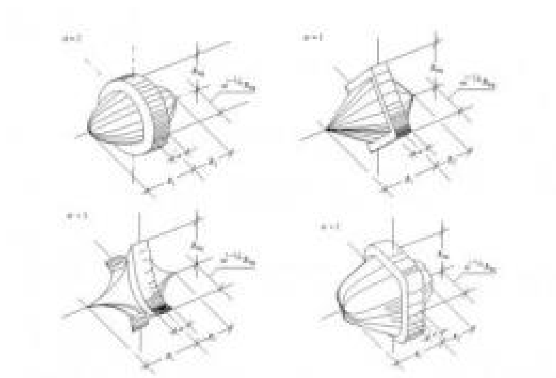
Research outlines math framework that could help convert 'junk' energy into useful power

July 20 2011



When "designer" particles like these are placed next to one another, the way mechanical energy travels through them is profoundly affected, according to new University at Buffalo research. Crafting such designer particles would enable scientists and engineers to control how energy travels through a granular system. Credit: Surajit Sen, University at Buffalo

A University at Buffalo-led research team has developed a mathematical framework that could one day form the basis of technologies that turn road vibrations, airport runway noise and other "junk" energy into useful power.

The concept all begins with a granular system comprising a chain of equal-sized particles -- spheres, for instance -- that touch one another.

In a paper in *Physical Review E* this June, UB theoretical physicist Surajit Sen and colleagues describe how altering the shape of grain-to-grain contact areas between the particles dramatically changes how energy propagates through the system.

Under "normal" circumstances, when the particles are perfect spheres, exerting force on the first sphere in the chain causes energy to travel through the spheres as a compact bundle of energy between 3 to 5 particle diameters wide, at a rate set by Hertz's Law.

But Sen and his collaborators have discovered that by altering the shape of the surface area of each particle where it presses against the next, it is possible to change how the energy moves. While this finding is yet to be demonstrated experimentally, Sen said that "mathematically, it's correct. We have proven it."

"What this work means is that by tweaking force propagation from one grain to another, we can potentially channel energy in controllable ways, which includes slowing down how energy moves, varying the space across which it moves and potentially even holding some of it down," said Sen, a professor of physics whose partners on the project included former graduate student Diankang Sun, now of New Mexico Resonance in Albuquerque, and Chiara Daraio, a professor at the California Institute of Technology.

"What we have managed to accomplish is we have broadened Hertz's theory with some extremely simple modifications," Sen said. "If I hit one end of the chain of particles, the perturbation will travel as an energy bundle. Now we can tune and control that energy." This modification to Heinrich Hertz's theory comes 130 years after Hertz's work was published, Sen said.

While the *Physical Review E* paper describes a granular, mechanical system, Sen believes the mathematical framework his team developed could be realized using electrical circuit systems as well. One practical application he foresees from such technology: "We could have chips that take energy from road vibrations, runway noise from airports -- energy that we are not able to make use of very well -- and convert it into pulses, packets of electrical energy, that become useful power."

"You give me noise," Sen said, "I give you organized bundles."

Provided by University at Buffalo

Citation: Research outlines math framework that could help convert 'junk' energy into useful power (2011, July 20) retrieved 3 May 2024 from https://phys.org/news/2011-07-outlines-math-framework-junk-energy.html