured to rotate the wheel about the wheel axis, and

a second actuator configured to rotate the wheel about a pivot axis perpendicular to the wheel axis.

4. The mobility platform of claim 3, further comprising a plurality of wheel odometers, wherein each one of the plurality of wheel odometers is associated with a respective wheel of the four wheel assemblies and is configured to measure a distance travelled by the respective wheel, wherein the at least one processor is further configured to estimate a change in position of the chassis from the first position based on odometry information from the plurality of wheel odometers.

5. The mobility platform of any of claims 1-4, further comprising a marking device disposed on the chassis and configured to deposit marking material on a floor of the worksite.

6. The mobility platform of any of claims 1-5, wherein acquiring the first passive landmark with the first laser rangefinder comprises:

sweep the worksite with the first laser rangefinder to collect first sweep information;

detect the first known landmark position of the first passive landmark based on the first sweep information; and

orient the first laser rangefinder toward the first passive landmark based on the first known landmark position.

7. The mobility platform of claim 6, wherein detecting the first known landmark position of the first passive landmark comprises detecting a shape of the first passive landmark.

8. The mobility platform of claim 6, wherein detecting the first known landmark position of the first passive landmark comprises detecting a color of the first passive landmark.

9. The mobility platform of any of claims 1-5, further comprising at least one camera, wherein acquiring the first passive landmark comprises:

identifying the first known landmark position of the first passive landmark with the at least one camera; and

orienting the first laser rangefinder toward the first passive landmark based on the first known landmark position.

10. The mobility platform of claim 9, wherein the at least one processor is further configured to, based on information from the at least one camera:

track the first passive landmark with the first laser rangefinder; and

track the second passive landmark with the second laser rangefinder.

11. The mobility platform of any of claims 1-10, wherein the at least one processor is further configured to command the drive system to move the mobility platform along a drive path to perform the one or more tasks at one or more task locations in the worksite.

12. The mobility platform of claim 11, wherein the one or more tasks comprise marking a floor of the worksite with a marking material.

13. The mobility platform of any of claims 11-12, wherein the at least one processor is further configured to, based on odometry information from at least one odometry sensor:

track the first passive landmark with the first laser rangefinder; and

track the second passive landmark with the second laser rangefinder.

14. The mobility platform of any of claims 11-13, wherein the at least one processor is further configured to command the drive system to stop the mobility platform at the one or more task locations in the worksite, and, upon commanding the drive system to stop:

reacquire the first passive landmark with the first laser rangefinder;

reacquire the second passive landmark with the second laser rangefinder;

determine a second position of the chassis based on:

the first distance measured by the first laser rangefinder between the first location and the first known landmark position, and

the second distance measured by the second laser rangefinder between the second location and the second known landmark position, and

determine a second orientation of the mobility platform based on second yaw angle information from at least one of the first laser rangefinder and the second laser rangefinder.

15. The mobility platform of any of claims 11-14, wherein the at least one processor is further configured to:

detect a discontinuity in the first distance measured by the first laser rangefinder; and

upon detecting the discontinuity in the first distance measured by the first laser rangefinder, reacquire the first passive landmark with the first laser rangefinder.

16. The mobility platform of any of claims 12-15, wherein the at least one processor is further configured to:

detect a discontinuity in the first distance measured by the first laser rangefinder; and

upon detecting the discontinuity in the first distance measured by the first laser rangefinder, acquire a third passive landmark disposed in the worksite at a third known landmark position with the first laser rangefinder.

17. The mobility platform of any of claims 15-16, wherein the discontinuity in the first distance measured by the first laser rangefinder is a change in the measured first distance above a range change threshold.

18. The mobility platform of any of claims 11-17, wherein the at least one processor is further configured to command the drive system to move the mobility platform to a third orientation based on the drive path and the one or more task locations.

19. The mobility platform of claim 18, wherein the at least one processor is further configured to:

determine a crossover point of the first laser rangefinder and the second laser rangefinder within the movement of the mobility platform to the third orientation;

acquire the first passive landmark with the second laser rangefinder at the crossover point; and

acquire the second passive landmark with the first laser rangefinder at the crossover point.

