**Effects of Fuselage and Seat Compliance on System Crashworthiness: a Preliminary Investigation**

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## Introduction

During a crash-type event, the seat and fuselage response can significantly affect the risk of injury experienced by aircraft occupants. However, it is unclear which factors governing the overall seat and fuselage response are most important for occupant safety (e.g. initial stiffness, stroke distance, plasticity, etc.). Understanding these factors can help guide future seat and fuselage design in aircraft. The goal of this investigation is to evaluate the effects of seat and fuselage response variables have on occupant injury risk and determine which factors deserve the most consideration during the design process.

## Methods

Simplified models describing the seat and fuselage response were created and combined with a commercial dummy model (Humanetics, H3, 50$^{th}$ percentile) (Figure 1). Acceleration data from drop and sled tests were utilized to estimate reasonable force-displacement curves for the fuselage and seat respectively, which were parameterized using polynomial fits. These fit parameters, along with values for seat stroke, maximum fuselage crush, fuselage mass, and seat mass serve as modifiable input parameters within our finite element model (Figure 1, left). This finite element model was used in a sensitivity study to determine the effects of these parameters on lumbar spine loads and DRIz values, which are common occupant injury criteria.

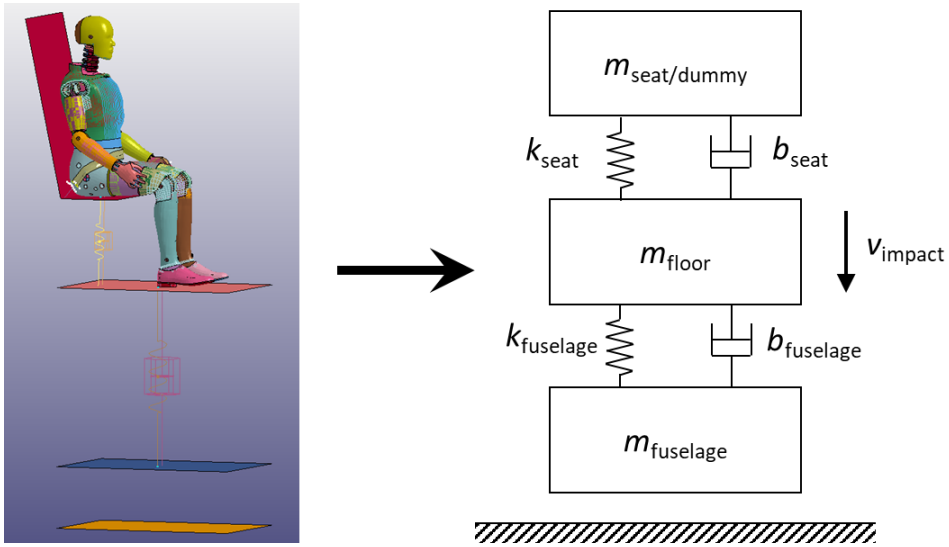


Figure 1. Left: finite element model of a simple fuselage, seat, occupant drop test. Right: mathematical schematic of the finite element model.

## Results and Discussion

Small floor mass, stiff initial fuselage response, and a stiff seat resulted in the highest DRIz values and lumbar loads (stiff being relative to the average taken from the drop test data). Having a larger stroke and a more compliant fuselage response resulted in the lowest DRIz and lumbar loads experienced by the dummy. These results are preliminary and are based on data from only one drop test. Current work is focused on incorporating more drop test data into our statistical representation of possible input values.