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(54) **CONTROLLER AND CONTROL METHOD FOR MANEUVERING A MOTORCYCLE**

(71) Applicant: **Robert Bosch GmbH**, Stuttgart (DE)

(72) Inventor: **Lars Pfau**, Kanagawa (JP)

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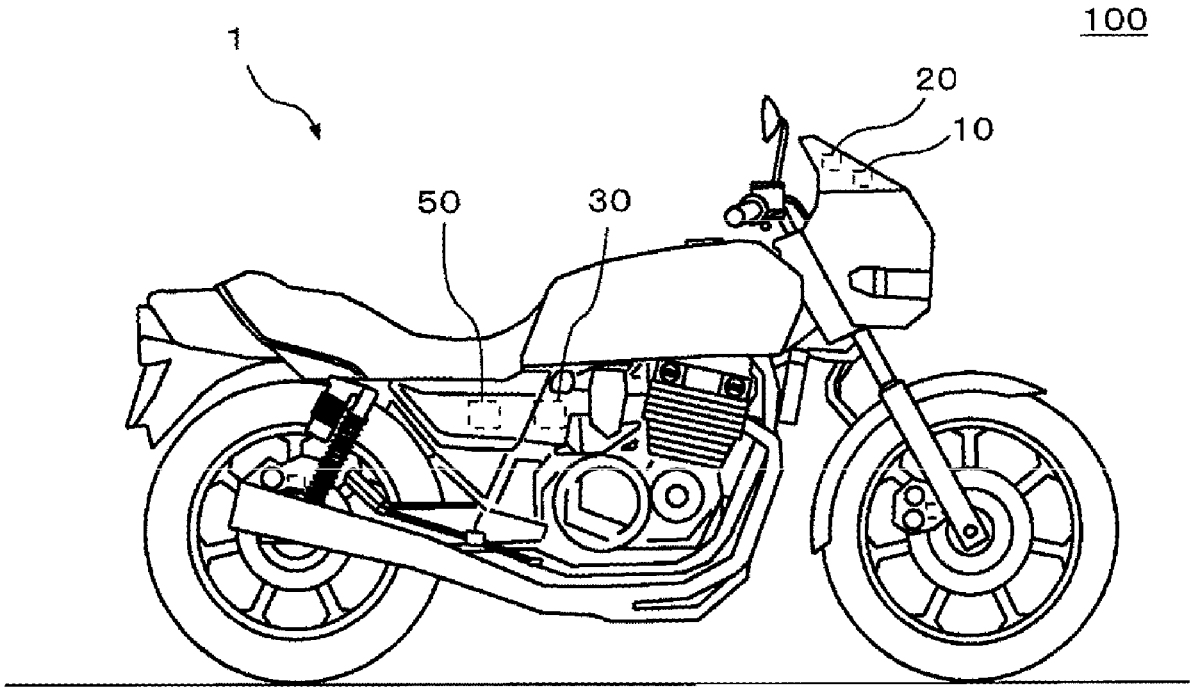
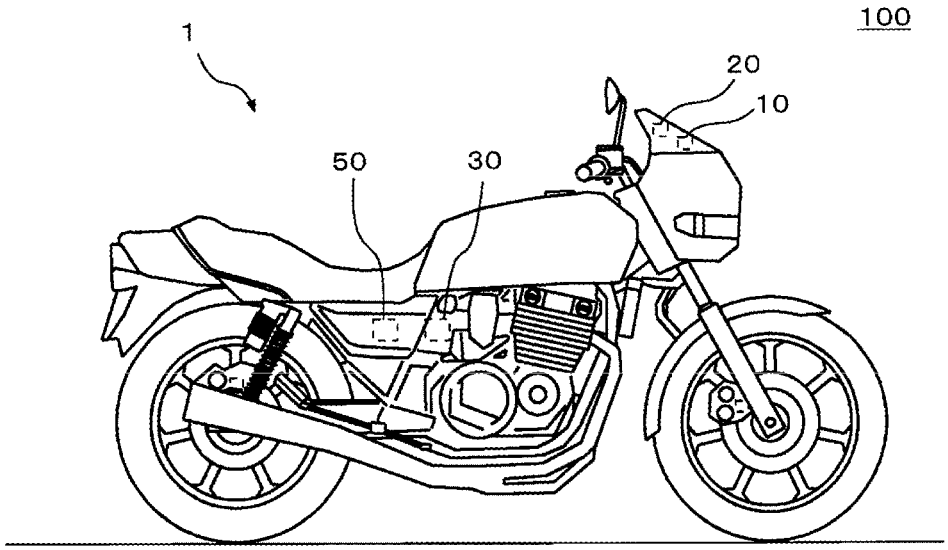
(57) **ABSTRACT**

The present disclosure provides a controller and a control method that appropriately assists a rider to drive of a motorcycle.

