Department of Mechanical and Materials Engineering

SENIOR DESIGN ORGANIZATION SYNOPSIS – SPRING 2013

ACTIVE/PASSIVE DAMPING SOLID SHOCK ABSORBING

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By clever use of material properties Team Vibranium will design an adjustable suspension system with a focus on the shock absorber. The shock absorber will not be based on the traditional strut design as Nitinol™ springs will be replace the working fluid. Because Nitinol™ can exist as a Super-Elastic Alloy (SEA) and Shape Memory Alloy (SMA) Team Vibranium will also attempt to vary the damping characteristics of the system by altering the crystalline structure from austenitic to martensitic states by application of heat.

The objective is to design an active and passive solid shock absorber for the SAE car, and other applications including but not limited to: earthquake damping systems, isolation tables, and other systems that require isolation from undesired frequencies. The project will be divided into the following four main phases:

Phase I (Material Selection Phase): A rough estimate of working load was established and specific material properties of current automotive springs were analyzed and a literature survey was performed to determine the feasibility of the use of Nitinol.

Phase II (Design Phase): The design of a Macpherson Strut was analyzed and initial conceptual designs were posited based on pre-determined constraints. One of the aforementioned constraints was the desire for the shock absorber to be compatible with existing hardware and to be comparable to the dimensions of existing shock absorbers.

Phase III (Analysis Phase): Analysis will consist of static, dynamic, frequency, and fatigue analysis in SolidWorks and ANSYS. The results will be examined to ensure the stability, reliability, and effectiveness of the system.

Phase IV (Manufacturing & Testing Phase): Once the design has decided to be implemented the raw materials will be ordered from various vendors, and manufacturing/machining quotes will be obtained for the fixtures and the final product and then selected by lowest cost. The prototype will be tested by introducing varying frequencies into the system and measuring the ratio of the output vs. input amplitude and frequencies. By doing so a dimensionless parameter that provides the effectiveness of damping will be obtained. Once these tests have been performed a transfer function will be generated and analyzed in order to establish the effectiveness of the system. Based on the results revisions/implementations will be decided.

- Confirm proof of concept for solid shock absorber and variable damping “settings”
- Decrease of the transmissibility of vibrations through the system
- Optimize the chemical composition of the Ti-Ni or ternary alloy for characteristics of a spring
- Produce successful prototype that leads to a multi-million dollar patent