

# Model-Aided Design of a Rear-Impact Collision Testing System for *in-vivo* Investigations

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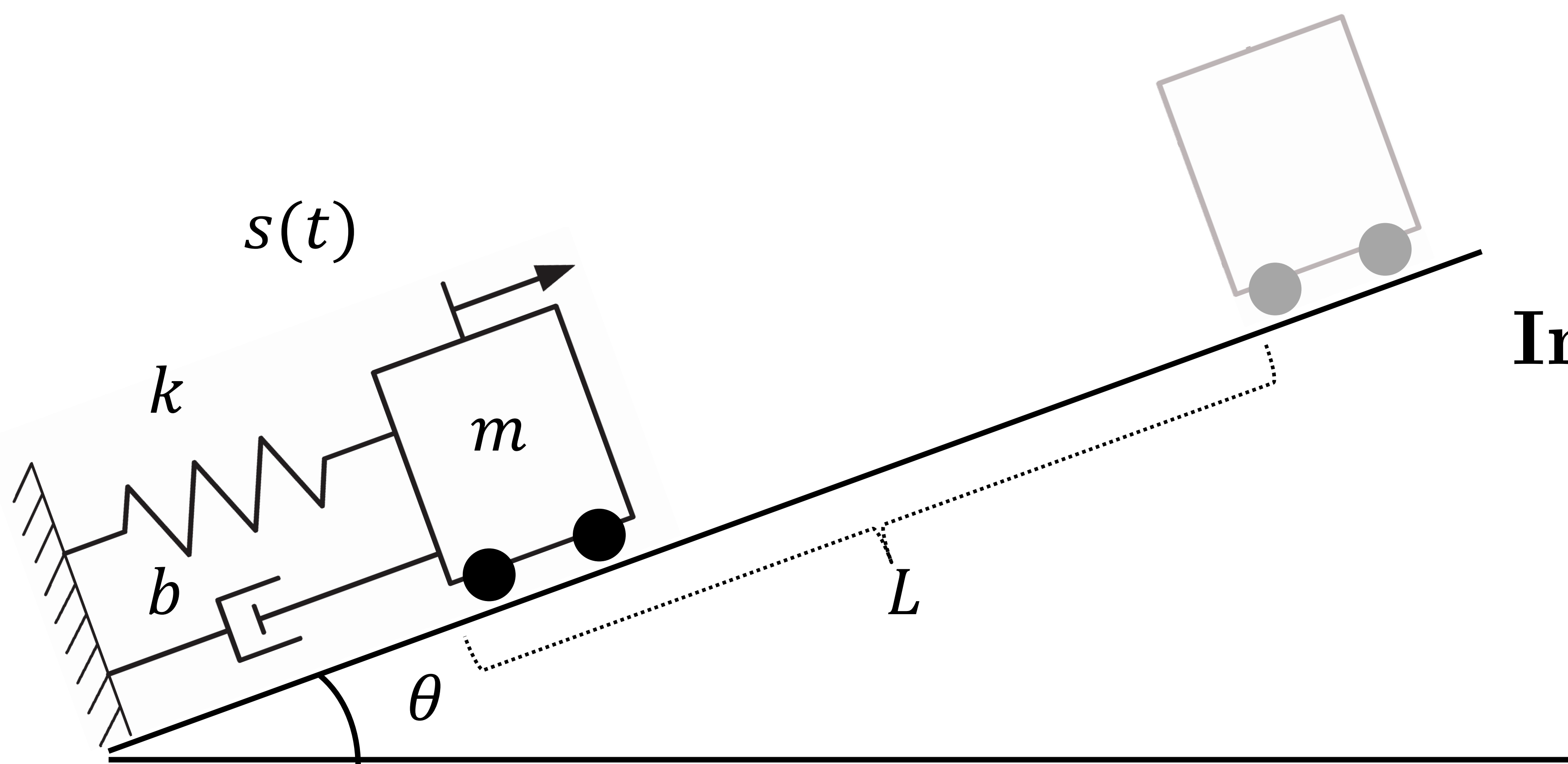


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A simple mechanical model of a rear-impact collision testing system was able to successfully aid in the design of a test system for *in-vivo* volunteers.

## Simple Model:



## Equation of Motion:

$$m \ddot{s} + b \dot{s} + ks = -mg(\sin \theta - \mu \cos \theta)$$

## Initial Conditions:

$$\begin{cases} s(0) = 0 \\ \dot{s}(0) = -\sqrt{2Lg(\sin \theta - \mu \cos \theta)} \end{cases}$$

**Table 1:** Estimated Design parameters values from least-squares. These were calculated as the design parameters which minimized the normalized-squared error between the estimated impact parameters and the desired impact parameters.

Parameter	Stiffness	Damping	Ramp Length	Angle
Value	31991 N/m	593.78 Ns/m	1.12 m	5.8°

**Table 2:** Comparison of the desired impact parameters to those estimated from the model, to those measured from impact testing.

Variable	Desired Value	Estimated Value	Measured Value
Duration	135 ms	123.5 ms	107 ms
Restitution	0.60	0.599	0.511
Max Acceleration	3.5 g	3.3 g	3.99 g
Delta-V	7 km/h	7.99 km/h	7.26 km/h

## REFERENCES

Argatov, I.I., 2013, Triobol. Int. **63**, pp. 213-225  
Siegmund, G.P., et al., 2001, Stapp Car Crash J. **45**(November), pp. 239-256.



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