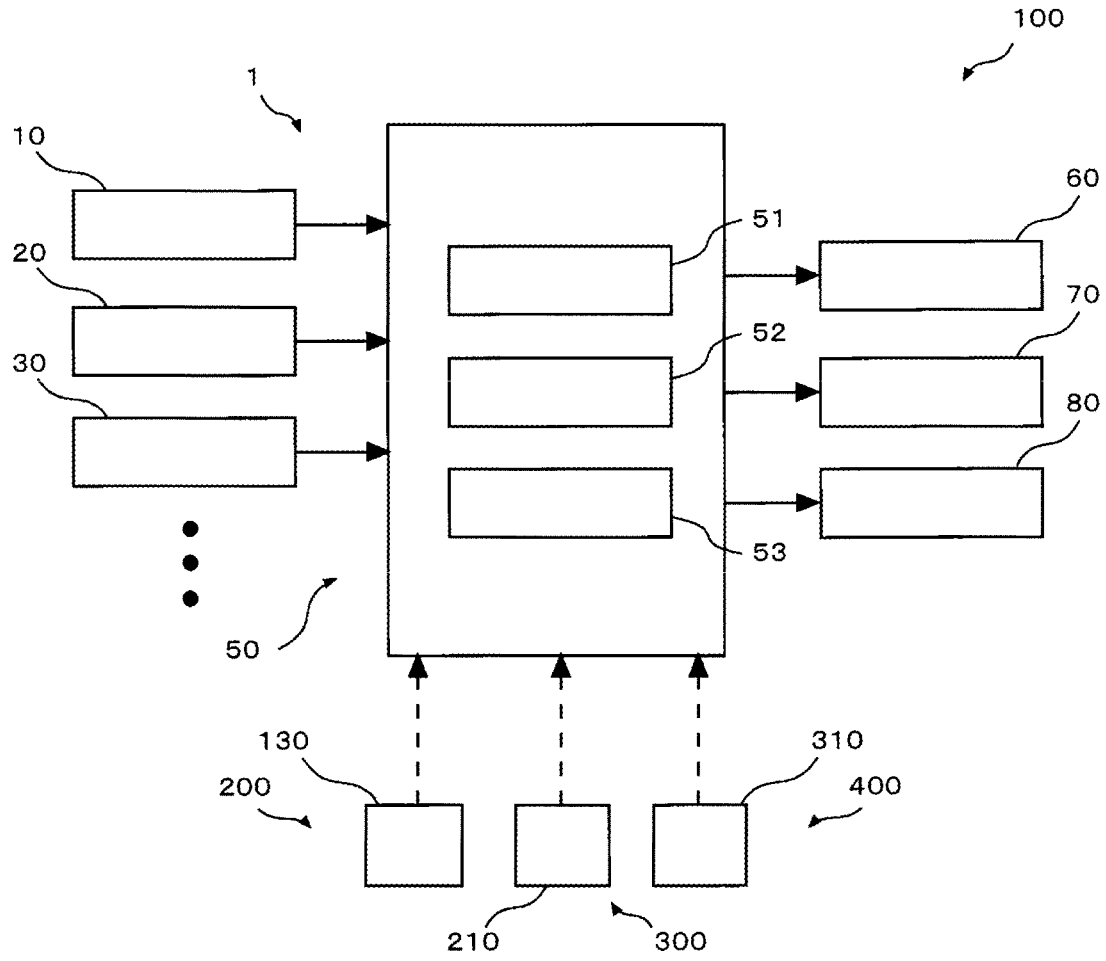
An acquisition section (**51**) acquires a state information of another motorcycle (**200**) via wireless communication other than the motorcycle (**100**). The state information of the other motorcycle (**200**) is information about a travel state of the other motorcycle (**200**) turning a curve in a traveling direction of the motorcycle (**100**). A safety operation execution section (**53**) causes the motorcycle (**100**) to perform a safety operation in response to the state information of the other motorcycle (**200**) acquired by the acquisition section (**51**) when the motorcycle (**100**) is performing the automatic cruise operation.



[FIG. 1]


100
1
20
10
50
30

[FIG. 2]


100
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10
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30
50
51
52
53
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70
80
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200
210
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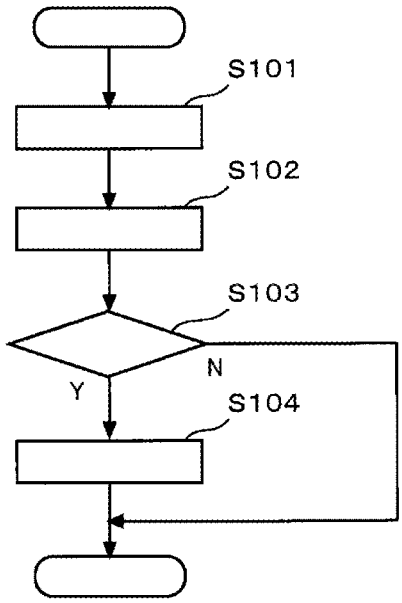
310
400

[FIG. 3]



CONTROLLER AND CONTROL METHOD FOR MANEUVERING A MOTORCYCLE

BACKGROUND

[0001] The present disclosure relates to a controller and a control method for maneuvering a motorcycle capable of performing automatic cruise operation.

[0002] Techniques for maneuvering a motorcycle (a two-wheeled motor vehicle or a three-wheeled motor vehicle) to perform an automatic cruise operation are known. The automatic cruise operation automatically controls a speed of the motorcycle without relying on an accelerating/decelerating operation by a rider.

[0003] When a lane is curved ahead of the motorcycle in a traveling direction of the motorcycle, an amount of acquired information is limited. In addition, since the rider's attention tends to become distracted when the automatic cruise operation is performed, a larger amount of the information is needed to be acquired. Furthermore, behavior/movement of the motorcycle is different from other types of vehicles (for example, a passenger car, a truck, and the like). As such, unique information, which is specific to the motorcycle, is required for the automatic cruise operation of the motorcycle. For example, when the motorcycle turns a curve during the automatic cruise operation, a lot of motorcycle specific information is required. If the amount of information is insufficient, it may be difficult to assist the rider of the motorcycle to drive of the motorcycle appropriately.

