

CLAIMS

1. A method of navigating an unmanned ground vehicle (UGV), the vehicle comprising a scanning device providing scanning output data and a processor, the method comprising:
 - receiving an indication that generation of a new navigation command has being triggered;
 - estimating, by the processor, an expected state of the UGV when the new navigation command is to be executed, based on accumulated effects of pending commands;
 - generating, by the processor, the new navigation command based on the expected state; and
 - following execution of pending commands, executing the new navigation command, for steering the UGV.
2. The method of Claim 1, wherein estimating the expected state of a UGV comprises:
 - while there is at least one pending navigation command which has not been processed since the indication has been received:
 - retrieving by the processor an earliest pending navigation command which has not been processed since the indication has been received;
3. determining, by the processor, an expected effect of the earliest pending navigation command on the state of the UGV; and updating the expected state of the UGV according to the expected effect. The method of Claim 1, wherein the expected state of the UGV includes at least a location of the UGV.
4. The method of Claim 1, further comprising steering the UGV in accordance with the new navigation command.
5. The method of Claim 1, wherein generating the new navigation command for navigating the UGV comprises planning a path from a current location of the UGV to a destination of the UGV.

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6. The method of Claim 1, wherein the at least one pending navigation command comprises a number of commands, the number determined in accordance with a command providing rate and an expected delay between provisioning and execution times of a command.
7. The method of Claim 1, further comprising:
 - comparing a current state of the UGV with a state predicted in association with generating a previous command to obtain comparison results; and
 - adapting the new navigation command in accordance with the comparison results.
8. The method of Claim 1, wherein the indication which is received responsive to an event is selected from a group comprising a timer and arrival of the UGV to a predetermined location.
9. The method of Claim 1, wherein the UGV further comprises an Inertial Navigation System (INS) operatively connected to a processor, the method further comprising:
 - receiving INS data indicative of a location of the UGV relative to a previous location; and
 - using the INS data in determining the state of the UGV to be used in obtaining the expected state of the UGV.
10. The method of Claim 1 further comprising:
 - storing an expected state of the UGV after execution of one or more commands;
 - upon execution of the one or more commands, comparing an actual state of the UGV to the expected state of the UGV, respectively to obtain comparison results; and
 - updating the new navigation command based on the comparison results.
11. An unmanned ground vehicle (UGV), comprising:
 - a scanning device for scanning an area surrounding the UGV to thereby provide scanning output data providing information about distances between

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objects in the area and the UGV in a multiplicity of directions;

an Inertial Navigation System (INS) for providing kinematic parameters of the UGV at a given time; and

a processor configured to:

receive an indication that generation of a new navigation command has been triggered;

estimate, by the processor, an expected state of the UGV when the new navigation command is to be executed, based on accumulated effects of pending commands;

generate, by the processor, the new navigation command based on the expected state; and

following execution of pending commands, execute the new navigation command, thereby steering the UGV.

12. The UGV of Claim 11, wherein for estimating the expected state of UGV, the processor is further configured to:

while there is at least one pending navigation command which has not been processed since the indication has been received:

retrieve by the processor an earliest pending navigation command which has not been processed since the indication has been received; and

determine, by the processor, an expected effect of the earliest pending navigation command on the state of the UGV to update the expected state of the UGV.

13. The UGV of Claim 11, wherein the expected state of the UGV includes at least a location of the UGV.

14. The UGV of Claim 11, wherein the UGV is steered in accordance with the new navigation command.

15. The UGV of Claim 11, wherein for generating the new navigation command for navigating the UGV, the processor is further adapted to plan a path from a current location of the UGV to a destination of the UGV.
16. The UGV of Claim 11, wherein the at least one pending navigation command comprises a number of commands, the number determined in accordance with a command providing rate and an expected delay between provisioning and execution times of a command.
17. The UGV of Claim 11, wherein the processor is further configured to:
 - compare a current state of the UGV with a state predicted in association with generating a previous command to obtain comparison results; and
 - adapt the new navigation command in accordance with the comparison results.
18. The UGV of Claim 11, wherein the indication is received responsive to an event selected from the group comprising a timer; and arrival of the UGV to a predetermined location.
19. The UGV of Claim 11, further comprising an Inertial Navigation System (INS) operatively connected to a processor, wherein the processor is further configured to:
 - receive INS data indicative of a location of the UGV relative to a previous location; and
 - use the INS data in determining the state of the UGV to be used in obtaining the expected state of the UGV.
20. The method of Claim 1 wherein the processor is further configured to:
 - store an expected state of the UGV after execution of one or more commands;
 - upon execution of the one or more commands, compare an actual state of the UGV to the expected state of the UGV, respectively to obtain comparison results; and
 - update the new navigation command based on the comparison results.
21. A system mountable on an unmanned ground vehicle (UGV), comprising:

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a processor configured to:

receive an indication that generation of a new navigation command has been triggered;

estimate, by the processor, an expected state of the UGV when the new navigation command is to be executed, based on accumulated effects of pending commands;

generate, by the processor, the new navigation command based on the expected state; and

following execution of pending commands, execute the new navigation command, thereby steering the UGV.