20. The mobility platform of any of claims 1-9, wherein the at least one processor is further configured to:

acquire a third passive landmark disposed at a third unknown landmark position with the first laser rangefinder; and

determine the third unknown landmark position based on:

the first position of the chassis,

a third distance measured by the first laser rangefinder between the first location and the third unknown landmark position, and

yaw angle information from the first laser rangefinder.

21. A method for operating a mobility platform in a worksite, the mobility platform comprising a chassis, a first laser rangefinder disposed at a first location on the chassis, a second laser rangefinder disposed at a second location on the chassis, and a drive system, the method comprising:

acquiring a first passive landmark disposed at a first known landmark position with the first laser rangefinder;

acquiring a second passive landmark disposed at a second known landmark position with the second laser rangefinder;

determine a first position of the chassis based on:

a first distance measured by the first laser rangefinder between the first location and the first known landmark position, and

a second distance measured by the second laser rangefinder between the second location and the second known landmark position, and

determine a first orientation of the mobility platform based on first yaw angle information from at least one of the first laser rangefinder and the second laser rangefinder.

22. The method of claim 21, wherein acquiring the first passive landmark comprises:

sweeping the worksite with the first laser rangefinder to collect first sweep information;

detecting the first known landmark position of the first passive landmark based on the first sweep information; and

orienting the first laser rangefinder toward the first passive landmark based on the first known landmark position.

23. The method of claim 22, wherein detecting the first known landmark position of the first passive landmark comprises detecting a shape of the first passive landmark.

24. The method of claim 22, wherein detecting the first known landmark position of the first passive landmark comprises detecting a color of the first passive landmark.

25. The method of claim 21, wherein acquiring the first passive landmark comprises:

identifying the first known landmark position of the first passive landmark with at least one camera of the mobility platform; and

orienting the first laser rangefinder toward the first passive landmark based on the first known landmark position.

26. The method of claim 25, further comprising, based on information from the at least one camera:

tracking the first passive landmark with the first laser rangefinder; and

tracking the second passive landmark with the second laser rangefinder.

27. The method of any of claims 21-26, further comprising moving the mobility platform along a drive path to perform one or more tasks at one or more task locations in the worksite.

28. The method of claim 27, wherein the one or more tasks comprise marking a floor of the worksite with a marking material.

29. The method of any of claims 27-28, further comprising, based on odometry information from at least one odometry sensor of the mobility platform:

tracking the first passive landmark with the first laser rangefinder, and

tracking the second passive landmark with the second laser rangefinder.

30. The method of any of claims 27-29, further comprising stopping the mobility platform at the one or more task locations in the worksite, and, upon stopping the mobility platform:

reacquiring the first passive landmark with the first laser rangefinder;

reacquiring the second passive landmark with the second laser rangefinder;

determining a second position of the chassis based on:

the first distance measured by the first laser rangefinder between the first location and the first known landmark position, and

the second distance measured by the second laser rangefinder between the second location and the second known landmark position, and

determining a second orientation of the mobility platform based on second yaw angle information from at least one of the first laser rangefinder and the second laser rangefinder.

31. The method of any of claims 27-30, further comprising:

detecting a discontinuity in the first distance measured by the first laser rangefinder; and

upon detecting the discontinuity in the first distance measured by the first laser rangefinder, reacquiring the first passive landmark with the first laser rangefinder.

32. The method of any of claims 27-30, further comprising:

detecting a discontinuity in the first distance measured by the first laser rangefinder; and

upon detecting the discontinuity in the first distance measured by the first laser rangefinder, acquiring a third passive landmark disposed in the worksite at a third known landmark position with the first laser rangefinder.

33. The method of any of claims 31-32, wherein the discontinuity in the first distance measured by the first laser rangefinder is a change in the measured first distance above a range change threshold.

34. The method of any of claims 27-33, further comprising moving the mobility platform to a third orientation based on the drive path and the one or more task locations.

35. The method of claim 34, further comprising:

determining a crossover point of the first laser rangefinder and the second laser rangefinder within the movement of the mobility platform to the third orientation;

acquiring the first passive landmark with the second laser rangefinder at the crossover point; and

acquiring the second passive landmark with the second laser rangefinder at the crossover point.