SUMMARY

[0004] The present disclosure addresses the above-described issues and therefore it is an objective of the present disclosure to provide a controller that appropriately assists a rider of a motorcycle to drive the motorcycle. It is another objective of the present disclosure to provide a control method for appropriately assisting a rider of a motorcycle to drive the motorcycle.

[0005] As one aspect of the present disclosure, a controller maneuvers a motorcycle. The controller includes an automatic cruise execution section, an acquisition section, and a safety operation execution section. The automatic cruise execution section is configured to cause the motorcycle to perform an automatic cruise operation. The acquisition section is configured to acquire a state information of another motorcycle via wireless communication. The state information of the other motorcycle is information about a travel state of the other motorcycle turning a curve in a traveling direction of the motorcycle. The safety operation execution section is configured to cause the motorcycle to perform a safety operation in response to the state information of the other motorcycle acquired by the acquisition section. The safety operation execution section is configured to cause the motorcycle to perform the safety operation when the motorcycle is performing the automatic cruise operation.

[0006] As one aspect of the present disclosure, a control method for maneuvering a motorcycle includes: executing an automatic cruise operation of the motorcycle by using an automatic cruise execution section included in a controller; acquiring a state information of another motorcycle via wireless communication by using an acquisition section included in the controller, the state information of the other motorcycle being information about a travel state of the other motorcycle turning a curve in a traveling direction of the motorcycle; and executing, by using a safety operation execution section included in the controller, a safety operation of the motorcycle in response to the state information of the other motorcycle acquired in the acquisition step, the safety operation execution section configured to cause the motorcycle to perform the safety operation when the motorcycle is performing the automatic cruise operation.

[0007] According to the controller and the control method of the present disclosure, the acquisition section acquires the state information of the other motorcycle via wireless communication. The state information of the other motorcycle is information about the travel state of the other motorcycle turning a curve in a traveling direction of the motorcycle. The safety operation execution section causes the motorcycle to perform the safety operation in response to the state information of the other motorcycle acquired by the acquisition section. The safety operation execution section causes the motorcycle to perform the safety operation when the motorcycle is performing the automatic cruise operation. Therefore, when the motorcycle is under the automatic cruise operation and is turning a curve, the controller and the control method can acquire the motorcycle specific information and compensate the shortage of information. The acquisition section acquires the other vehicle travel state information, as a result, it is possible to appropriately assist a rider to drive of the motorcycle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a view illustrating a mounted state of a rider-assistance system according to an embodiment of the present disclosure to a motorcycle.

[0009] FIG. **2** is a diagram for explaining a system configuration of the rider-assistance system according to the embodiment of the present disclosure.

[0010] FIG. **3** is a chart illustrating an example of a control flow by a controller in the rider-assistance system according to the embodiment of the present disclosure.

DETAILED DESCRIPTION

[0011] A description will hereinafter be made on a controller and a control method according to the present disclosure with reference to the drawings.

[0012] A term "motorcycle" means a two-wheeled motor vehicle or a three-wheeled motor vehicle among straddle-type vehicles straddled by riders. The motorcycles include: the two-wheeled motor vehicle or the three-wheeled motor vehicle that has an engine as a propelling source; the two-wheeled motor vehicle or the three-wheeled motor vehicle that has an electric motor as the propelling source; and the like, and examples of the motorcycle are a bike, a scooter, and an electric scooter. The following description will be made on a case where the motorcycle is the two-wheeled motor vehicle. However, the motorcycle may be the three-wheeled motor vehicle.

[0013] A configuration, operation, and the like, which will be described below, merely constitute one example. The controller and the control method according to the present disclosure are not limited to a case with such a configuration, such operation, and the like. The same or similar description will appropriately be simplified or will not be made below. A detailed structure will appropriately be illustrated in a simplified manner or will not be illustrated.

[0014] A description will hereinafter be made on a rider-assistance system according to an embodiment.

<Configuration of Rider-Assistance System>

[0015] A description will be made on a configuration of the rider-assistance system according to the embodiment.

[0016] FIG. **1** is a view illustrating a mounted state of the rider-assistance system according to the embodiment of the present disclosure to the motorcycle. FIG. **2** is a diagram for explaining a system configuration of the rider-assistance system according to the embodiment of the present disclosure.

[0017] As illustrated in FIG. **1** and FIG. **2**, a rider-assistance system **1** is mounted to a motorcycle **100**. The rider-assistance system **1** at least includes: a surrounding environment detector **10** that detects surrounding environment in front of the motorcycle **100**; an input device **20** that is operated by a rider; a travel state detector **30** that detects a travel state of the motorcycle **100**; and a controller (ECU) **50**.

[0018] The surrounding environment detector **10** monitors an area in front of the motorcycle **100** and detects various types of information about the area in front of the motorcycle **100**. More specifically, the surrounding environment detector **10** detects a predicted route that is a route predicted to be traveled by the motorcycle **100** in the future. The surrounding environment detector **10** may detect another physical quantity that can substantially be converted to the predicted route. The surrounding environment detector **10** also detects a distance from the motorcycle **100** to a preceding vehicle. The surrounding environment detector **10** may detect another physical quantity that can substantially be converted to the distance from the motorcycle **100** to the preceding vehicle.

