

Noisy electric vehicles—but not too noisy. At city speeds, electric cars and hybrids in electric mode are very quiet. That silent operation is a boon to urban dwellers plagued by noise pollution, but it poses a threat to pedestrians, particularly if they are visually impaired. So groups worldwide are exploring how to best equip electric vehicles with warning sounds. One such group, a part of the European Union-funded eVADER (electric vehicle alert for detection and emergency response) project, is working specifically to produce a readily perceived signal that does not generate excessive noise; the group presented its first experimental results at the June meeting of the Acoustical Society of America in Montreal. As part of its experiment, the team, led by Etienne Parizet (INSA Lyon), simulated the sounds of nine electric vehicles whose alerts, based on a 300-Hz sinusoidal tone, differed in their harmonic richness, purity of frequency, and consistency of amplitude. It also used the sounds of two controls: an unalarmed electric car and a diesel car 7 dB louder. A total of 91 subjects, 33 visually impaired, listened to an urban soundscape that included one of the vehicles ap-



proaching at 20 km/h; the subjects were tasked to strike a computer key when they perceived the oncoming car. Two of the nine alarmed electric cars were identified as readily as the diesel, even though they were less than 1 dB louder than the control electric car. Amplitude variation and a relatively narrow bandwidth, the eVADER group reported, were key elements that allowed warning signals to be easily perceived. (E. Parizet et al., *Proc. Mtg. Acoust.* **19**, 040033, 2013; see also E. Parizet et al., http://www.acoustics.org/press/165th/2aNSa5_Parizet.html.) —SKB

How sandfish lizards swim through sand. Like other desert dwellers, sandfish lizards hide themselves in sand when the day gets too hot or when a predator looms. They dive in head first, tuck their legs beside their bodies, and swim through the sand with an undulatory motion. If sand were transparent, you'd see the lizard advance as its body flexed in a continuous backward-propagating sinusoidal wave. Since 2008 Daniel Goldman of Georgia Tech has been studying how sandfish lizards swim. In his latest paper, he and his colleagues have developed a simple kinematic model that relates the undulations to the torque exerted by the lizard's muscles. The simplicity arises in part from the sand's rheological properties. Friction so dominates the dynamics that the inertia of both the lizard and the sand can be neglected. Deriving the lizard's equation of motion amounts to balancing local

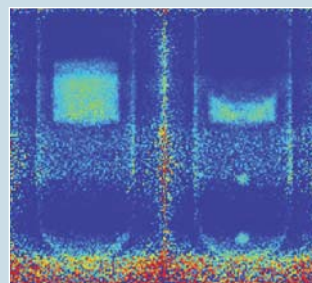
torques while specifying that the undulations be sinusoidal. The model, which has no free parameters, not only mimics the lizard's motion, it also elucidates a neurological mystery



observed in all undulatory swimmers. The lizard's motion is controlled by an activation wave that starts at the head and triggers muscles to contract sequentially down the body. Counterintuitively, the activation

wave is faster than the undulation wave; the two waves reach the tail significantly out of step. In the kinematic model, the lizard's locally exerted torque—the equivalent to the activation wave—leads the undulation in the same way. Evidently, the waves' otherwise puzzling phase behavior is simply part of nature's solution to the problem of swimming in sand and other fluid media. (Y. Ding et al., *Proc. Natl. Acad. Sci. USA* **110**, 10123, 2013.) —CD

Muon scattering at the Fukushima nuclear reactors. On 11 March 2011 a 9.0-magnitude earthquake and enormous tsunami created human and economic catastrophes in Japan on an almost unimaginable scale. (For more about the earthquake, see the news story on page 22.) Among the infrastructure casualties was the Fukushima Daiichi nuclear power station; more than two years later, the buildings remain almost entirely inaccessible due to high radiation levels. A team from Los Alamos National Laboratory hopes to hasten the dismantlement and remediation efforts by remotely imaging the damaged reactor cores with atmospheric muons produced by cosmic rays. The particles' penetrating power would produce an x-ray-like image that includes shadows from the denser re-



gions (see the Quick Study by Giulio Saracino and Cristina Cârloganu, *PHYSICS TODAY*, December 2012, page 60). But because muons are strongly scattered by uranium and other heavy elements, the researchers plan to use their recently developed method that tracks both incident and transmit-

ted particles using two muon detectors, fore and aft of the building. The resulting scattering information can be used to reconstruct the spatial distribution of fuel materials. To demonstrate the feasibility of the approach, the group tested a detector at Fukushima, radiographed both a mockup reactor and a university research reactor, and performed simulations. The simulation results shown here depict an intact 4-m-diameter core (left) and one that is 70% melted with two 40-cm spheres of debris (right). If the proposal is approved and the equipment installed, a few months of data collection would yield the required information. (H. Miyadera et al., *AIP Advances* **3**, 052133, 2013.) —SGB ■