Computer simulations help predict blast scenarios, also have crossover appeal in animation

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Simulation-based engineering science (SBES) allows researchers to predict the effects of building explosions and analyze the response of building materials to those threats. Using a $400,000, five-year CAREER grant from the National Science Foundation, researchers at the University of Missouri developed the Material Point Method (MPM) a computer-generated tool that not only creates blast scenarios that informs blast and impact resistant materials and design, but also is crossing over into Hollywood animation—most recently, Disney's Oscar-winning animated film, Frozen.

"Motivated by the need for better simulations that demonstrate impact and penetration phenomena, we developed the MPM more than 20 years ago," said Zhen Chen, C.W. LaPierre Professor of civil and environmental engineering at the College of Engineering at MU. "Since then, the MPM has been further developed and applied by many global research teams to real-world problems including fire, explosions and impacts in buildings and structures. Our first study on the MPM has been cited more than 400 times, and Disney is now using physics-based simulation methods as they create sequences for their popular animated movies including Frozen."

The computer-based tests developed using MPM can create scenarios that help determine which materials and designs respond most favorably to impact and blast loadings, Chen said. Using the information and

analysis provided by simulations, designers can then validate the results with laboratory tests before applying them to full-scale construction including stronger building components such as columns, walls and windows.

Animators at Disney took note of the Material Point Method and used it to develop snow simulations that mimicked snowball drops and smashes. They also animated the effects of characters walking through snowy backdrops.

"We're proud of the computational methods we've developed and our work in SBES through the years," Chen said. "The nation's engineering and science communities have become increasingly aware that SBES is an indispensable tool for resolving a multitude of scientific and technological problems facing our country. An added bonus of having the SBES tool used in animation and popular media is that children, who are more touch-oriented through tablets and smartphones, also are fans of Disney and Frozen. We hope they'll get excited about STEM (science, technology, engineering and mathematics) fields and that our methods will help shape and inspire the next generation of scientists and engineering researchers."

Additionally, an interdisciplinary research team at MU is developing a multiscale MPM for creating alternative energy sources, with the most recent study, "A particle-based multiscale simulation procedure within the MPM framework," to be published in *Computational Particle Mechanics*.

More information: For a video demonstration of Disney's Frozen techniques, please visit: www.wimp.com/disneysnow/

For more information on SBES technology and methods, please visit: engineering.missouri.edu/2009/ … ast-resistant-glass/