[0019] For example, in the case where plural vehicles travel in front of the motorcycle **100**, based on the predicted route of the motorcycle **100** and behavior of each of the plural vehicles, the surrounding environment detector **10** selects the vehicle that travels at the closest position to the motorcycle **100** on the same lane as a travel lane of the motorcycle **100** as the preceding vehicle that is a target for detecting the distance thereof from the motorcycle **100**. At this time, in addition to the vehicle that travels at the closest position to the motorcycle **100** on the same lane as the travel lane of the motorcycle **100**, the vehicle traveling ahead of several vehicles in front of the motorcycle **100**, the vehicle traveling on an adjacent lane to the travel lane of the motorcycle **100**, or the like may be included as the preceding vehicle that is the target for detecting the distance thereof from the motorcycle **100**. Adaptive cruise control operation, which will be described below, is performed by using a detection result of the distance from the motorcycle **100** to the preceding vehicle. Here, in the case where cruise control operation, which will be described below, is performed, the distance from the motorcycle **100** to the preceding vehicle may not be detected.

[0020] As the surrounding environment detector **10**, for example, a camera that captures an image of the area in front of the motorcycle **100** and a radar capable of detecting the distance from the motorcycle **100** to the target in front are used. In such a case, for example, white lines, guardrails, and the like are recognized by using the image captured by the camera. Then, by using recognition results of these and a detection result by the radar, the predicted route of the motorcycle **100** can be detected. In addition, for example, the preceding vehicle is recognized by using the image captured by the camera. Then, by using a recognition result of the preceding vehicle and the detection result by the radar, the distance from the motorcycle **100** to the preceding vehicle can be detected. The surrounding environment detector **10** is provided to a front portion of a vehicle body, for example.

[0021] The configuration of the surrounding environment detector **10** is not limited to that in the above example. For example, the function of detecting the predicted route of the motorcycle **100** and the function of detecting the distance from the motorcycle **100** to the preceding vehicle by the surrounding environment detector **10** may be implemented by the radar only or may be implemented by a stereo camera. Alternatively, the function of detecting the predicted route of the motorcycle **100** by the surrounding environment detector **10** may be implemented by using a signal received from the Global Positioning System (GPS) satellite and map information, for example.

[0022] The input device **20** accepts a travel mode selecting operation by the rider and outputs information about a travel mode selected by the rider. Here, in the motorcycle **100**, the controller **50** can perform the adaptive cruise control operation or the cruise control operation. Each of the adaptive cruise control operation and the cruise control operation corresponds to an example of automatic cruise operation for automatically controlling a speed of the motorcycle **100** without relying on an accelerating/decelerating operation by the rider. In the cruise control operation, the speed of the motorcycle **100** is controlled by the controller **50** such that the motorcycle **100** travels at a target speed set by the rider. Meanwhile, in the adaptive cruise control operation, in addition to such control, an inter-vehicular distance from or collision avoidance performance with the preceding vehicle is maintained. That is, in the adaptive cruise control operation, in the case where there is no preceding vehicle, the speed of the motorcycle **100** is controlled by the controller **50** such that the motorcycle **100** travels at the target speed set by the rider. On the other hand, in the case where there is the preceding vehicle, the speed of the motorcycle **100** is controlled by the controller **50** such that the motorcycle **100** travels at a speed that is equal to or lower than the target speed and aims to maintain the inter-vehicular distance from or the collision avoidance performance with the preceding vehicle. By using the input device **20**, the rider can select a travel mode in which none of the automatic cruise operation is performed, a travel mode in which the adaptive cruise control operation is performed, or a travel mode in which the cruise control operation is performed. As the input device **20**, a lever, a button, a touchscreen, or the like is used, for example. The input device **20** is provided to a handlebar, for example.

[0023] The travel state detector **30** includes a front-wheel rotational frequency sensor, a rear-wheel rotational frequency sensor, and the like, for example. Each of the front-wheel rotational frequency sensor and the rear-wheel rotational frequency sensor detects a rotational frequency of a wheel and outputs a detection result. Each of the front-wheel rotational frequency sensor and the rear-wheel rotational frequency sensor may detect another physical quantity that can substantially be converted to the rotational frequency of the wheel.

[0024] In addition, the travel state detector **30** includes an inertial measurement unit, for example. The inertial measurement unit includes a three-axis gyroscope sensor and a three-directional acceleration sensor, and outputs detection results of three-axis acceleration and three-axis angular velocities of the motorcycle **100**. The inertial measurement unit may detect other physical quantities that can substantially be converted to the three-axis acceleration and the three-axis angular velocities.

[0025] Furthermore, the travel state detector **30** includes a braking force measurement unit and a drive power measurement unit, for example. For example, the braking force measurement unit outputs detection results such as an operation amount of a brake operation by the rider and an actual braking force generated by a braking device **60**. The braking force measurement unit may detect other physical quantities that can substantially be converted to the operation amount of the brake operation by the rider and the actual braking force generated by the braking device **60**. For example, the drive power measurement unit outputs detection results such as an operation amount of an accelerator operation by the rider and actual drive power generated by a drive device **70**. The drive power measurement unit may detect other physical quantities that can substantially be converted to the operation amount of the accelerator operation by the rider and the actual drive power generated by the drive device **70**.

[0026] Moreover, the travel state detector **30** includes: a receiver that receives the signal from the GPS satellite; and a storage section for the map information, for example. Another configuration capable of detecting a position or a[[n]] traveling direction of the motorcycle **100** may be adopted.

