PHOTOVOLTAICS

Solar-assisted cars

In the same month that Ferrari showed the world that it is going green — with the installation of 1,500 m^2 of solar panels on the rooftop of its production facility in Maranello, Italy, providing 213,985 kW h per year to help power its operations — Toyota revealed that solar panels will adorn the roof of the 2010 model of the Toyota Prius. Meanwhile, after-market manufacturers are providing solar kits for the Prius and other electric–petrol hybrids.

The Prius was launched in Japan in 1997, making it the first mass-produced hybrid vehicle, and was released worldwide in 2001. In May 2008, worldwide sales passed 1,000,000, with more than half of those sales in the United States. The solar panel used by Toyota is reportedly made by Kyocera and is used to power the car's climate control (including the air-conditioning motor), reducing the burden on the battery and petrol motor. The solar cells reportedly supply about 1 kW of power, which is enough to keep things cool, even while the car is parked out in the sunlight with its engine turned off. Additionally, the system


TOYOTA

(which is an optional extra) can be activated remotely from the key fob to start up the air conditioner before you get in the car.

The idea of fitting cars with solar panels is not new, and after-market companies already provide solar kits for various hybrid vehicles including the Prius. For example, California-based Solar Electric Vehicles (SEV) has offered customized solar panels for the Prius roof since 1994. The panel can generate 215 watts of power and is manufactured from high-efficiency monocrystalline photovoltaic cells. The system, which takes only a few hours to install and has a cost–benefit break-even period of about 2–3 years, ultimately provides about 20 miles per day of electric driving range, resulting in a claimed improvement in fuel efficiency of about 29 per cent (depending on driving habits and conditions). Back in 1984, the founders of SEV actually developed the first car powered exclusively by solar energy with a 1.2-kW solar array, a 1-hp wheel motor and no batteries, which ran at speeds of up to 41 mph.

The new Prius is the first production car whose air conditioning can run on solar power alone. The big question is: will other car manufacturers follow suit, perhaps ultimately resulting in a completely solar-powered production car?

DAVID PILE

IMAGE TRANSMISSION

Looking into a self-distorting world

Imaging through linear media is straightforward, but light beams propagating through nonlinear media become heavily distorted, rendering all usual imaging techniques practically useless. Now, scientists have found a way to recover images transmitted through nonlinear media — by using back-propagation simulations.

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Light beams, and thus images, passing through nonlinear media are heavily distorted as they propagate because of a complex and dynamic interaction between light and matter. As a result, it is difficult to look through nonlinear media or to extract three-dimensional images from within the media. Is it possible to recover pictorial information transmitted through them? Yes, if information is not lost — radiated away or simply absorbed. Would we be able one day to look through such an environment, which is generically hostile to transmission of structured light beams? Or, better, could we look into such media and obtain three-dimensional images within the material? Here we describe the issues involved, review the historical evolution of the ideas, discuss the recent success, pose some non-trivial questions, and, we hope, provide some insight into the subject. On page 211 of this issue[1], Jason Fleischer and co-workers at Princeton University demonstrate a computational method of recovering images transmitted through a nonlinear medium. By measuring the output and numerically back-propagating the wave dynamics, they not only show that they can recover the input of two-dimensional spatial beams containing images, but also reconstruct the light field at intermediate points in the medium.

Nature is inherently nonlinear in its response to beams of light. Take a light beam, launch it through any medium and raise the intensity. At some point the beam will start modifying the properties of the medium, which will, in turn, modify the structure of the beam itself, causing further changes in the medium properties, which again change the beam pattern, in a dynamical fashion. In most material systems, nonlinear optical dynamics can occur by virtue of a variety of physical mechanisms. Examples range from ultrafast