Use of Smart Rocks to Improve Rock Slope Design

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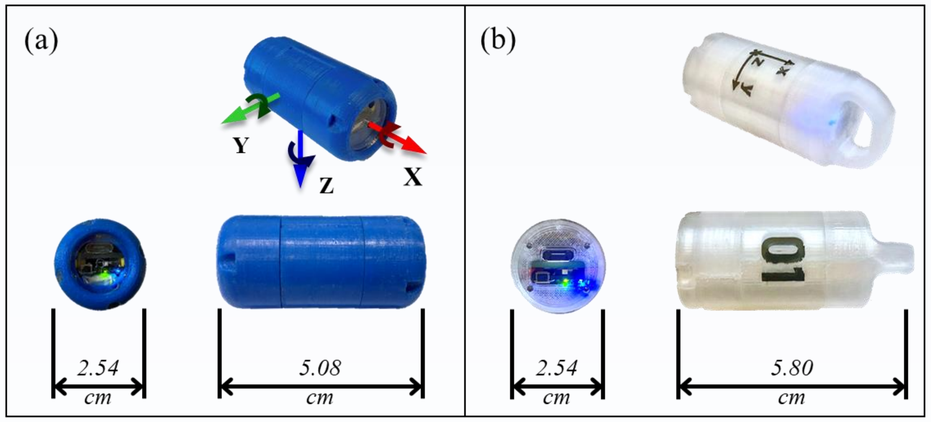
BACKGROUND

Extensive research conducted at UNH developed a Smart Rock (SR) sensor, capable of instrumenting field and laboratory rockfall experiments to better understand rockfall mechanics.



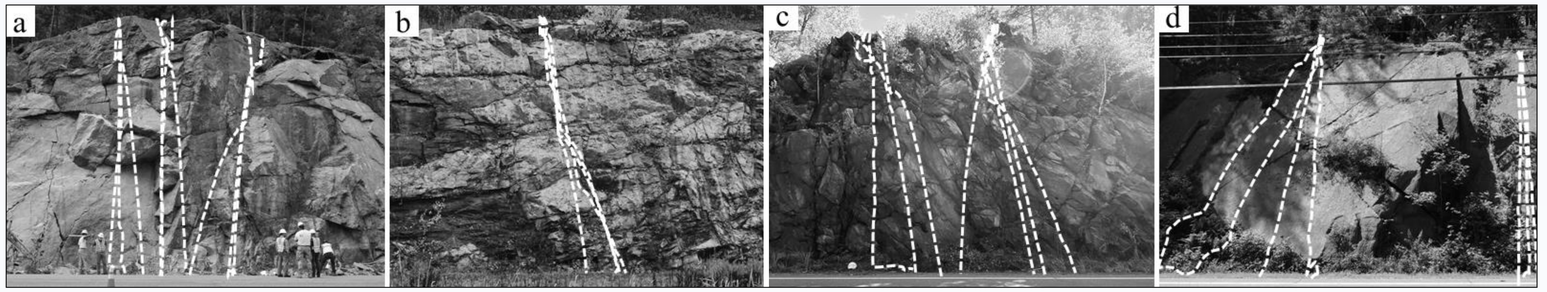
Smart Rock sensors

Observations from 85 instrumented rockfalls at 10 sites in NH.
SR and video measurements were obtained for each test.

Change in parameter	Acceleration	Impact force	Block rotation	Lateral dispersion	Runout distance
Increase block mass	↓	↑	↓	-	-
Decrease slope angle	↑	↑	↑	↑	↑
Increase slope height	↑	↑	-	-	-
Increase rotation	-	-	-	↑	↑
Slope irregularities	↑	↑	↑	↑	↑
Stiffer impact surfaces	↑	↑	↓	↑	↑

CONCLUSIONS

The protective design against rockfall events must primarily account for the slope conditions and expected rockfall modes of motion, verified for different slope configurations typically encountered in NH. The SR data can be used to estimate impact forces and block rotational kinetic energies leading to safer design for motorists across the state.

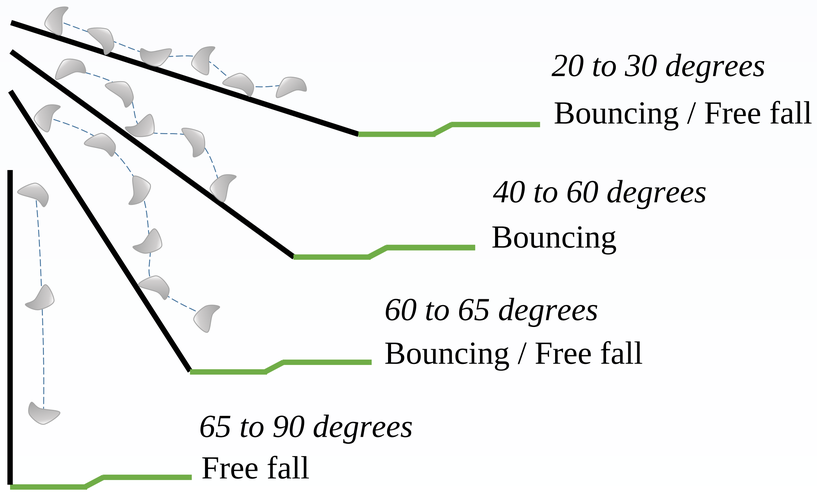


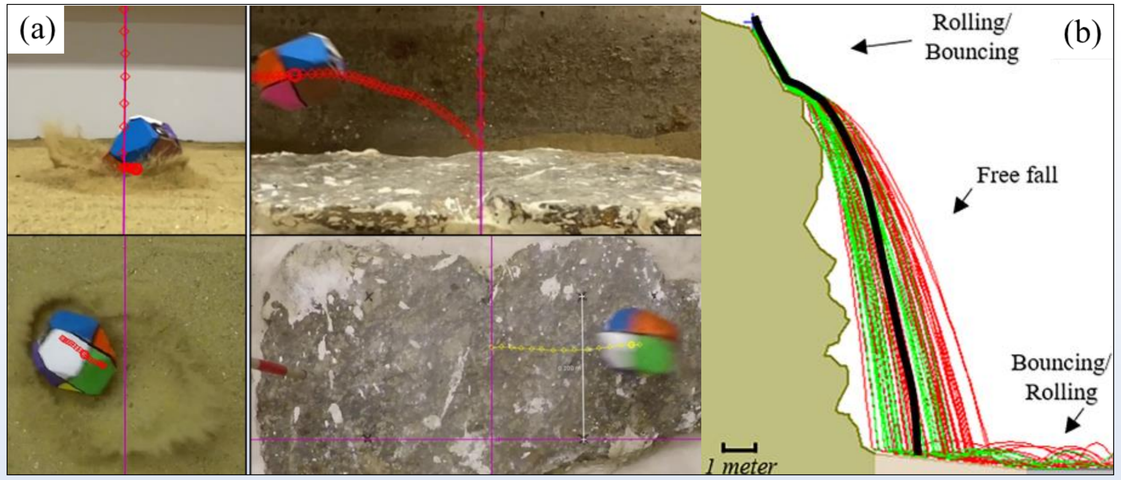
Rockfall trajectories at different site locations

Smart Rocks

- 3-axis accelerometers: ± 16 g and ± 400 g
- 3-axis gyroscope: ± 4000 dps
- Altimeter

The Smart Rock output patterns can be used to characterize the motion of a falling rock:





(a) Laboratory experiments and (b) model simulations with laboratory parameters

Detailed test trajectory