[0027] The controller **50** controls operation of the motorcycle **100**. For example, the controller **50** is partially or entirely constructed of a microcomputer, a microprocessor unit, or the like. Alternatively, the controller **50** may partially or entirely be constructed of a member in which firmware or the like can be updated, or may partially or entirely be a program module or the like that is executed by a command from a CPU or the like, for example. The controller **50** may be provided as one unit or may be divided into multiple units, for example.

[0028] As illustrated in FIG. **2**, the controller **50** includes an acquisition section **51**, an automatic cruise execution section **52**, and a safety operation execution section **53**.

[0029] The acquisition section **51** acquires information that is output from each of the devices mounted to the motorcycle **100**, and outputs the acquired information to the automatic cruise execution section **52**. More specifically, the acquisition section **51** acquires surrounding environment information based on the information output from the surrounding environment detector **10**, acquires rider setting information based on the information output from the input device **20**, and acquires travel state information of the motorcycle **100** based on the information output from the travel state detector **30**. The travel state information includes information about at least one of the speed, deceleration, the position, and the traveling direction of the motorcycle **100**.

[0030] The automatic cruise execution section **52** controls operation of each of the devices (the braking device **60**, the drive device **70**, and the like) mounted to the motorcycle **100**, so as to control the drive power and the braking force to be generated to the motorcycle **100**. In this way, the automatic cruise execution section **52** controls the acceleration/deceleration of the motorcycle **100** and performs the automatic cruise operation (that is, the adaptive cruise control operation or the cruise control operation). In the case where the rider performs the accelerating/decelerating operation (that is, the accelerator operation or the brake operation) during the automatic cruise operation, the automatic cruise execution section **52** cancels or temporarily stops the automatic cruise operation.

[0031] The acquisition section **51** acquires other vehicle travel state information via wireless communication and outputs the acquired other vehicle travel state information to the safety operation execution section **53**. The other vehicle travel state information is information about a travel state of another motorcycle **200** that turns a curve in the traveling direction of the motorcycle **100**. Preferably, the other motorcycle **200** is a motorcycle that travels on the same lane as the motorcycle **100**. The acquisition section **51** acquires the other vehicle travel state information based on information that is output from a travel state detector **130** of the other motorcycle **200**. The travel state detector **130** may be the same as the travel state detector **30** mounted to the motorcycle **100** or may differ therefrom. That is, the other vehicle travel state information includes information about at least one of a speed, deceleration, a position, and a traveling direction of the other motorcycle **200**. In the case where position information about the motorcycle that is detected by the surrounding environment detector **10** and is located around the motorcycle **100** is information indicating that such a motorcycle turns the curve in the traveling direction of the motorcycle **100** and is located within a specified distance from the motorcycle **100**, the acquisition section **51** identifies such a motorcycle as the other motorcycle **200**. In the case where, due to a blind spot produced by the curve, the position information about such a motorcycle cannot be detected by the surrounding environment detector **10**, or in the case where only the cruise control operation can be performed as the automatic cruise operation and the surrounding environment detector **10** is not mounted, the position information about the motorcycle can be detected by wireless communication therewith. In other words, the other motorcycle **200** preferably includes: a receiver for the signal from the GPS satellite; and a storage section for the map information, for example. Here, the position information about the other motorcycle **200** may be detected by another means.

[0032] The other vehicle travel state information may be information about a travel state of the other motorcycle **200** that is output from a surrounding environment detector **210** mounted to a vehicle **300** around the other motorcycle **200** or from a surrounding environment detector **310** provided to infrastructure equipment **400** around the other motorcycle **200**. Each of the surrounding environment detector **210** and the surrounding environment detector **310** may be the same as the surrounding environment detector **10** mounted to the motorcycle **100** or may differ therefrom. The other motorcycle **200**, the nearby vehicle **300**, or the nearby infrastructure equipment **400** can recognize the position of itself. Thus, by acquiring information about the position thereof and information about a relative position of a motorcycle, which is located around the motorcycle **100**, to such a position, the acquisition section **51** can identify the other motorcycle **200**.

[0033] The acquisition section **51** may acquire the other vehicle travel state information by the direct wireless com-

munication between a communication device of the motorcycle **100** and a communication device of the other motorcycle **200**, the nearby vehicle **300**, or the nearby infrastructure equipment **400**. Alternatively, the acquisition section **51** may acquire the other vehicle travel state information by the indirect wireless communication between the communication device of the motorcycle **100** and the communication device of the other motorcycle **200**, the nearby vehicle **300**, or the nearby infrastructure equipment **400** via another medium (for example, a network server, a mobile terminal, or the like).

[0034] The safety operation execution section **53** determines whether it is necessary to cause the motorcycle **100** to perform safety operation based on the other vehicle travel state information acquired by the acquisition section **51**. If determining that it is necessary, the safety operation execution section **53** causes the motorcycle **100** to perform the safety operation. The safety operation is operation to improve safety of the rider of the motorcycle **100**.

[0035] For example, a notification device **80** is mounted to the motorcycle **100**. By using the notification device **80**, the safety operation may: alert the rider to an area in front of the motorcycle **100**; encourage the rider to decelerate the motorcycle **100**; encourage the rider to reduce a set value which is set as a target speed when the automatic cruise operation is being performed; encourage the rider to travel between lines of vehicles; or encourage the rider to change lanes. As other examples, the safety operation may: output a signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** decelerates the motorcycle **100** automatically; output a signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** reduces the set value of the target speed automatically when the automatic cruise operation is being performed; or output a signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** cancel or stop the automatic cruise operation automatically. The safety operation may output a combination of the above-described signals.

