This research addresses various models of a spring-mass system that uses a spring made of a shape memory alloy (SMA). The system model describes the martensite fractions, which are values that describe an SMA’s crystalline phases, via differential equations. The model admits and this thesis contrasts two commonly used but distinct assumptions: a homogeneous case where the martensite fractions are constant throughout the spring’s cross section, and a bilinear case where the evolution of the martensite fractions only occurs beyond some critical radius. While previous literature has developed a model of the system dynamics under the homogeneous assumption using the martensite fraction differential equations, little research has focused on the dynamics when considering the bilinear case, especially using the differential equations. This thesis models the system dynamics under both the homogeneous and bilinear assumptions and determines which assumption better captures the reality of the system dynamics. The research develops a numerical approach of the system dynamics for both martensite fraction assumptions. For various initial displacements and temperatures, plotting the resulting displacement, velocity, and martensite fractions over time determines the coherence of the assumptions. Not only did the bilinear assumption offer more reasonable plots, but the homogeneous assumption failed to deliver realistic plots for certain temperatures and initial displacements. For future research, a fully nonlinear case can replace the homogeneous and bilinear assumptions. Additionally, future research can utilize other martensite fraction evolution models, as opposed to differential equations.

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The public is welcome to attend.