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NASA TECH BRIEF

Ames Research Center

Suppression of Bending Motion in Elastic Bodies

The problem:

Undesirable bending motion occurs in large structures, such as aircraft frames or space vehicles, because they are not completely rigid and hence behave as elastic beams. In aircraft, the bending motion can result in noise and vibration which is unpleasant for travelers and crew; in space vehicles, undesired components may be produced in the motion signals supplied from sensors, and manual or automatic control is made more difficult.

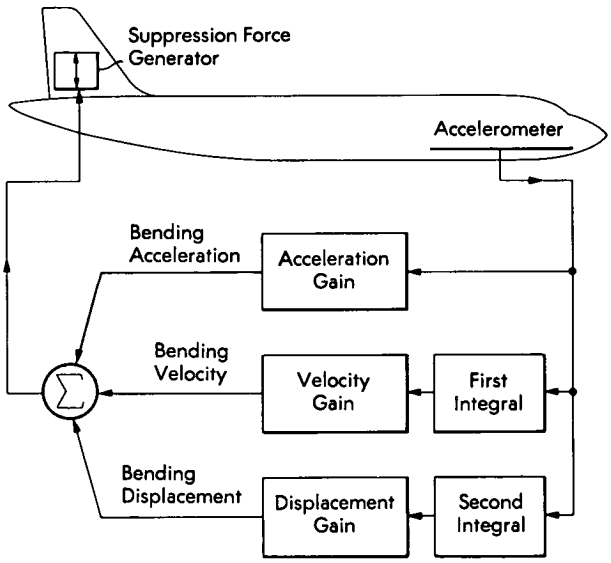
The solution:

Analyze the bending motion of the elastic body and apply a corrective force of the body to attenuate or suppress the undesired motion.

How it's done:

As suggested by the diagram, a sensor such as an accelerometer may be located on an aircraft at such a point that there can be extracted an output signal which is a function of the acceleration of the aircraft. The sensor signals are fed to networks which generate first integrals of the acceleration signals to produce an output which is proportional to the bending velocity and the bending displacement of the aircraft at the site of the sensor. The output from the sensors and the integrators is then used to generate one or more suppression forces which may be applied anywhere along the structure, but nodal points should be avoided.

For simplicity, the diagram shows only one sensor; however, if the aircraft is undergoing both bending motion and rigid-body motion, it will be necessary to isolate the bending motion components. In practice, a number of motion sensors is used, and the acceleration, velocity, and displacement signals obtained from the sensors and integrators are supplied to associated controllable gain networks (feedback loops), where the signals are operated on by processing functions determined from the modal characteristic of the aircraft. The modified signals are supplied to a summing



device where they are combined to produce the output signal which controls application of suppression forces. The suppression force generator may be of any suitable type which can apply the required force in response to the controlling signal; for example, the force may be obtained from the jet engines of an aircraft, or from controlled flow of compressed air. In these instances, the force generation system would consist of a valve to control the jet flow, or the release of compressed air, and a hydraulic actuator to move the valve in response to command signals; the position of the valve would determine the magnitude of the forces generated.

(continued overleaf)

Note:

No additional documentation is available. Specific questions, however, may be directed to:

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Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,412,961). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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