[0036] Here, the notification device **80** may warn the rider by sound (that is, a sensation through an auditory organ as a sensory organ), may warn the rider by display (that is, a sensation through a visual organ as the sensory organ), may warn the rider by a vibration (that is, a sensation through a tactile organ as the sensory organ), or may warn the rider by a combination of those. In addition, the notification device **80** may be provided to the motorcycle **100** or may be provided to an accessory such as a helmet that is associated with the motorcycle **100**. Furthermore, the notification device **80** may be constructed of a single output device or may be constructed of plural output devices of the same type or different types. Such plural output devices may be provided integrally or may be provided separately. Moreover, the notification device **80** may warn the rider by generating instantaneous acceleration/deceleration to the motorcycle **100**. That is, the braking device **60**, the drive device **70**, or the like may be implemented as the notification device **80**.

[0037] The state information of the other motorcycle **200** may be information about a speed of the other motorcycle **200** when the other motorcycle **200** is turning a curve. The safety operation execution section **53** determines that it is necessary to cause the motorcycle **100** to execute the safety operation in response to the state information about the speed of the other motorcycle **200**. For example, when the speed of the other motorcycle **200** is slower/smaller than a speed of the motorcycle **100** and a difference between the speed of the other motorcycle **200** and the speed of the motorcycle **100** is larger than a reference value, the safety operation execution section **53** determines that it is necessary to cause the motorcycle **100** to execute the safety operation. In this situation, the safety operation preferably may execute at least one of: alerting the rider to the area in front of the motorcycle **100**; encouraging the rider to decelerate the motorcycle **100**; encouraging the rider to reduce the set value of the target speed when the motorcycle **100** is under the automatic cruise operation; outputting the signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** decelerates the motorcycle **100** automatically; or outputting the signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** reduces the set value of the target speed automatically when the automatic cruise operation is being performed. As another example, the other motorcycle **200** may be one of a plurality of other motorcycles **200**. In this situation, the state information of the other motorcycle **200** may be information about speeds of a plurality of other motorcycles **200** preferably. By acquiring the state information about the speeds of the other motorcycles **200**, the safety operation execution section **53** can determine the necessity of executing the safety operation with greater accuracy. It may be determined whether it is necessary to perform the safety operation by comparing an average value of the speeds of the other motorcycles **200** to the speed of the motorcycle **100**. Alternatively, it may be determined whether it is necessary to perform the safety operation by comparing the lowest value of the speeds of the other motorcycles **200** to the speed of the motorcycle **100**. In addition, the safety operation is preferably performed at a stage where the motorcycle **100** travels straight, that is, at a stage before the motorcycle **100** is shifted to turn the curve. With such a configuration, the safety operation is performed in a situation where the rider relatively feels at ease, and thus the safety is improved. However, the safety operation may be performed at a stage where the motorcycle **100** turns the curve. Also, in such a case, the safety of the rider is improved.

[0038] In the case where, as the other vehicle travel state information, information about the deceleration of the other motorcycle **200** turning the curve is acquired and, for example, in the case where such information is information indicating that the deceleration exceeds a reference value, the safety operation execution section **53** determines that it is necessary for the motorcycle **100** to perform the safety operation. In particular, as the safety operation, at least one of the following is preferably executed: alerting the rider to the area in front of the motorcycle **100**; encouraging the rider to decelerate the motorcycle **100**; encouraging the rider to reduce the set value of the target speed when the motorcycle **100** is under automatic cruise operation; outputting the signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** automatically reduces the speed of the motorcycle **100**; or outputting the signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** automatically reduces the set value of the target speed when the motorcycle **100** is under the automatic cruise operation. The other vehicle travel state information is preferably the information about the deceleration of each of the other motorcycles **200**

turning the curve. With such a configuration, the accuracy of the determination is improved. It may be determined whether it is necessary to perform the safety operation by comparing an average value of the deceleration of the other motorcycles **200** to the reference value. Alternatively, it may be determined whether it is necessary to perform the safety operation by comparing a maximum value of the deceleration of the other motorcycles **200** to the reference value. In addition, the safety operation is preferably performed at the stage where the motorcycle **100** travels straight, that is, at the stage before the motorcycle **100** is shifted to turn the curve. With such a configuration, the safety operation is performed in the situation where the rider relatively feels at ease, and thus the safety is improved. However, the safety operation may be performed at the stage where the motorcycle **100** turns the curve. Also, in such a case, the safety of the rider is improved.

[0039] In the case where, as the other vehicle travel state information, the position information about the other motorcycle **200** turning the curve is acquired and, for example, in the case where such information is information indicating that the other motorcycle **200** travels at a position where a distance from a lane boundary falls below a reference value, the safety operation execution section **53** determines that it is necessary for the motorcycle **100** to perform the safety operation. In particular, as the safety operation, at least one of the following is preferably executed: alerting the rider to the area in front of the motorcycle **100**; encouraging the rider to travel between the lines of the vehicles; or outputting the signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** automatically cancels or temporarily stops the currently-performed automatic cruise operation. The other vehicle travel state information is preferably the position information about the other motorcycles **200** turning the curve. With such a configuration, the accuracy of the determination is improved. It may be determined whether it is necessary to perform the safety operation by comparing an average value of the distances of the other motorcycles **200** from the lane boundary to the reference value. Alternatively, it may be determined whether it is necessary to perform the safety operation by comparing a minimum value of the distances of the other motorcycles **200** from the lane boundary to the reference value. In addition, the safety operation is preferably performed at the stage where the motorcycle **100** travels straight, that is, at the stage before the motorcycle **100** is shifted to turn the curve. With such a configuration, the safety operation is performed in the situation where the rider relatively feels at ease, and thus the safety is improved. However, the safety operation may be performed at the stage where the motorcycle **100** turn the curve. Also, in such a case, the safety of the rider is improved.

