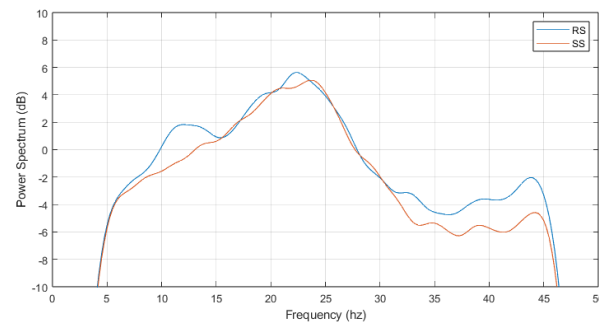
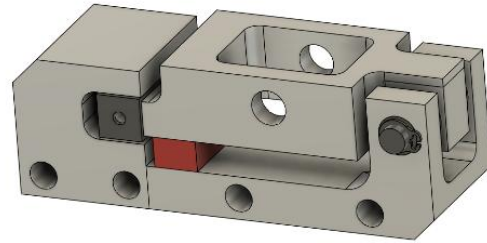


DESIGN, FABRICATION, AND TESTING OF A DUAL-RATE SPRING SYSTEM FOR MOUNTAIN BIKE FRAMES

A Master's Thesis Defense in Mechanical Engineering
California Polytechnic State University, San Luis Obispo
Presented By: Lucas Grizzle

Thursday June 5th, 2025, 1:10 PM, Building 13 Room 124b

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The design of full-suspension mountain bikes is a careful balance of suspension kinematics, structural dynamics, and manufacturing optimization for the expected use case. A bike designed to excel in one area will likely exhibit reduced performance in others. This thesis addresses this optimization problem by designing, integrating, and testing a dual-rate spring system within a fully custom frame. The dual-rate spring is fully decoupled from the rest of the suspension kinematics, providing designers with an additional parameter to achieve ideal suspension behavior. This is accomplished by placing a thermoplastic polyurethane (TPU) bushing in series with the rear shock. The influence of this bushing is limited to the first 30% of suspension travel by use of bump stops. The design and manufacturing of the test platform are covered. The viscoelastic behavior of the TPU bushing is analyzed and its effects on the vibratory response of the theoretical system is studied. Testing methodology is covered, and frequency analysis is used to determine the efficacy of the design.

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