There are sensors known for measuring the tilt of a payload. Such a complicated sensor is disclosed for instance in J. Winterflood, Z.B. Zhou, L. Lu and D.G. Blair, *Tilt suppression for ultra-low residual motion vibration isolation in gravitational wave detection*, Physics Letter A 277 (2000) pp. 143-155. This specially designed sensor comprises a laser beam that is bounced forth and back between mirrored surfaces into a quadrant photo-diode. Such a sensor can be applied in an active vibration system but it does not provide a relatively simple solution.

It is an objective of the present invention to provide an active vibration isolation and damping system with an improved isolation of the payload from disturbing vibration imposed by the environment on the payload and an improved damping of vibrations of the payload.

The objective of the invention is obtained by a system as defined above comprising a vibration sensor having a low stiffness connection to the payload for rotation along an axis perpendicular to the gravitational force, and having a high stiffness connection to the payload for the vibration detectable with the vibration sensor.

According to a first aspect of the present invention, there is provided an active vibration isolation and damping system comprising a payload that has to be isolated or damped, a vibration sensor for detecting a vibration of the payload, an actuator for moving the payload relative to a bearing body supporting the payload, and a controller for providing the actuator with a signal that is representative for the vibration, **characterized in that** the vibration sensor has a low stiffness connection to the payload for rotation along an axis perpendicular to the gravitational force, and a high stiffness connection to the payload for the vibration detectable with the vibration sensor.

According to a second aspect of the present invention, there is provided an active vibration isolation and damping system in accordance with the first aspect, **characterized in that** the system comprises at least one additional vibration sensor for detecting vibrations.

The effect of the low stiffness connection to the payload for rotation along an axis perpendicular to the gravitational force is that a tilting of the payload will not result in an additional force on the vibration sensor in the direction of the measurement. So actually the sensor is decoupled from tilting vibrations. In an active vibration system according to the state of the art, the additional force will be interpreted as a vibration with a degree of freedom different from the rotation. In such an active vibration isolation system comprising a vibration sensor that is designed to measure for instance horizontal vibrations, the tilting vibration will, erroneously, be interpreted as a horizontal vibration of the payload. As a consequence, the controller of the system according to the state of the art will give a signal to a horizontal actuator to displace the payload horizontally. The decoupling according to the invention prevents such an erroneous displacement.

The present invention is based on the insight that a further improvement of already known active vibration isolation systems is possible when the movement of the

Claims

1. An active vibration isolation and damping system ~~(11)~~ comprising
- a payload ~~(12)~~ that has to be isolated or damped,
- a vibration sensor ~~(14)~~ for detecting a vibration of the payload,
- an actuator ~~(15)~~ for moving the payload relative to a bearing body ~~(13)~~ supporting the payload, and
- a controller ~~(16)~~ for providing the actuator with a signal that is representative for the vibration,

characterized in that the vibration sensor ~~(14)~~ has
- a low stiffness connection to the payload ~~(12)~~ for rotation along an axis ~~(17)~~ perpendicular to the gravitational force ~~(18)~~, and
- a high stiffness connection to the payload ~~(12)~~ for the vibration detectable with the vibration sensor.

2. A system according to claim 1, wherein the vibration sensor ~~(14)~~ has a high stiffness connection to the bearing body ~~(13)~~ for rotation along an axis ~~(17)~~ perpendicular to the gravitational force ~~(18)~~.

3. A system according to claim 1 or 2, wherein at least one of the degrees of freedom of the vibration sensor ~~(14)~~ is connected with a high stiffness to the payload ~~(12)~~.

4. A system according to claim 1 or 2, wherein at least one of the degrees of freedom of the vibration sensor ~~(14)~~ is connected with a high stiffness to the bearing body ~~(13)~~.

5. A system according to claim 2 wherein the high stiffness connection comprises an auxiliary mass ~~(57)~~ being connected with a first rotational stiffness to the sensor ~~(53)~~ and with a second rotational stiffness to the bearing body ~~(13)~~.

6. An active vibration isolation and damping system according to any of the preceding claims, **characterized in that** the system comprises at least one additional vibration sensor ~~(25)~~ for detecting vibrations.

7. A system according to claim 6, wherein the vibration sensor ~~(24)~~ is suitable for measuring vibrations perpendicular to the gravitational force and the additional sensor ~~(25)~~ is suitable for measuring vibration in the direction of the gravitational force.

8. A system according to claim 6 or 7, wherein at least one of the vibration sensors ~~(14, 24, 25)~~ comprises an inertial reference mass.

9. A system according to any of the preceding claims wherein the actuator ~~(15)~~ is a Lorentz actuator.