[0040] In the case where, as the other vehicle travel state information, information about the traveling direction of the other motorcycle **200** turning the curve is acquired and, for example, in the case where such information is information indicating that the other motorcycle **200** is changing the lane, the safety operation execution section **53** determines that it is necessary for the motorcycle **100** to perform the safety operation. In particular, as the safety operation, at least one of the following is preferably executed: alerting the rider to the area in front of the motorcycle **100**; encouraging the rider to change lanes; or outputting the signal to the automatic cruise execution section **52** so that the automatic cruise execution section **52** automatically cancels or temporarily stops the currently-performed automatic cruise operation. The other vehicle travel state information is preferably the information about the traveling directions of the other motorcycles **200** turning the curve. With such a configuration, the accuracy of the determination is improved. In the case where all the other motorcycles **200** are changing the lane, it may be determined that it is necessary to perform the safety operation. Alternatively, in the case where one of the other motorcycles **200** is changing the lane, it may be determined that it is necessary to perform the safety operation. In addition, the safety operation is preferably performed at the stage where the motorcycle **100** travels straight, that is, at the stage before the motorcycle **100** is shifted to turn the curve. With such a configuration, the safety operation is performed in the situation where the rider relatively feels at ease, and thus the safety is improved. However, the safety operation may be performed at the stage where the motorcycle **100** turns the curve. Also, in such a case, the safety of the rider is improved.

<Operation of Rider-Assistance System>

[0041] A description will be made on operation of the rider-assistance system according to the embodiment.

[0042] FIG. **3** is a chart of an example of a control flow by the controller in the rider-assistance system according to the embodiment of the present disclosure.

[0043] The controller **50** repeatedly executes the control flow illustrated in FIG. **3** while the automatic cruise operation is valid.

(Acquisition Step)

[0044] In step S**101**, the acquisition section **51** acquires the other vehicle travel state information that is the information about the travel state of the other motorcycle **200** turning the curve in the traveling direction of the motorcycle **100**.

(Automatic Cruise Execution Step)

[0045] In step S**102**, the automatic cruise execution section **52** controls the operation of each of the devices (the braking device **60**, the drive device **70**, and the like) mounted to the motorcycle **100**, so as to cause the motorcycle **100** to perform the automatic cruise operation.

(Safety Operation Execution Step)

[0046] In step S**103**, the safety operation execution section **53** determines whether it is necessary for the motorcycle **100** to perform the safety operation based on the other vehicle travel state information acquired in step S**101**. If determining that it is necessary, in step S**104**, the safety operation execution section **53** causes the motorcycle **100** to perform the safety operation.

Effects of Rider-Assistance System>

[0047] A description will be made on effects of the rider-assistance system according to the embodiment.

[0048] In the rider-assistance system **1**, the acquisition section **51** in the controller **50** acquires the other vehicle travel state information, which is the information about the travel state of the other motorcycle **200** turning the curve in the traveling direction of the motorcycle **100**, via the wire-

less communication. Then, the safety operation execution section **53** in the controller **50** causes the motorcycle **100**, which is performing the automatic cruise operation, to perform the safety operation based on the other vehicle travel state information acquired by the acquisition section **51**. Accordingly, in the automatic cruise operation under the situation where the lane is curved, it is possible to compensate for shortage of the amount of the information by acquiring unique information to the motorcycle. As a result, it is possible to appropriately assist the rider to drive the motorcycle **100**.

[0049] Preferably, in the rider-assistance system **1**, the other vehicle travel state information is the information about the travel states of the other motorcycles **200** turning the curve. With such a configuration, the accuracy of the determination on the necessity of the safety operation is improved. As a result, it is possible to appropriately assist the rider to drive the motorcycle **100**.

[0050] Preferably, in the rider-assistance system **1**, at the stage where the motorcycle **100** travels straight, the safety operation execution section **53** causes the motorcycle **100**, which is performing the automatic cruise operation, to perform the safety operation. With such a configuration, the safety operation is performed in the situation where the rider relatively feels at ease. As a result, it is possible to appropriately assist the rider to drive the motorcycle **100**.

[0051] Preferably, in the rider-assistance system **1**, the other vehicle travel state information includes the information about the speed of the other motorcycle **200**. For example, due to a fact that stability of body behavior of the motorcycle is lower than other types of vehicles (for example, a passenger car, a truck, and the like), the motorcycle tends to turn the curve at a unique speed. With such a configuration, it is possible to perform the safety operation, for which the speed generated to the other motorcycle **200**, that is, a unique driving tendency to the motorcycle on the curve is considered, with the sufficient amount of the information. As a result, driving assistance for the motorcycle **100** by the rider becomes further appropriate.

[0052] Preferably, in the rider-assistance system **1**, the other vehicle travel state information includes the information about the deceleration of the other motorcycle **200**. For example, due to the fact that the stability of the body behavior of the motorcycle is lower than the other types of the vehicles (for example, the passenger car, the truck, and the like), the unique deceleration tends to be generated to the motorcycle on the curve. With such a configuration, it is possible to perform the safety operation, for which the deceleration generated to the other motorcycle **200**, that is, the unique driving tendency to the motorcycle on the curve is considered, with the sufficient amount of the information. As a result, the driving assistance for the motorcycle **100** by the rider becomes further appropriate.

