# Nonlinear Dynamic Analysis of Structures with Hyperelastic Devices

by

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(ABSTRACT)

This thesis presents the results of an investigation of a multiple degree of freedom (MDOF) structure with hyperelastic bracing using nonlinear and incremental dynamic analysis. New analytical software is implemented in the investigation of the structure, and the study seeks to investigate the effectiveness of hyperelastic bracing as a seismic protection device. Hyperelastic braces incorporate a new idea of a nonlinear elastic material that gains stiffness as the brace deforms. Structural behaviors of particular concern for an MDOF frame are stability, residual displacement, base shear, and dispersion. The structure is analyzed under two ground motion records of varying content, and for two separate P-Delta cases of varying severity. Two sets of hyperelastic braces are investigated for their influence under the two ground motions and two P-Delta cases. Each scenario is analyzed using nonlinear dynamic analyses to investigate the response histories, and Incremental Dynamic Analysis (IDA) to investigate dispersion and the behavior of specific response measures as ground motion intensity increases. IDA curves are created for interstory drift and base shear for comparison between the two response measures. The research shows that the inclusion of hyperelastic braces in the MDOF frame improves the overall stability of the structure and reduces the amount of dispersion and residual displacement. The hyperelastic braces are shown to give positive performance characteristics while not detrimentally increasing system forces under regular service loads. The results highlight the benefit of the unique stiffening properties of hyperelastic braces as a seismic protection device.

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# Table of Contents

# List of Figures

# List of Tables

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