Actuator System, Vehicle, Vehicle Control Method, And Non-Transitory Storage Medium

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present disclosure relates to an actuator system, a vehicle, a vehicle control method, and a non-transitory storage medium.

2. Description of Related Art

[0002] For example, a control device described in Japanese Unexamined Patent Application Publication No. 2020-032892 (JP 2020-032892 A) includes a request arbitration unit that arbitrates motion requests from a plurality of application request units on driver assistance. The request arbitration unit is included in a brake ECU, which is a control device used for controlling a brake of a vehicle. The application request units and the brake ECU (the request arbitration unit) are included in different ECUs. In other words, the application request units and the brake ECU can communicate with each other via inter-ECU communication.

SUMMARY OF THE INVENTION

[0003] In the control device described in JP 2020-032892 A, as above, the application request units and the brake ECU (the request arbitration unit) are included in different ECUs and can communicate with each other via the inter-ECU communication. For this reason, when a request (a kinematic plan) from the application request unit is transmitted to the request arbitration unit, the request (the kinematic plan) may be altered between the ECUs. Therefore, it is desirable to restrict the request (the kinematic plan) by an application from being altered.

[0004] The present disclosure provides an actuator system, a vehicle, a vehicle control method, and a non-transitory storage medium capable of restricting a request (a kinematic plan) by an application from being altered.

[0005] An actuator system according to a first aspect of the present disclosure

comprises a first actuator system configured to control an operation of a vehicle. The first actuator system includes at least one application configured to set a first kinematic plan for the vehicle and one or more processors including a first processor configured to arbitrate a plurality of kinematic plans including the first kinematic plan set by the at least one application and a second actuator system that is configured to set a second kinematic plan for the vehicle and is different from the first actuator system. The first processor is configured to execute an arbitration The plurality of kinematic plans arbitrated in the arbitration include the second kinematic plan set by the second actuator system in addition to the first kinematic plan set by the at least one application of the first actuator system.

[0006] As above, the actuator system according to the first aspect includes the application and the processors as an arbitration unit. Therefore, since the application and the arbitration unit are included in a common system (the actuator system), the arbitration unit can easily acquire a request (the kinematic plan) by the application without using communication. As a result, since the request (the kinematic plan) by the application is not altered during the communication, it is possible to restrict the request (the kinematic plan) by the application from being altered.

[0007] In the first aspect, the actuator system may further include an actuator configured to control driving of the vehicle and an electronic control unit configured to control an operation of the actuator. The electronic control unit may include the at least one application and the processors. With such a configuration, since the application and the arbitration unit are included in the common part (the electronic control unit as an actuator control unit) of the actuator system, the arbitration unit can more easily acquire the request (the kinematic plan) by the application without using the communication. As a result, it is possible to restrict the request (the kinematic plan) by an application from being altered.

[0008] In the first aspect, the actuator system may further include an actuator configured to control driving of the vehicle and an electronic control unit configured to control an operation of the actuator. The actuator may include a power train. With such a configuration, it is possible to restrict the request (the kinematic plan) from the actuator system (a power train system) that controls the power train from being altered.

[0009] In the first aspect, the at least one application may include an application used for limiting a velocity of the vehicle. With such a configuration, it is possible to restrict the request (the kinematic plan) that limits the velocity of the vehicle from being altered.

[0010] A vehicle according to a second aspect of the present disclosure includes a

vehicle body, a first actuator system configured to control an operation of the vehicle body and including at least one first application and a first processor, and a third actuator system that is configured to set a third kinematic plan for the vehicle and is different from the first actuator system. The first application is configured to set a first kinematic plan for the vehicle, and the first processor is configured to arbitrate a plurality of kinematic plans including the first kinematic plan. The first processor is configured to execute a second arbitration. The plurality of kinematic plans arbitrated in the second arbitration includes the third kinematic plan set by the third actuator system in addition to the first kinematic plan set by the first application of the first actuator system.