22. The system of Claim 21, wherein for estimating the expected state of UGV, the processor is further configured to:

while there is at least one pending navigation command which has not been processed since the indication has been received:

retrieve by the processor an earliest pending navigation command which has not been processed since the indication has been received; and

determine, by the processor, an expected effect of the earliest pending navigation command on the state of the UGV to update the expected state of the UGV.

23. The system of Claim 21, wherein the expected state of the UGV includes at least a location of the UGV.
24. The system of Claim 21, wherein the UGV is steered in accordance with the new navigation command.
25. The system of Claim 21, wherein for generating the new navigation command for navigating the UGV, the processor is further adapted to plan a path from a current location of the UGV to a destination of the UGV.
26. The system of Claim 21, wherein the at least one pending navigation command comprises a number of commands, the number determined in accordance with a

command providing rate and an expected delay between provisioning and execution times of a command.

27. The system of Claim 21, wherein the processor is further configured to:
 - compare a current state of the UGV with a state predicted in association with generating a previous command to obtain comparison results; and
 - adapt the new navigation command in accordance with the comparison results.
28. The system of Claim 21, wherein the indication is received responsive to an event selected from the group comprising a timer; and arrival of the UGV to a predetermined location.
29. The system of Claim 21, wherein the processor is further configured to:
 - receive Inertial Navigation System (INS) data indicative of a location of the UGV relative to a previous location from an Inertial Navigation System (INS) operatively connected to a processor; and
 - use the INS data in determining the state of the UGV to be used in obtaining the expected state of the UGV.
30. The system of Claim 21 wherein the processor is further configured to:
 - store an expected state of the UGV after execution of one or more commands;
 - upon execution of the one or more commands, compare an actual state of the UGV to the expected state of the UGV, respectively to obtain comparison results; and
 - update the new navigation command based on the comparison results.
31. A computer program product comprising a computer readable storage medium retaining program instructions, which programs instructions when read by a processor, and causes the processor to perform a method comprising:
 - receiving an indication that generation of a new navigation command has been triggered;
 - estimating, by the processor, an expected state of the UGV when the

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new navigation command is to be executed, based on accumulated effects of pending commands;

generating, by the processor, the new navigation command based on the expected state; and

following execution of pending commands, executing the new navigation command, thereby steering the UGV.

32. The computer program product of Claim 31, wherein estimating the expected state of the UGV comprises:

while there is at least one pending navigation command which has not been processed since the indication has been received:

retrieving, by the processor, an earliest pending navigation command which has not been processed since the indication has been received; and

determining, by the processor, an expected effect of the earliest pending navigation command on the state of the UGV to update the expected state of the UGV.

33. The computer program product of Claim 31, wherein the expected state of the UGV includes at least a location of the UGV.

34. The computer program product of Claim 31, wherein the method further comprises steering the UGV in accordance with the new navigation command.

35. The computer program product of Claim 31, wherein generating the new navigation command for navigating the UGV comprises planning a path from a current location of the UGV to a destination of the UGV.

36. The computer program product of Claim 31, wherein the at least one pending navigation command comprises a number of commands, the number determined in accordance with a command providing rate and an expected delay between provisioning and execution times of a command.

37. The computer program product of Claim 31, wherein the method further comprises:

comparing a current state of the UGV with a state predicted in

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association with generating a previous command to obtain comparison results;
and

adapting the new navigation command in accordance with the
comparison results.

38. The computer program product of Claim 31, wherein the indication is received responsive to an event selected from the group comprising a timer; and arrival of the UGV to a predetermined location.
39. The computer program product of Claim 31, wherein the method further comprises:
 - receiving Inertial Navigation System (INS) from an INS operatively connected to a processor, the INS data indicative of a location of the UGV relative to a previous location; and
 - using the INS data to determine the state of the UGV to be used in obtaining the expected state of the UGV.
40. The computer program product of Claim 31, wherein the method further comprises:
 - storing an expected state of the UGV after execution of one or more commands;
 - upon execution of the one or more commands, comparing an actual state of the UGV to the expected state of the UGV, respectively, to obtain comparison results; and
 - updating the new navigation command based on the comparison results.