36. The method of any of claims 21-25, further comprising:

acquiring a third passive landmark disposed at a third unknown landmark position with the first laser rangefinder; and

determining the third unknown landmark position based on:

the first position of the chassis,

a third distance measured by the first laser rangefinder between the first location and the third unknown landmark position, and

yaw angle information from the first laser rangefinder.

37. A method for operating a mobility platform in a worksite, the mobility platform comprising a chassis, a first laser rangefinder disposed on the chassis, and a drive system comprising at least one wheel, the method comprising:

acquiring a first passive landmark with the first laser rangefinder;

moving the mobility platform along a drive path with the drive system;

changing a first rangefinder pitch of the first laser rangefinder to maintain the first laser rangefinder at a first target elevation range on the first passive landmark as the mobility platform moves along the drive path;

determining a chassis pitch of the mobility platform for each position of the mobility platform along the drive path based on the change in the first rangefinder pitch of the first laser rangefinder; and

for each position of the mobility platform along the drive path, determining an elevation of the worksite at the at least one wheel based on the chassis pitch.

38. The method of claim 37, wherein changing the first rangefinder pitch comprises commanding an actuator to move the first laser rangefinder.

39. The method of any of claims 37-38, wherein the drive system is a holonomic drive system.

40. The method of claim 39, wherein the at least one wheel is four wheels, wherein the drive system comprises four wheel assemblies, wherein each of the four wheel assemblies comprises:

a wheel of the four wheels configured to rotate about a wheel axis,

a first actuator configured to rotate the wheel about the wheel axis, and

a second actuator configured to rotate the wheel about a pivot axis perpendicular to the wheel axis.

41. The method of any of claims 37-40, wherein the mobility platform further comprises a second laser rangefinder disposed on the chassis, wherein the method further comprises:

acquiring a second passive landmark with the second laser rangefinder;

change a second rangefinder pitch of the second laser rangefinder to maintain the second laser rangefinder at a second target elevation range on the second passive landmark as the mobility platform moves along the drive path;

determine a second chassis pitch of the mobility platform for each position of the mobility platform along the drive path based on the change in the second rangefinder pitch of the second laser rangefinder; and

for each position of the mobility platform along the drive path, determine an elevation of the worksite at the at least one wheel based on the chassis pitch and the second chassis pitch.

42. The method of any of claims 37-41, further comprising generating a topographical map of the drive path based on elevation of the worksite for each position of the mobility platform along the drive path.

43. The method of any of claims 37-42, wherein acquiring the first passive landmark comprises:

sweeping the worksite with the first laser rangefinder to collect first sweep information;

detecting a first landmark position of the first passive landmark based on the first sweep information; and

orienting the first laser rangefinder toward the first passive landmark based on the first landmark position.

44. The method of claim 43, wherein detecting the first landmark position of the first passive landmark comprises detecting a shape of the first passive landmark.

45. The method of claim 43, wherein detecting the first landmark position of the first passive landmark comprises detecting a reflectivity threshold of the first passive landmark.

46. The method of claim 43, wherein detecting the first landmark position of the first passive landmark comprises detecting a color of the first passive landmark.

47. The method of any of claims 37-42, wherein acquiring the first passive landmark comprises:

identifying a first landmark position of the first passive landmark with at least one camera of the mobility platform; and

orienting the first laser rangefinder toward the first passive landmark based on the first landmark position.

48. The method of any of claims 37-47, further comprising, based on odometry information from at least one odometry sensor of the mobility platform, tracking the first passive landmark with the first laser rangefinder.

49. The method of any of claims 37-48, further comprising:

detecting a discontinuity in information from the first laser rangefinder; and

upon detecting the discontinuity in the information from the first laser rangefinder, reacquiring the first passive landmark with the first laser rangefinder.

50. The method of any of claims 37-48, further comprising:

detecting a discontinuity in information from the first laser rangefinder; and

upon detecting the discontinuity in the information from the first laser rangefinder, acquiring a third passive landmark disposed in the worksite with the first laser rangefinder.

51. The method of any of claims 49-50, wherein the discontinuity in the information is a change in distance measured above a range change threshold.

52. At least one non-transitory computer-readable medium comprising instructions thereon that, when executed by at least one processor, perform the method of any one of claims 21-51.