[0011] As above, the vehicle according to the second aspect includes the at least one application and a processor as an arbitration unit that arbitrates the plurality of kinematic plans including the kinematic plan set by the at least one application. Therefore, since the first application and a first arbitration unit are included in a common system (a first actuator system), the first arbitration unit can easily acquire a request (the kinematic plan) by the first application without using communication. As a result, it is possible to restrict the request (a first kinematic plan) by the first application from being altered.

[0012] In the second aspect, the vehicle may further include a second application configured to set a second kinematic plan for the vehicle, and a second actuator system that is configured to control the operation of the vehicle body and is different from the first actuator system. The first processor may be configured to execute a first arbitration, and the second actuator system may include a second processor configured to arbitrate an arbitration result by the first arbitration of the first actuator system and the second kinematic plan set by the second application. With such a configuration, a result of the arbitration of the request of the second application by the second processor as a second arbitration unit is input in a predetermined system to which the kinematic plan by the second application is transmitted without directly inputting the request (the kinematic plan) of the second application. As such, even when the number of requests (the second kinematic plans) by the second application is increased, it is not required to increase the number of interfaces between the second arbitration unit and the predetermined system. In other words, it is

possible to integrate the interface between the second actuator system and the predetermined system into an interface between the second arbitration unit and the predetermined system. As a result, even when the number of requests (the second kinematic plans) by the second application is increased, it is possible to restrict a configuration of the vehicle from becoming complicated.

being executed based on the abnormality in the first processor.

[0013] A third aspect of the present disclosure is a vehicle control method using a first actuator system configured to control an operation of a vehicle and a second actuator system different from the first actuator system. The vehicle control method includes receiving a plurality of kinematic plans including a first kinematic plan set by at least one application included in the first actuator system and a second kinematic plan for the vehicle set by the second actuator system, and arbitrating, by one or more processors including a first processor included in the first actuator system, the received plurality of kinematic plans in the receiving. The first processor is configured to execute an arbitration. The plurality of kinematic plans arbitrated in the arbitration include the second kinematic plan set by the second actuator system in addition to the first kinematic plan set by the at least one application of the first actuator system.

[0014] As above, in the vehicle control method according to the third aspect, the plurality of kinematic plans including the kinematic plans set by at least one application included in the actuator system is received, and the plurality of kinematic plans is arbitrated by the processor, as the arbitration unit, included in the actuator system. Therefore, since the first application and a first arbitration unit are included in a common system (a first actuator system), the first arbitration unit can easily acquire a request (the kinematic plan) by the first application without using communication. As a result, it is possible to provide the vehicle control method in which it is possible to restrict the request (the first kinematic plan) by the first application from being altered.

[0015] A fourth aspect of the present disclosure is a non-transitory storage medium storing instructions that are executable by a computer and that cause the computer to perform functions. The functions include receiving a plurality of kinematic plans including a first kinematic plan set by at least one application included in a first actuator system configured to control an operation of a vehicle and a second kinematic plan for the vehicle set by a second actuator system different from the first actuator system, and arbitrating, by one or more processors including a first processor included in the first actuator system, the received plurality of kinematic plans in the receiving. The first processor is configured to execute an

arbitration. The plurality of kinematic plans arbitrated in the arbitration include the second kinematic plan set by the second actuator system in addition to the first kinematic plan set by the at least one application of the first actuator system.

[0016] As above, in the non-transitory storage medium according to the fourth aspect, the instructions that cause the computer to receive the plurality of kinematic plans including the kinematic plan set by at least one application included in the actuator system, and arbitrate, by the processor as an arbitration unit included in the actuator system, the plurality of kinematic plans are stored. Therefore, since the first application and a first arbitration unit are included in a common system (a first actuator system), the first arbitration unit can easily acquire a request (the kinematic plan) by the first application without using communication. As a result, it is possible to provide the non-transitory storage medium in

CLAIMS

1. An actuator system comprising:

a first actuator system configured to control an operation of a vehicle, the first actuator system comprising:

at least one application configured to set a first kinematic plan for the vehicle; and

one or more processors including a first processor configured to arbitrate a plurality of kinematic plans including the first kinematic plan set by the at least one application; and

a second actuator system that is configured to set a second kinematic plan for the vehicle and is different from the first actuator system, wherein:

the first processor is configured to execute an arbitration; and

the plurality of kinematic plans arbitrated in the arbitration include the second kinematic plan set by the second actuator system in addition to the first kinematic plan set by the at least one application of the first actuator system.

