

Inerter-Based Devices for vibration mitigation

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Abstract

Unwanted vibrations occur in a range of important engineering application areas. For example, in civil engineering, tall buildings and structures can suffer from vibrations caused by earthquakes, tsunamis or strong winds. In the most severe cases, the human and economic consequences can be devastating. One of the most useful state-of-the-art techniques engineers can use to guard against this type of problem is called the *tuned-mass-damper*. It is based on an idea patented by Hermann Frahm in 1909. Although many modifications and minor improvements to Frahm's idea have been suggested, nothing fundamentally changed until the advent of the *inerter*. The term inerter was first coined by Malcolm Smith in Cambridge to represent a mechanical device that produced an inertia force from a relative acceleration. In fact, these type of devices had previously been known about for a range of other mechanical and civil engineering applications, but by different names.

In automotive and aerospace applications the inerter was used primarily as a vibration isolator, for example in engine mounts of cars, and helicopters. This is because unwanted noise and vibrations from the engine (i.e. in cars and helicopters) are not wanted in the passenger cabin of these vehicles. Inerter based isolation devices, (for example hydramounts), are used to try and minimise the amount of unwanted vibration that is transmitted to the passenger cabin, a technology that is still the state-of-the-art. Smith and co-workers also developed the inerter concept for automotive applications, particularly suspension systems, with McLaren Formula-1 to great success, and they are now available commercially as in performance motorsport.

The introduction of the inerter is the most exciting thing to happen in this research field for 100 years! In this talk, we will discuss the history and development of the inerter, including applications to a range of engineering problems. Specifically, we will discuss the concept of the *tuned-inerter-damper* which is a direct analogy to the tuned-mass-damper, along with other inerter based devices. We will also discuss, different types of inerter, and highlight some of the latest research developments and test results.