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# COMPENSATION OF UMBILICAL STIFFNESSES AND DECREASED CROSS-TALK OF MECHANICAL DECOUPLING SYSTEMS THROUGH 3D ANTISPRINGS.

**Abstract**

Many microgravity experiments require mechanical decoupling systems to minimize vibrations and pertubations. Different passive and active systems were developed for all kind of $\mu$g -plattforms during the last decades.

The quality and useability of decoupling systems depends mainly on the following factors: Cut-off frequency, damping rate at the natural frequencies and the decoupling quality in the overcritical regions. The useability of passive decoupling systems, as basis for multi dimensional active systems, depends additionally on their cross-talk tendencies which may overburden the PID controller. Most experiments require umbilicals for power supplies, data lines and other media. Those umbilicals short-out the decoupling mechanism by transporting and inducing vibrations into the decoupled parts.

The new approach introduces spring-antispring systems and takes all mentioned potential sources of perturbations into account. Currently spring-antispring systems are commonly used in low-frequency seismic attenuation systems. While existing seismic attenuation systems usually are able to decouple one degree of freedom per system, for microgravity applications a 3D system is required.

A combination of several pre-stressed springs, whose forces act against each other, allow to adjust the resulting stiffness, even down to negativ stiffnesses. Therewith a dedicated design of umbilicals enables their use as springs as parts of a spring-antispring-system. Using geometrically attenuated pads of elastic materials as springs a low-stiffness-region emerges. In this region a nearly free positioning of the payload with very low crosstalk is achieved.

In this paper this new 3D spring-antispring system is presented in detail. Passive decoupling systems for microgravity applications based on this new approach and different materials were investigated and evaluated regarding their applicability.