2. The actuator system according to claim 1, further comprising:

an actuator configured to control driving of the vehicle; and

an electronic control unit configured to control an operation of the actuator,

wherein the electronic control unit includes the at least one application and the processors.

3. The actuator system according to claim 1 or 2, further comprising:

an actuator configured to control driving of the vehicle; and

an electronic control unit configured to control an operation of the actuator,

wherein the actuator includes a power train.

4. The actuator system according to claim 3, wherein the at least one application

includes an application used for limiting a velocity of the vehicle.

5. A vehicle characterized by comprising:

a vehicle body;

a first actuator system configured to control an operation of the vehicle body and including at least one first application and a first processor, the first application being configured to set a first kinematic plan for the vehicle and the first processor being configured to arbitrate a plurality of kinematic plans including the first kinematic plan; and

a third actuator system that is configured to set a third kinematic plan for the vehicle and is different from the first actuator system, wherein:

the first processor is configured to execute a second arbitration; and

the plurality of kinematic plans arbitrated in the second arbitration includes the third kinematic plan set by the third actuator system in addition to the first kinematic plan set by the first application of the first actuator system.

6. The vehicle according to claim 5, further comprising:

a second application configured to set a second kinematic plan for the vehicle; and

a second actuator system that is configured to control the operation of the vehicle body and is different from the first actuator system, wherein:

the first processor is configured to execute a first arbitration; and

the second actuator system includes a second processor configured to arbitrate an arbitration result by the first arbitration of the first actuator system and the second kinematic plan set by the second application.

7. The vehicle according to claim 6, further comprising a driver assistance system configured to set a driver assistance kinematic plan on driver assistance of the vehicle,

wherein the driver assistance system is configured to set the driver assistance kinematic plan based on an arbitration result by the second processor.

8. The vehicle according to claim 5, wherein the first processor is configured to:

determine whether the first kinematic plan set by the first application is normal and execute, upon determining that the first kinematic plan is not normal, first processing for rejecting or changing the first kinematic plan;

determine whether the third kinematic plan set by the third actuator system is normal and execute, upon determining that the third kinematic plan is not normal, second processing for rejecting or changing the third kinematic plan; and

arbitrate, in the second arbitration, a result processed by the first processing and a result processed by the second processing.

9. A vehicle control method using a first actuator system configured to control an operation of a vehicle and a second actuator system different from the first actuator system, the vehicle control method comprising:

receiving a plurality of kinematic plans including a first kinematic plan set by at least one application included in the first actuator system and a second kinematic plan for the vehicle set by the second actuator system; and

arbitrating, by one or more processors including a first processor included in the first actuator system, the received plurality of kinematic plans in the receiving, wherein:

the first processor is configured to execute an arbitration; and

the plurality of kinematic plans arbitrated in the arbitration include the second kinematic plan set by the second actuator system in addition to the first kinematic plan set by the at least one application of the first actuator system.

10. A non-transitory storage medium storing instructions that are executable by a computer and that cause the computer to perform functions characterized by comprising:

receiving a plurality of kinematic plans including a first kinematic plan set by at least one application included in a first actuator system configured to control an operation of

a vehicle and a second kinematic plan for the vehicle set by a second actuator system different from the first actuator system; and

arbitrating, by one or more processors including a first processor included in the first actuator system, the received plurality of kinematic plans in the receiving, wherein:

the first processor is configured to execute an arbitration; and

the plurality of kinematic plans arbitrated in the arbitration include the second kinematic plan set by the second actuator system in addition to the first kinematic plan set by the at least one application of the first actuator system.