

## **Inerter Nonlinearities and the Impact on Suspension Control**

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### **Abstract**

This paper discusses the nonlinear properties of Inerters and their impact on vehicle suspension control. The Inerter was recently introduced as an ideal mechanical two-terminal element which is a substitute for the mass element with the applied force proportional to the relative acceleration across the terminals. Until now, ideal Inerters have been applied to car, motorcycle and train suspension systems, in which significant performance improvement was achieved. However, due to the mechanical construction, some nonlinear properties of the existing mechanical Inerter models are noted. This paper investigates the Inerter nonlinearities, including friction, backlash and the elastic effect, and their influence on vehicle suspension performance. A testing platform is also built to verify the nonlinear properties of the Inerter model. It is shown from the results that the suspension performance is in general degraded by inerter nonlinearities. However, the overall suspension performance with inerters is still better than the traditional suspensions.