[0053] Preferably, in the rider-assistance system **1**, the other vehicle travel state information includes the position information about the other motorcycle **200**. For example, due to a fact that a vehicle width of the motorcycle is narrower than the other types of the vehicles (for example, the passenger car, the truck, and the like), the motorcycle can travel at a unique travel position on the curve. With such a configuration, it is possible to perform the safety operation, for which the travel position of the other motorcycle **200**, that is, the unique driving tendency to the motorcycle on the curve is considered, with the sufficient amount of the information. As a result, the driving assistance for the motorcycle **100** by the rider becomes further appropriate.

[0054] Preferably, in the rider-assistance system **1**, the other vehicle travel state information includes the information about the traveling direction of the other motorcycle **200**. For example, due to the fact that the vehicle width of the motorcycle is narrower than the other types of the vehicles (for example, the passenger car, the truck, and the like), the motorcycle can travel in a unique traveling direction on the curve. With such a configuration, it is possible to perform the safety operation, for which the traveling direction of the other motorcycle **200**, that is, the unique driving tendency to the motorcycle on the curve is considered, with the sufficient amount of the information. As a result, the driving assistance for the motorcycle **100** by the rider becomes further appropriate.

[0055] The present disclosure is not limited to the embodiment that has been described. For example, only a part of the embodiment may be implemented, or parts of the embodiment may be combined.

REFERENCE SIGNS LIST

[0056] **1**: Rider-assistance system
[0057] **10**, **210**, **310**: Surrounding environment detector
[0058] **20**: Input device
[0059] **30**, **130**: Travel state detector
[0060] **50**: Controller
[0061] **51**: Acquisition section
[0062] **52**: Automatic cruise execution section
[0063] **53**: Safety operation execution section
[0064] **60**: Braking device
[0065] **70**: Drive device
[0066] **80**: Notification device
[0067] **100**: Motorcycle
[0068] **200**: Another motorcycle
[0069] **300**: Vehicle around another motorcycle
[0070] **400**: Infrastructure equipment around another motorcycle

1. A controller (**50**) that is configured to maneuver a motorcycle (**100**), the controller comprising:
an automatic cruise execution section (**52**) that is configured to cause the motorcycle (**100**) to perform an automatic cruise operation;
an acquisition section (**51**) that is configured to acquire a state information of another motorcycle (**200**) via wireless communication, the state information of the other motorcycle (**200**) being information about a travel state of the other motorcycle (**200**) turning a curve in a traveling direction of the motorcycle (**100**); and
a safety operation execution section (**53**) that is configured to cause the motorcycle (**100**) to perform a safety operation in response to the state information of the other motorcycle (**200**) acquired by the acquisition section (**51**), the safety operation execution section (**53**) configured to cause the motorcycle (**100**) to perform the safety operation when the motorcycle (**100**) is performing the automatic cruise operation.

2. The controller according to claim **1**, wherein
the other motorcycle (**200**) is one of a plurality of other vehicles, and
the state information of the other motorcycle (**200**) is information about travel states of the plurality of other motorcycles turning the curve.

3. The controller according to claim 1, wherein
the safety operation execution section (53) causes the motorcycle (100) to perform the safety operation while the motorcycle (100) travels straight and performs the automatic cruise operation.

4. The controller according to claim 1, wherein
the state information of the other motorcycle (200) includes information about at least one of a speed, deceleration, a position, or a traveling direction of the other motorcycle (200).

5. The controller according to claim 1, wherein
the safety operation alerts a rider of the motorcycle (100) to an area in front of the motorcycle (100).

6. The controller according to claim 1, wherein
the safety operation alerts the rider of the motorcycle (100) to perform a decelerating operation.

7. The controller according to claim 1, wherein
the safety operation encourages the rider of the motorcycle (100) to reduce a setting value of a target speed during the automatic cruise operation.

8. The controller according to claim 1, wherein
the safety operation encourages the rider of the motorcycle (100) to travel between lines of vehicles.

9. The controller according to claim 1, wherein
the safety operation encourages the rider of the motorcycle (100) to change lanes.

10. The controller according to claim 1, wherein
the safety operation automatically reduces a speed of the motorcycle (100).

11. The controller according to claim 1, wherein
the safety operation automatically reduces a set value of a target speed which is set during the automatic cruise operation.

12. The controller according to claim 1, wherein
the safety operation automatically cancels or temporarily stops the automatic cruise operation when the automatic cruise operation is being executed.

13. The controller according to claim 1, wherein
the automatic cruise operation is an adaptive cruise control operation.

14. The controller according to claim 1, wherein
the automatic cruise operation is a cruise control operation.

15. A control method for maneuvering a motorcycle (100), the control method comprising:
executing (S102) an automatic cruise operation of the motorcycle (100) by using an automatic cruise execution section (52) included in a controller (50);
acquiring (S101) a state information of another motorcycle (200) via wireless communication by using an acquisition section (51) included in the controller (50), the state information of the other motorcycle (200) being information about a travel state of the other motorcycle (200) turning a curve in a traveling direction of the motorcycle (100); and
executing (S103, S104), by using a safety operation execution section (53) included in the controller (50), a safety operation of the motorcycle (100) in response to the state information of the other motorcycle (200) acquired in the acquisition step (S101), the safety operation execution section (53) configured to cause the motorcycle (100) to perform the safety operation when the motorcycle (100) is performing the automatic cruise operation.

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